FINGERPRINT VENDOR TECHNOLOGY EVALUATION 2003

APPENDIX A

ANNOUNCEMENT AND WEBSITE DOCUMENTS

Contents of Appendix A

Documents A2 through A9 were available on the public website (fpvte.nist.gov). Documents A10 through A17 were only available on the participant's website, which was restricted to registered participants.

A1. FEDBIZOPPS ANNOUNCEMENT

66 -- SOURCES SOUGHT FOR FINGERPRINT IDENTIFICATION AND VERIFICATION SYSTEMS

General Information

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Contracting Office Address

Department of Commerce, National Institute of Standards and Technology (NIST), Acquisition and Logistics Division, 100 Bureau Drive, Building 301, Room B129, Mail Stop 3571, Gaithersburg, MD, 20899-3571

Description

The U. S. Department of Commerce, National Institute of Standards and Technology (NIST) in Gaithersburg, MD seeks to identify potential sources that currently can provide, or will soon be able to provide, commercially available, or soon-to-be commercially available, fingerprint identification and verification systems. THIS FEDBIZOPPS POSTING IS STRICTLY A SOURCES SOUGHT NOTICE THAT PART OF A TECHNOLOGY RESEARCH SURVEY THAT IS BEING CONDUCTED FOR PLANNING PURPOSES ONLY; IT IS NOT TO BE CONSTRUED AS A SOLICITATION OR A REQUEST FOR QUOTATIONS OR PROPOSALS. Available systems may be selected by the Government to participate in the Fingerprint Vendor Technology Evaluation (FpVTE) 2003, a government-sponsored technology evaluation of fingerprint matching technologies. Potential sources of fingerprint technology will not be funded, nor charged, to participate in FpVTE 2003. Rules for participants are outlined

in the FpVTE 2003 HOW TO PARTICIPATE page at http://fpvte.nist.gov. A deadline for submission is shown on the CALENDAR page of http://fpvte.nist.gov.

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A2. ABOUT FPVTE 2003

About FpVTE 2003

Last updated 11 December 2003

- The Fingerprint Vendor Technology Evaluation (FpVTE) 2003 is an independently administered technology evaluation of fingerprint matching, identification, and verification systems. FpVTE 2003 is being conducted by the National Institute of Standards & Technology (NIST) on behalf of the Justice Management Division (JMD) of the U.S. Department of Justice.

- FpVTE was designed to assess the capability of fingerprint systems to meet requirements for both large-scale and small-scale real world applications. FpVTE 2003 consists of multiple tests performed with combinations of fingers (e.g., single fingers, two index fingers, four to ten fingers) and different types and qualities of operational fingerprints (e.g., flat livescan images from visa applicants, multi-finger slap livescan images from present-day booking or background check systems, or rolled and flat inked fingerprints from legacy criminal databases).

- FpVTE 2003 will serve as part of NIST's statutory mandate under section 403c of the USA PATRIOT Act to certify those biometric technologies that may be used in U.S. VISIT (U.S. Visitor and Immigrant Status Indication Technology, formerly known as the US entry-exit system). In addition, FpVTE results may form the basis for the design and acquisition of other large-scale fingerprint identification systems.

- FpVTE 2003 evaluations were conducted at the NIST facilities at Gaithersburg, MD, from October 2003 through November 2003.

- Small, Medium, and Large-Scale Tests (SST, MST and LST) were conducted using systems provided by 18 Participants:

    - 123 ID, Inc. (MST, LST)
    - Antheus Technology, Inc. (MST, LST)
    - Av@lon Systems Inc. (MST)
    - BioLink Technologies International, Inc. (MST, LST)
    - Bioscrypt, Inc. (SST)
    - Cogent Systems, Inc. (SST, MST, LST)
    - Dermalog Identification Systems GmbH (MST, LST)
    - Golden Finger Systems (MST, LST)
    - Griaule Tecnologia (LST)
    - Identix, Inc. (MST, LST)
    - SAGEM MORPHO, Inc. (MST, LST)
    - NEC (MST, LST)
    - Neurotechnologija Ltd. (MST)
    - The Phoenix Group, Inc. (MST)

  - Motorola (MST, LST)
  - Raytheon Company (MST, LST)
  - Technoimagia Co., Ltd. (MST)
  - Ultra-Scan Corporation (MST)

- FpVTE 2003 analysis and methodologies were built in part on the multi-agency Face Recognition Vendor Test (FRVT) 2002. See http://www.frvt.org
- Test results will be made publicly available in a NIST report after the results are analyzed. The Final Report will not be released before the second quarter of 2004.
- FpVTE was announced on FedBizOpps.gov (FpVTE Listing; cached), and in several postings to the Biometric Consortium Listserv (http://www.biometrics.org/html/listserv.html).
- Interested parties should send contact information (name, email, telephone, address) to FpVTE@nist.gov to receive email updates on the status of FpVTE 2003.

A3. TEST OVERVIEW

FpVTE Test Overview

Last updated 19 September 2003

1 Overview

The Fingerprint Vendor Technology Evaluation (FpVTE) 2003 is an independently administered technology evaluation of fingerprint matching, identification, and verification systems. FpVTE 2003 is being conducted by the National Institute of Standards & Technology (NIST) on behalf of the Justice Management Division (JMD) of the U.S. Department of Justice.

FpVTE is designed to assess the capability of fingerprint systems to meet requirements for both large-scale and small-scale real world applications. FpVTE 2003 consists of multiple tests performed with combinations of fingers (e.g., single fingers, two index fingers, four to ten fingers) and different types and qualities of operational fingerprints (e.g., flat livescan images from visa applicants, multi-finger slap livescan images from present-day booking or background check systems, or rolled and flat inked fingerprints from legacy criminal databases).

FpVTE 2003 will serve as part of NIST's statutory mandate under section 403c of the USA PATRIOT Act to certify those biometric technologies that may be used in U.S. VISIT (U.S. Visitor and Immigrant Status Indication Technology, formerly known as the US entry-exit system). In addition, FpVTE results may form the basis for the design and acquisition of other large-scale fingerprint identification systems.

FpVTE 2003 analysis and methodologies are built on the multi-agency Face Recognition Vendor Test (FRVT) 2002. See http://www.frvt.org

FpVTE 2003 evaluations will be conducted at the NIST facilities at Gaithersburg, MD, no earlier than September 29 and no later than December 31, 2003.

Test results will be made publicly available in a NIST report after the conclusion of the test.

Interested parties should send contact information (name, email, telephone, address) to FpVTE@nist.gov to receive email updates on the status of FpVTE 2003.

The deadline for registration for Participants was 12 August 2003.

2 Purpose

FpVTE is intended to evaluate the state of the art / state of the practice in fingerprint matching systems. The Supporters and Sponsors of FpVTE are specifically interested in fingerprint matcher performance in these areas:

- Accuracy of very large-scale automated fingerprint identification systems (AFIS) in general
- Accuracy of fingerprint identification systems using different combinations of fingers (e.g., single fingers, two index fingers, four to ten fingers)
- Accuracy of fingerprint identification systems using the range of different types and qualities of operational U.S. Government fingerprints (e.g., individual flat livescan images from visa applicants, multi-finger slap livescan images from present-day booking or background check systems, and rolled and flat inked fingerprints from legacy criminal databases).
- Accuracy of fingerprint verification systems
- Accuracy of fingerprint binning, screening or filtering systems (such as are used as processing stages in large identification systems)

3 Who Should Participate

Makers of commercially available fingerprint matching, verification, or identification (AFIS) systems are invited to participate in the Fingerprint Vendor Technology Evaluation 2003.

In addition, companies, research organizations, and universities that have developed mature prototype or research fingerprint matching, verification, or identification systems are invited to participate. Makers of fingerprint screening or filtering systems are also encouraged to participate.

FpVTE is ***not*** evaluating image acquisition devices (fingerprint scanners).

4 Sponsors and Supporters

Click here to jump to the current list of Sponsors and Supporters.

5 Overview of Tests

FpVTE will be composed of three separate tests, the Small-Scale Test (SST), Medium-Scale Test (MST), and the Large-Scale Test (LST).

The SST and MST will evaluate matching accuracy using ***individual*** fingerprint images. This contrasts with the LST, which will evaluate matching accuracy using ***sets*** of fingerprint images.

In general, the SST and MST will be of interest to makers of single-stage matchers, verification or small-scale identification systems, or new algorithms. Makers of fingerprint screening or filtering systems are also encouraged to participate in the MST. In general, the LST will be of interest to AFIS vendors.

The tests are designed so that the SST is a subset of the MST. LST participants are encouraged to participate in the MST.

If space is available, FpVTE personnel may allow a participant to enter more than one system in the evaluation. A second system might be submitted to demonstrate capabilities that can be achieved only through distinct parameter settings, an alternate system configuration, or different algorithms.

5.1 Throughput Requirements

Tentative Participants will be required to complete a *System Throughput Questionnaire* to qualify for the tests. This information will be used to determine the final test design. The size and structure of the test will be designed to optimize among competing analysis objectives, available resources, and the desire to include all qualified participants.

The *System Throughput Questionnaire* is located in the Participant Area, which is only available to registered Participants and Tentative Participants.

5.2 Matcher Results

The results from each test are participant-defined measures of similarity, which for most systems means matcher scores. Note that the systems do ***not*** return Match and Non-match determinations. FpVTE analysis is based on distributions of similarity scores for mate vs. non-mate comparisons. Which fingerprints are mated is, of course, not revealed.

For the SST and MST tests, matchers compare individual fingerprint images, and return a similarity score for each comparison. When comparing one dataset of fingerprint images against another, a fully-populated matrix of similarity scores is generated. This fully-populated similarity matrix is what will be used to evaluate SST and MST Participants.

For the LST, matchers compare sets of fingerprint images (e.g. a 2-image, 4-image, or 10-image electronic "card" of fingerprint images). Since an AFIS generally filters out many non-mates, similarity

scores may not be available for every comparison. Participants nevertheless will be expected to generate a fully-populated matrix of scores, but may, for instance, fill the majority of the matrix with a default value indicating no similarity. Participants are advised that the choice of true scores vs. default values will affect scoring, and are encouraged to fill the matrix as completely as possible with true scores.

5.3 Operating Points

Evaluations will be based on ROC (Receiver Operator Characteristic) or, equivalently, DET (Detection Error Trade-off) analysis based on similarity scores. Rank-based analysis will also be performed.

For SST, evaluations will focus on the relationship between TAR (True Accept Rate: TAR = 1 - FRR (False Reject Rate)) and FAR (False Accept Rate), when FAR is between 10^{-2} and 10^{-5}.

For MST, evaluations will focus on the relationship between TAR and FAR when FAR is between 10^{-2} and 10^{-7}. In addition, evaluations will focus on the relationship between TAR and FAR when TAR is between 98% and 99.99%.

For LST, the relationship between TAR and FAR will be analyzed, focusing solely on very low FAR values (down to about 10^{-8}).

Since some algorithms do not operate equally well at a broad range of operating points, participants may submit two algorithms or tunings of an algorithm for the SST or MST, one optimized for low FAR and another for high TAR.

6 Data Description and Restrictions

The fingerprints have been collected from a range of U.S. Government sources. Some of the fingerprints are representative of current operational data, while others are representative of legacy data.

6.1 Fingerprint Types

The fingerprints are of three types:

- Flat (plain) fingerprints, individually collected
- Fingerprints segmented from slap (simultaneous plain) fingerprints (segmented by FpVTE personnel using a combination of automatic and manual methods).
- Rolled fingerprints

Note that the slap fingerprints have already been segmented into individual fingerprints.

6.2 Fingerprint Sources

Individual flat (plain) fingerprints were collected using a variety of single-finger livescan devices.

Slap fingerprints were collected using multi-finger livescan devices, as well as inked fingerprint cards scanned using flatbed scanners.

Rolled fingerprints were collected using rolled livescan devices, as well as inked fingerprint cards scanned using flatbed scanners.

The fingerprints were collected by the following devices. The listing of makes and models does not imply a recommendation by NIST or FpVTE personnel, but simply recognizes the actual devices used by the variety of Federal agencies that contributed data to FpVTE.

Single-finger livescan devices:

- Identix/Identicator DFR-90

- Cross Match Verifier Model 300
- Identix TV555

Rolled and multi-finger livescan devices:

- Identix TP-600
- CrossMatch ID-1000
- DBI Tenprinter
- Heimann LS2 Check **NEW**

Inked cards were scanned using FBI EFTS Appendix F-certified flatbed scanners.

The source (type of scanner) of each fingerprint will *not* be provided in the tests.

6.3 Fingerprint File Format

Each fingerprint (SST or MST) or fingerprint set (LST) will be contained in an ANSI/NIST format file. Each file contains

- a single fingerprint image (SST and MST), or
- a set of fingerprint images (LST)

All images are WSQ compressed.

Note: The FBI's Electronic Fingerprint Transmission Specification (EFTS) is based on ANSI/NIST. Fingerprint files that are EFTS compliant are necessarily ANSI/NIST compliant.

6.4 Data Restrictions

The FpVTE 2003 Evaluation Datasets will bear the legend "Notice: May contain Privacy Act or FOIA Protected Information" and, to the extent permitted by law, will be protected under the Freedom of Information Act (5 U.S.C 552) and the Privacy Act (5 U.S.C. 552a) as applicable.

FpVTE 2003 Evaluation Datasets and data derived from the datasets shall not be retained in any way or form whatsoever by Participants after completion of the Evaluation.

Systems being evaluated in FpVTE 2003 shall not be accessible from outside the room in which the evaluation is being conducted. No system entered in the test can have or use any wireless networking equipment, modems, or access to the Internet.

7 Test Preparation

Participants will be expected to modify their systems as necessary to meet the following test requirements:

- Produce properly formatted matrices of similarity scores as output.
- Perform a sequence of subtests with little or no human intervention. Matchers will be expected to load datasets and generate similarity matrices as specified in an XML document provided during the test.
- Complete within the allotted time.

The satisfaction of these requirements is addressed in the process through which a Tentative Participant becomes a full Participant, which is defined in the document *Application to Participate in FpVTE 2003*.

FpVTE 2003 Sample Datasets and Software will be supplied to Participants to assist in preparing for FpVTE 2003. The FpVTE 2003 Sample Datasets are representative of the FpVTE 2003 Evaluation

Datasets in format. Image quality, collection device and other characteristics may vary between the Sample and Evaluation Datasets.

8 Final Report

After completion of the evaluations, the Government will combine all results into a Final Report. The FpVTE 2003 Final Report is expected to be released in early 2004. The FpVTE 2003 Final Report will contain, at a minimum, descriptive information concerning FpVTE 2003, descriptions of each experiment, evaluation results, and each Participant's five-page system description document.

Participants will get an advance copy of the draft final report shortly before release and will be allowed to submit a position paper that will be included in the FpVTE 2003 Final Report when released.

The Final Report will be placed on the FpVTE 2003 website (http://FpVTE.nist.gov) when it has been completed and approved for public release. We will announce the release on the Biometrics Consortium listserv.

A4. TEST PLAN

FpVTE Test Plan

Last updated 19 September 2003

Note: The *FpVTE Test Overview* serves as an introduction to this document.

1 Terminology Used in This Document

Flat fingerprint

A fingerprint image collected from a single-finger livescan device, resulting from the touching of a finger to a platen without any rolling motion. Also known as a single-finger plain impression.

Segmented slap

An image of a single fingerprint that was segmented (cropped) from an image of a 4-finger slap (4-finger simultaneous impression), such as found at the bottom of a fingerprint card. Slaps may be from livescan devices or scanned from paper fingerprint cards. FpVTE segmented slaps have been segmented using automatic and/or manual processes; all segmentation has been human verified.

Rolled fingerprint

A fingerprint image collected by rolling the finger edge to edge across the livescan platen (or paper) from nail to nail. Rolls may be from livescan devices or scanned from paper fingerprint cards.

ANSI/NIST

A file format for fingerprint files compliant with *NIST Special Publication 500-245, Data Format for the Interchange of Fingerprint, Facial, & Scar Mark & Tattoo (SMT) Information* (ftp://sequoyah.nist.gov/pub/nist_internal_reports/sp500-245-a16.pdf) The FBI's *Electronic Fingerprint Transmission Specification* (EFTS) is based on ANSI/NIST. Fingerprint files that are EFTS compliant are necessarily ANSI/NIST compliant. In FpVTE, all images embedded in ANSI/NIST files use WSQ compression.

WSQ

Wavelet Scalar Quantization. The image compression method used for fingerprint images.

Fingerprint set

A single ANSI/NIST file containing multiple fingerprint images from a single individual, collected at one time. The fingerprint positions (finger numbers) are noted in the file. The finger positions are not repeated in the file: no more than one fingerprint per position is included.

Dataset

A collection of multiple fingerprint sets.

Subject

An individual person

Target Set

The dataset being searched against in a given test or subtest: an experiment searches a Query Set against a Target Set. Also known as a File set or just fingerprint database.

Query Set

The dataset containing the searches for a given test or subtest: an experiment searches a Query Set against a Target Set. Also known as a Search set.

Similarity matrix

A matrix of Participant-specific matcher scores, which compare each member of a Query Set against each member of a Target Set. The file format for a similarity matrix is defined in the *Data Format Specification*.

Mate

Different fingerprint sets are mates if they came from the same person. The tests (of course) do not note which fingerprint sets are mates.

Self-ident

The special case of a fingerprint set (or an individual fingerprint) being compared against itself. Self-idents are ignored during analysis. When a dataset is compared against itself and a square matrix of scores is generated, the scores on the diagonal are self-idents.

Preprocessing

Also known as Characterization or Feature Extraction. The process of creating a machine representation of a fingerprint image. A few matchers do not perform preprocessing.

Finger number

Finger 01	Right thumb
Finger 02	Right index
Finger 03	Right middle
Finger 04	Right ring
Finger 05	Right little
Finger 06	Left thumb
Finger 07	Left index
Finger 08	Left middle
Finger 09	Left ring
Finger 10	Left little

2 Overview of Tests

2.1 Small-Scale Test (SST)

The SST is designed for Participants whose throughput rates will not allow them to complete the MST. This test will evaluate matching accuracy using individual fingerprint images, not sets of multiple fingerprint images.

The test will consist of a single SST dataset containing 1,000 ANSI/NIST files. The SST dataset will be used as both the Query Set and the Target Set — in other words, all fingerprints in the dataset will be compared against all other fingerprints in the dataset.

The images in the dataset may have zero, one, or more mates in the dataset (disregarding self-idents). The SST dataset will consist exclusively of single-finger flat images (not segmented slap or rolled images). The images will be images of the right index finger (Finger 02). No other fingers will be included in the test.

The SST must be completed in a period of no more than two weeks (1,209,600 seconds), not including setup and checkout.

SST Participants may ***optionally*** provide normalization code for post-processing of the SST Similarity Matrix. See the Normalization section below for additional information.

2.2 Medium-Scale Test (MST)

The MST is designed to evaluate matching accuracy using individual fingerprint images, not sets of fingerprint images.

The test will consist of a single MST dataset containing 10,000 files.

The MST dataset will be used as both the Query Set and the Target Set — in other words, all fingerprints in the dataset will be compared against all other fingerprints in the dataset. The MST dataset will be larger

than the SST dataset. The images in the dataset may have zero, one, or more mates in the dataset (disregarding self-idents).

The MST dataset will consist exclusively of single-finger flat images and segmented slap images (not rolled images). 50-60% of the images will be single-finger flat; 40-50% of the images will be segmented slaps. All of the images will be from livescan devices. Most of the images will be images of the right index finger (Finger 02) but some may be of the right middle finger (Finger 03). No other fingers will be included in the test. The finger number will ***not*** be identified for each image.

The MST is designed so that the SST is a subset of the MST. That is, all images in the SST dataset will be scattered within the first quarter of the MST dataset. The MST will be sized with the expectation that all MST Participants will complete the test within the allotted time. However, if an MST Participant only partially completes the MST for any reason, the likelihood is high that the SST comparisons within the MST would have been completed. In this case, the FpVTE 2003 personnel may be able to meaningfully analyze the partially completed MST results in the context of the SST.

The MST must be completed in a period of no more than two weeks (1,209,600 seconds), not including setup and checkout.

MST Participants may ***optionally*** provide normalization code for post-processing of the MST Similarity Matrix. See the Normalization section below for additional information.

2.3 Large-Scale Test (LST)

The LST is designed primarily for AFIS Participants. The test is composed of a series of subtests to measure:

- Performance of rolled fingerprint sets against rolled fingerprint sets. Subtests of 10 fingers per set will be conducted.
- Performance of segmented slap fingerprint sets against rolled fingerprint sets. Subtests of 1,2,4,8, and 10 fingers per set will be conducted.
- Performance of segmented slap fingerprint sets against segmented slap fingerprint sets. Subtests of 1,2,4,8, and 10 fingers per set will be conducted.
- Performance of flat fingerprint sets against flat fingerprint sets. Subtests of 1 and 2 fingers per set will be conducted. All fingers are index fingers (fingers 02 and 07).

The rolled and segmented slap images come from livescan devices, or from paper fingerprint cards that were, scanned on flatbed scanners. Images from paper cards may include pencil marks, or printed lines and text from the card itself.

The LST must be completed in a period of no more than three weeks (1,814,400 seconds), not including setup and checkout.

More information about the LST is included in Section 5, *Large-Scale Test (LST) Details* .

LST Participants do ***not*** provide normalization code for post-processing of similarity matrices. See the Normalization section below for additional information.

3 Evaluation Data

The fingerprints in FpVTE have been collected from a range of U.S. Government sources. Some of the fingerprints are representative of current operational data, while others are representative of legacy data. In practice, this means that the test data will range from good to poor quality.

It is critical to note that FpVTE will report multiple results based on multiple types or sources of fingerprints. It is assumed that an individual matcher will have very different performance using pristine, carefully collected data instead of legacy operational data. The results of FpVTE will not be a single data point or a single chart, but a series of charts describing the performance for the different types of data.

3.1 Mate Relationships

Most datasets are searched against themselves. Obviously such searches generate self-idents, which are ignored.

Each individual dataset will contain some mated subjects. Many subjects will not have mates within a single dataset, while some subjects will have more than one mate within a single dataset.

When searching a Query set against a different Target set, subjects in the Query set may have zero, one, or more mates in the Target set.

A dataset occasionally may contain duplicate images, which may be either the same livescan image or the same paper image scanned twice. These self-idents will be ignored during analysis, but similarity scores should be provided.

3.2 Individual Flat Fingerprint Images (SST, MST, and LST)

In FpVTE, a flat fingerprint is a fingerprint image collected from a single-finger livescan device, resulting from the touching of one finger to a platen without any rolling motion. A flat fingerprint is also known as a single-finger plain impression. In FpVTE, the term “flat” fingerprint always means an individual flat fingerprint and should not be confused with a “segmented slap.”

All of the fingerprints in the SST Evaluation Dataset will be individual flat fingerprint images. Some of the fingerprints in the MST, and LST Evaluation Datasets will be individual flat fingerprint images.

The flat fingerprints in the Evaluation Datasets were collected by the following single-finger optical livescan devices:

- Identix/Identicator DFR-90
- Cross Match Verifier Model 300
- Identix TV555

The type of scanner used to acquire each fingerprint will ***not*** be provided in the tests.

(The listing of makes and models does not imply a recommendation by NIST or FpVTE personnel, but simply recognizes the actual devices used by the variety of Federal agencies that contributed data to FpVTE.)

All images are 500 pixels per inch, 8-bit grayscale images.

Most of the flat fingerprints are 368 pixels by 368 pixels; the size may vary from 368x368 to 420x480 (width x height).

All of the flat fingerprints are from the index fingers. In SST and MST, only the right index fingers are used. In LST, both index fingers are used, and the finger position is always noted in the ANSI/NIST file.

The images are usually upright, but are sometimes rotated up to about ±25 degrees, and rarely up to about ±45 degrees. The core is usually (but not always) centered in each image.

Figure 1: Sample Flat Fingerprint

3.3 Segmented Slap Fingerprint Images (MST and LST)

In FpVTE, a segmented slap is an image of a single fingerprint that was segmented (cropped) from an image of a 4-finger slap (4-finger simultaneous impression), such as found at the bottom of a fingerprint card. Slaps may be from livescan devices or scanned from paper fingerprint cards. FpVTE segmented slaps have been segmented using automatic and/or manual processes; all segmentation has been human verified.

Some of the fingerprints in the MST and LST Evaluation Datasets will be segmented slap fingerprint images.

The slap fingerprints in the Evaluation Datasets were collected by the following multi-finger optical livescan devices:

- Identix TP-600
- CrossMatch ID-1000
- DBI Tenprinter
- Heimann LS2 Check **NEW**

The type of scanner used to acquire each fingerprint will ***not*** be provided in the tests.

(The listing of makes and models does not imply a recommendation by NIST or FpVTE personnel, but simply recognizes the actual devices used by the variety of Federal agencies that contributed data to FpVTE.)

All of the slap images in MST are from livescan devices.

Some of the slap images in LST were scanned from paper fingerprint cards, using FBI EFTS Appendix F-certified flatbed scanners. Fingerprints scanned from paper fingerprint cards may contain extraneous text, lines, or other marks.

All images are 500 pixels per inch, 8-bit grayscale images.

The size of segmented slap fingerprints varies. It may be as small as 150 pixels by 150 pixels, and may be as large as 500x600 (width x height).

In MST, slap fingerprints may be from the right index or right middle fingers, but the finger position is not noted in the ANSI/NIST file.

In LST, a variety of finger combinations is used, and the finger position is always noted in the ANSI/NIST file.

Figure 2 and Figure 3 show an example of a good-quality livescan slap image before and after segmentation. Note that part of the little finger was not included in the slap image: incomplete fingerprints such as this can sometimes occur with any finger in slap images.

Figure 2: Unsegmented 4-finger slap image (Unsegmented images are not used in FpVTE)

Figure 3: Segmented slap images as used in FpVTE — Note rotation

3.3.1 Rotation of Slap Images

Slap images (except for thumbs) are usually rotated, as shown in Figure 3. The average rotation is 20-25 degrees. Few images are rotated more than 45 degrees. Fingers from the left hand are usually rotated clockwise, and those from the right hand are usually rotated counterclockwise.

3.3.2 Masking of Extraneous Ridge Detail in Slap Images

In some cases, the rectangles used to segment images include extraneous ridge detail, as shown in Figure 4. This extraneous ridge detail is ***excluded*** in FpVTE by use of a white mask, as can be seen by comparing Figure 3 (with mask) and Figure 4 (without mask). Note that ridge detail below the crease is excluded (as shown in the ring finger image).

Figure 4: Segmented slap images showing extraneous ridge detail excluded in FpVTE

3.4 Rolled fingerprints (LST only)

A rolled fingerprint is a fingerprint image collected by rolling the finger edge to edge across the livescan platen (or paper) from nail to nail. Rolls may be from livescan devices or scanned from paper fingerprint cards.

Some of the fingerprints in the LST Evaluation Datasets will be rolled fingerprint images.

The rolled fingerprints in the Evaluation Datasets were collected by the following multi-finger optical livescan devices:

- Identix TP-600
- CrossMatch ID-1000
- DBI Tenprinter
- Heimann LS2 Check **NEW**

The type of scanner used to acquire each fingerprint will ***not*** be provided in the tests.

(The listing of makes and models does not imply a recommendation by NIST or FpVTE personnel, but simply recognizes the actual devices used by the variety of agencies that contributed data to FpVTE.)

All images are 500 pixels per inch, 8-bit grayscale images.

Rolled fingerprints can vary in size from 500 pixels by 500 pixels up to 800x750 (width x height).

The images are usually upright. The core is usually (but not always) centered in each image.

Figure 5: Sample Rolled Fingerprint (Scanned from Paper)

4 Similarity Scores and Matrices

The output from FpVTE tests is a Participant-specific measure of similarity known as a ***similarity score***. For most Participants, this corresponds to a matcher score. Note that the systems ***do not*** return Boolean Match and Non-match determinations: for analysis to be meaningful, a continuous distribution of degrees of similarity must be present.

Each similarity score compares the similarity of the fingerprints in an ANSI/NIST file to those in another ANSI/NIST file:

- In SST and MST, an ANSI/NIST file always contains a single fingerprint, so a similarity score is a determination of the similarity of an ***individual*** fingerprint to another ***individual*** fingerprint.

- In LST, an ANSI/NIST file may contain from one to ten fingerprints (collected at one time from an individual), so a similarity score is a determination of the similarity of a ***set*** of fingerprints to another ***set*** of fingerprints. Put another way, in LST, when comparing a set of ten fingerprints to another set of ten fingerprints, ***one*** similarity score is put in the similarity matrix, ***not ten*** scores.

The scale used for similarity scores is entirely up to the Participant: one Participant may use a scale of 0.0 (no similarity) to 1.00 (identical), while another may use a scale of -1,000,000 to 1,000,000. It is also permissible for Participants to use distance scores, in which increasing values indicate dissimilarity rather than similarity — for simplicity, only similarity scores are discussed in this document.

Scores should not be quantized to a limited range. If internal matcher scores are reported on a 0 to 1000 range, quantizing (or grouping) them to a 1 to 5 scale will have a negative effect of the FpVTE results for that matcher.

A ***similarity matrix*** is the array of scores produced by a matcher when a Query set is searched against a Target set. If a Query set contains 1,000 ANSI/NIST files and a Target set contains 3,000 ANSI/NIST files, the resulting similarity matrix contains 1,000 columns, each of which contains 3,000 scores. The exact format of a similarity matrix is defined in the *Data Format Specification*. In short, the values in a

similarity matrix are stored as floating point numbers, and each column of values is stored as a separate file, with a minimal header.

- SST and MST Participants will produce only one similarity matrix.
- LST Participants will produce multiple similarity matrices, one for each subtest.

FpVTE analyses are based on distributions of similarity scores for mate vs. non-mate comparisons. Within a single similarity matrix (of scores generated in a single subtest), all the scores ***must*** be comparable: a higher score ***must*** mean a higher degree of similarity.

For the different subtests in LST, scores do ***not*** have to be comparable between different subtests (and the associated similarity matrices). For example, different subtests can use different scoring methods: the scores when comparing 2-flats against 2-flats do not have to correspond to the scores comparing 10-rolls against 10-rolls.

Systems will sometimes modify the distribution of scores based on the Target set being used, a process known in FpVTE as Normalization. Please see the Normalization section for details.

4.1 Reporting Similarity Scores for Multi-Stage Systems

Since a multi-stage AFIS generally filters out many non-mates before the final matcher assigns scores, the system will generally not calculate similarity scores for every comparison. Participants nevertheless will be expected to generate a fully-populated matrix of scores, but may fill the majority of the matrix with one or more default values. Participants are advised that the choice of true scores vs. default values will affect evaluation results, and are encouraged to fill the matrix as completely as possible with true scores.

There are several considerations guiding how similarity scores are reported for multi-stage systems:

- An AFIS will often only assign a matcher score to a small portion of searches, and all other comparisons default to a value indicating no similarity. For FpVTE a Participant may consider using some method that differentiates between borderline comparisons, and comparisons that were dropped at different matcher stages.
- Scores in different similarity matrices do not have to be comparable. For example, scores comparing flats to flats may have an entirely different scale than would roll to roll scores.
- FpVTE analyses assume that all scores above a Participant-defined level of similarity will be returned. Please do ***not*** return a fixed, limited number of scores for every search regardless of the level of similarity: this would negatively affect the analysis of matcher performance.

5 Large-Scale Test (LST) Details

5.1 Evaluation Datasets Used in LST

All datasets contain ANSI/NIST files. Every file in a given dataset contains the same number of images, in type-4 records, WSQ-compressed. In LST, all finger positions are noted (correctly) in the type-4 record headers. A single dataset will not commingle rolled, slap, and flat images. A single dataset will not commingle images from Livescan and Paper sources. The following list identifies the types and sizes of datasets that will be used in LST.

Sizes of individual datasets may vary slightly, but by no more than +/- 15%. The overall size of the test will not change substantially from the numbers stated here.

LST Dataset A: 2F

Set of 8,000 ANSI/NIST files, each containing 2 Flat fingerprint images, one for each index finger (fingers 02 and 07). All images are from livescan devices.

LST Dataset B: 1F

Set of 3,000 ANSI/NIST files, each containing 1 Flat fingerprint image, for either index finger (finger 02 or 07). All images are from livescan devices.

LST Dataset C: 10S-L

Set of 9,000 ANSI/NIST files, each containing 10 segmented Slap fingerprint images. Every file contains images for all 10 fingers. All images were collected from Livescan devices.

LST Dataset D: 10S-P

Set of 4,000 ANSI/NIST files, each containing 10 segmented Slap fingerprint images. Every file contains images for all 10 fingers. All images were scanned from Paper fingerprint cards. (Same as 10S-L, but contains only images scanned from Paper fingerprint cards.)

LST Dataset E: 8S-L

Set of 7,000 ANSI/NIST files, each containing 8 segmented Slap fingerprint images. Every file contains images for 8 fingers, excluding thumbs. All images were collected from Livescan devices.

LST Dataset F: 4S-L

Set of 7,000 ANSI/NIST files, each containing 4 segmented Slap fingerprint images. Every file contains images for 4 fingers. All images were collected from Livescan devices.
LST Dataset F (4S-L) will contain approximately equal numbers of the following finger groups, which will be noted in the Dataset Definition File's Metadata attribute:

- 4S-L-TI (Thumb-Index: fingers 01,02,06,07)
- 4S-L-IM (Index-Middle: fingers 02,03,07,08)
- 4S-L-Right (Right: fingers 02,03,04,05)

In the dataset definition file, all of the 4S-L-TI files will be listed first, then the 4S-L-IM, then the 4S-L-Right.

LST Dataset G: 2S-L

Set of 7,000 ANSI/NIST files, each containing 2 segmented Slap fingerprint images. All images were collected from Livescan devices.
LST Dataset G (2S-L) will contain approximately equal numbers of the following finger groups, which will be noted in the Dataset Definition File's Metadata attribute:

- 2S-L-T (Thumb: fingers 01,06)
- 2S-L-I (Index: fingers 02,07)

In the dataset definition file, all of the 2S-L-T files will be listed first, then the 2S-L-I.

LST Dataset H: 1S-L

Set of 3,000 ANSI/NIST files, each containing one single segmented Slap fingerprint image. All images were collected from Livescan devices. The dataset will include examples from all ten individual fingers, labeled in the Dataset Definition File's Metadata attribute as 1S-L-01 through 1S-L-10.

LST Dataset I: 10R-L

Set of 8,000 ANSI/NIST files, each containing 10 Rolled fingerprint images. Every file contains images for all 10 fingers. All images were collected from Livescan devices.

LST Dataset J: 10R-P

Set of 8,000 ANSI/NIST files, each containing 10 Rolled fingerprint images. Every file contains images for all 10 fingers. All images were scanned from Paper fingerprint cards. (Same as 10R-L, but contains only images scanned from Paper fingerprint cards.)

5.2 LST Subtests

The structure of the LST subtests is shown in Figure 6 . This structure includes ten LST datasets. Five of the datasets will be used as Target Sets, and all of the datasets will be used as Query sets. A total of 31 similarity matrices will be generated.

The subtests must be performed in row order: all of the tests using A as a target set must be performed first, then the tests using C as a target set, etc.

LST Subtests				Query Sets									
				A	B	C	D	E	F	G	H	I	J
				2F	1F	10S-L	10S-P	8S-L	4S-L	2S-L	1S-L	10R-L	10R-P
				8,000	3,000	9,000	4,000	7,000	7,000	7,000	3,000	8,000	8,000
Target Sets	A	2F	8,000	AxA	BxA	-	-	-	-	-	-	-	-
	C	10S-L	9,000	-	BxC	CxC	DxC	ExC	FxC	GxC	HxC	-	-
	D	10S-P	4,000	-	-	CxD	DxD	ExD	FxD	GxD	HxD	-	-
	I	10R-L	8,000	-	-	CxI	DxI	ExI	FxI	GxI	HxI	IxI	JxI
	J	10R-P	8,000	-	-	CxJ	DxJ	ExJ	FxJ	GxJ	HxJ	IxJ	JxJ

Figure 6 : LST Subtests

Each dataset will be used in multiple subtests. It is assumed that any preprocessing for a dataset will be performed only once, not each time it is used.

Failure to complete the entire test during the allotted time will be noted in the FpVTE 2003 Final Report. FpVTE personnel will decide, after conclusion of the test, if partial test results will be evaluated and reported in the FpVTE 2003 Final Report.

Note also that all subtests should run without human administration: starting or completion of a subtest cannot require operator intervention.

6 Advanced Topics

The following Advanced Topics and the implementations discussed are ***optional***.

6.1 Normalization

When an individual Query is searched against a Target set (database), a raw similarity score is computed for each pair-wise comparison. Normalization refers to a function that adjusts these scores. A normalization function simply maps raw scores to “normalized” scores, and it operates on the entire list of scores generated by each Query. For instance, the function might determine the mean and standard deviation of a set of raw scores, then adjust each score such that the resulting, normalized distribution has a mean of 0.0 and a standard deviation of 1.0.

One useful oversimplification is that normalization is the training of a system for the specific contents of each Target set.

A common misconception is that systems that perform 1:1 matches cannot use normalization. Verification systems can and do normalize based on the aggregate distribution of actual data.

In FpVTE, normalization is handled differently for the different tests:

- In MST and SST, Participants may ***optionally*** provide a compiled software object that performs normalization for use in post-test analysis. The format of this is described in the *FpVTE Normalization Specification*. The purpose for this is to allow FpVTE analysis on subsets of the similarity matrices, while still allowing Participants to control normalization. SST and MST results will be analyzed in three ways:
    - Participant-provided similarity scores will be analyzed
    - All scores will be normalized using FpVTE normalization methods, and analyzed
    - All scores will be normalized using Participant-specific normalization (if provided), and analyzed
- LST participants may perform normalization, but do ***not*** provide normalization software for post-test analysis. LST results will be analyzed based on subsets of Queries, but Target sets will not be partitioned during analysis. The rationale for this approach is based on the fact that a multi-stage AFIS generally returns true scores for only a portion of candidates from the Target set, and any post-test partitioning of the Target set might conflict with how those candidates were selected, thereby preventing statistically meaningful analyses. Analysis reports for LST will be conducted in two ways in terms of normalization:
    - Participant-provided similarity scores will be analyzed
    - All scores will be normalized using FpVTE normalization methods, and analyzed

It is important to differentiate between normalization, which is often used to great effect in real-world systems, and "gaming", or attempting to take advantage of the test structure. A variety of anti-gaming measures have been designed into FpVTE, which include (but are not limited to) use of a mix of true imposters (subjects in the Query but not Target sets), background subjects (subjects in the Target but not Query sets), duplicate images, and multiple subjects in Query and Target sets.

6.2 Failure to Enroll and Fingerprint Quality

Some systems are designed to reject some fingerprints due to poor image quality. This is generally known as the Failure to Enroll (FTE) rate. FpVTE datasets include some poor quality fingerprints. All fingerprints in FpVTE must be compared and similarity scores generated: fingerprints should not be ignored due to poor quality.

In addition to analysis of accuracy, FpVTE may include a secondary analysis of FTE and quality metrics. FpVTE provides an ***optional*** method for Participants to indicate which fingerprints would have been rejected as FTE in an operational system. Often this capability is used operationally to alert the fingerprint taker to attempt to obtain a better image

If a Participant's system uses quality metrics to reject poor quality fingerprints before attempting to match them under normal operations, then those quality metrics, and the thresholds used for rejection, can ***optionally*** be provided for FpVTE analysis. Whether or not a Participant provides quality metrics or FTE thresholds will not affect analysis of accuracy in any way.

The format for fingerprint quality vectors is defined in the *Data Format Specification*.

7 Test Procedures

Note: a detailed Test Procedures document will be provided to Participants when their evaluations are scheduled.

Test Preparation

FpVTE 2003 evaluations will be conducted at the NIST facilities at Gaithersburg, MD, no earlier than September 29 and no later than December 31, 2003.

Each FpVTE 2003 Participant will be assigned a date to arrive for the evaluation. Participants may ship equipment to NIST to arrive up to one week prior to their assigned date. NIST will provide suitable storage for shipped equipment, but will not provide personnel to set up or test equipment. Such set up and test activities are the responsibility of each Participant. Participants will be allotted a certain amount of time to set up and test their equipment. The *System Throughput Specification* requests an estimate of setup time.

Not all Participants will start the test on the same day.

Participants will be required to submit a five-page (maximum) System Description Document, in electronic form, on the first day of testing. This document will be included in the final FpVTE 2003 report that will be released to the public. This document must adequately address the following topics:

- Overview of the evaluated system(s).
- Component list for the evaluated system(s).
- Detailed cost breakdown of the submitted system(s) (commercial vendors only).
- Details of any modifications required to take FpVTE 2003.

FpVTE 2003 will serve as part of NIST's statutory mandate under section 403c of the USA PATRIOT Act to certify biometric technologies. This certification is for a specific system configuration. To define that specific system configuration, Participants will be required to submit a Configuration Management Document on the first day of testing. This document will treated as Proprietary by NIST, and will not be disclosed without the permission of the Participant. The Configuration Management Document will contain sufficient information to enable the Participant to precisely recreate, at some later date, the system(s) evaluated in FpVTE 2003. In addition, future Government evaluations or interested agencies may request that a Participant use precisely the same system as was used in FpVTE and certified by NIST. Some of the FpVTE Participants' systems are expected to be custom configurations that may be difficult to recreate without sufficient documentation, as provided in the configuration management document. The configuration management document will be archived by NIST and will not be included in the final FpVTE 2003 report. A copy will be provided to the Participant upon request, or to interested Government entities with permission of the Participant. Participants with custom or 1-of-a-kind systems should be especially careful to delineate every hardware and software component, and all modifications, in the Configuration Management Document so that the system certified by NIST can be precisely recreated in the future.

FpVTE 2003 Participants will be given the FpVTE Evaluation Datasets after their equipment is set up.

The agencies that have provided Evaluation Datasets have done so with the restriction that the data shall not be retained in any way or form whatsoever by Participants. The FpVTE 2003 Evaluation Datasets will be protected under the Freedom of Information Act (5 U.S.C 552) and the Privacy Act (5 U.S.C. 552a) to the extent permitted by law, and will bear the legend "Notice: May contain Privacy Act or FOIA Protected Information."

The FpVTE Evaluation Datasets will be provided on a CD for SST and MST, and on a Universal Serial Bus (USB) Hard Drive for LST. (If needed, Participants may request SST or MST Evaluation Datasets on USB.)

The USB drive will be an IDE hard drive, formatted either NTFS or EXT3 (as requested by the Participant), with one partition, in an external enclosure connected to host computer via a USB port (compatible with both USB 1.0 and USB 2.0). If required, a separate computer (provided by the Participant) may be used to facilitate transfer to and from the USB hard drive. This computer would be considered part of the overall system, and would have its drives expunged at the conclusion of the test.

Conduct of Test

Testing activities will be recorded using video cameras for documentation of the evaluations. Footage from this documentation will not be made available to the public without review and comment from any participant that is named in the video.

Systems being evaluated in FpVTE 2003 shall not be accessible from outside the room in which the evaluation is being conducted. Modem, Internet, or wireless access is expressly prohibited. After the Evaluation Datasets have been given to Participants, all removable media (such as CDs, DVDs, Zip disks, Jaz drives, USB memory sticks, etc.) and all devices connected to the system (such as additional computers, laptops, PDAs or other handheld devices, etc.) are considered part of the system, and shall not leave the room without express Government approval. Offenders will be subject to criminal penalties.

The FpVTE Evaluation is designed to test systems running continuously (24 hours per day) over the test period with no substantial user/operator intervention. Participants shall have very limited contact with their systems during the test: three minutes of supervised and videotaped direct operator access per hour, during normal work hours Monday through Friday, will be permitted for system administration. Greater interaction with the systems during the test will only be permitted for system administration reasons by the express permission of the FpVTE Lead Test Agent, with the following restrictions:

- A written explanation for the need of system administration (such as a system crash) will be signed by the Participant and the FpVTE Lead Test Agent;
- The explanation and the amount of time required will be included in the FpVTE 2003 Final Report;
- All activity will be supervised by and explained to an FpVTE Test Agent;
- All activity will be videotaped.

Failure to complete the test during the allotted time will be noted in the FpVTE 2003 Final Report. FpVTE personnel will decide, after conclusion of the test, if the partial test results will be reported in the FpVTE 2003 Final Report.

Post-Test Procedures

At the completion of the Evaluation, the Participants will transfer all required output files from their system to the storage medium used for the Evaluation Datasets. SST and MST Participants who received CDs will be required to burn a CD with their output files. The output CD and the Evaluation Dataset CD will be returned to the Government. LST and other Participants who received Evaluation Datasets on a USB will transfer all the required output files to the original USB hard drive. The USB drive will then be returned to the Government.

FpVTE 2003 Evaluation Datasets and data derived from the datasets shall not be retained in any way or form whatsoever by Participants after completion of the evaluation. FpVTE 2003 Evaluation Datasets and data derived from the datasets shall not be distributed, published, copied, or disseminated in any way or form whatsoever by Participants. Participants shall track all copies of the FpVTE 2003 Evaluation Datasets and return or destroy all copies at the end of the test, prior to leaving NIST. Failure to observe the restrictions on use of the FpVTE 2003 Evaluation Datasets is a violation of Federal law. Offenders will be subject to criminal penalties.

The Government will assure that none of the FpVTE fingerprints, or data derived from the fingerprints, are still resident on the Participant's system after the completion of the test. Participants will allow the Government to inspect all disks and other storage media on the system to verify compliance. This inspection will involve, at a minimum, the Government deleting files generated during testing and wiping free space on all disk drives and other storage media. The Government may choose to remove all files or format all disks, including system disks. The Government may also choose to remove and destroy certain storage media that cannot effectively be expunged of data.

It is recommended that Participants use separate drives or drive partitions for working space, including database management system (DBMS) data. This is so the areas for the operating system (OS) and fingerprint algorithms are clearly separated from the areas for working space. At the completion of the test, the Participant, under supervision, will perform a low-level format on the working space partition of their hard drive. If the working space is not clearly separated by drive or partition, all drives will be formatted. The Government will inspect all disks on the system to verify compliance.

A5. PUBLIC FAQ

FpVTE 2003: Frequently Asked Questions

Last updated 7 August 2003

To ask a question, please email us. All responses will be posted to this list: no individual responses will be sent. The newest Q&As are at the beginning of each section.

Note: a separate FAQ regarding test details will be available to registered test participants in the Participant Area.

1 Test Purpose

Is FpVTE 2003 testing slap segmentation?

No. The slap fingerprints (a.k.a. 4-finger simultaneous impressions) in the datasets have already been segmented using a combination of automated and manual segmentation.

Is FpVTE 2003 testing fingerprint scanners?

No. FpVTE is evaluating fingerprint identification and verification systems.

Is this a source selection for the U.S. VISIT program?

No. FpVTE is being conducted to assess the capability of currently available fingerprint systems for a range of large-scale and small-scale real world applications. NIST's role under the USA PATRIOT Act is to certify those biometric technologies that may be used in U.S. VISIT (U.S. Visitor and Immigrant Status Indication Technology, formerly known as the US entry-exit system). Any future source selection would obviously review the results from FpVTE 2003, but FpVTE is not itself a source selection.

How does FpVTE differ from FVC2002?

FpVTE focuses on the operational performance of large-scale identification systems in addition to verification systems. Performance using a variety of U.S. Government operational data will be evaluated. (See http://bias.csr.unibo.it/fvc2002/)

2 Applying to Participate

If we take the wording in paragraph 5.4 of the "Application to Participate in FpVTE 2003" literally, we would be unable to participate because we need to share the sample datasets and software with our engineering and technical groups who reside in other locations, both within the U.S. and internationally. What is the core intent of this paragraph? Additionally, we would appreciate clarity on corporate sharing of the information provided in the "Participant's Area", especially the FAQ.

The intent of paragraph 5.4 is to convey that use of the FpVTE 2003 Sample Datasets and Software (FSDS) is permitted only for the purpose of preparing for and participation in FpVTE 2003. Permission to use the FSDS expires at the conclusion of FpVTE 2003. Other uses of FSDS are specifically prohibited. This means that the FSDS may be shared with those entities within the Participant's organization that are necessary in order to prepare and perform as an FpVTE 2003 participant. The information in the website's "Participant's Area" should be treated similarly.

To participate in the test, should I send you the printed and signed form? Is there any other method to register, for example via fax or email?

Potential participants must fill out the *Application to Participate in FpVTE 2003*, print and sign the form, and send to the location designated on the form:
FpVTE 2003 Liaison, National Institute of Standards and Technology, Information Access Division (894), 100 Bureau Drive, Stop 8940, Gaithersburg, MD 20899-8940
Please do not fax or email the form.

Is there a fee to participate in FpVTE?

There is no participation fee. Participants will be required to provide hardware and software necessary for evaluating their system, as well as on-site representation during the evaluation.

Can non-US companies participate in FpVTE 2003?

Yes.

Can we participate anonymously?

No.

3 Test Administration

Are the three minutes an hour for system administration limited to work hours and work days, or 24/7?

Participant access is limited to three minutes of supervised and videotaped direct operator access per hour, ***during normal work hours Monday through Friday***.

Where will the test be held?

FpVTE 2003 evaluations will be conducted at the NIST facilities at Gaithersburg, MD. For information, see http://www.nist.gov/public_affairs/visitor/visitor.htm

When will the test be held?

FpVTE 2003 evaluations will be conducted no earlier than September 29 and no later than December 31, 2003. Start times for Participants will be staggered so that not all Participants will start on the same day.

If we want to have a test only in SST, is it expected that the participant will stay in the testing place for two weeks? Or longer?

The SST must be completed within a period of 14 days. The Participant must be present for setup, start of the test, completion of the test, and packing up the system. Participants will be allowed time for setup and packing up. Participants may leave while the test is being conducted. Participants are, however, responsible for insuring their systems complete all tests. FpVTE personnel are not responsible for informing Participants that their system has crashed or ceased to work for any reason. This includes (but is not limited to) power outages.

If we become a participant, should somebody in our company go to NIST to have a test? Is it not possible to have a test just by sending our software in executable form? Do we provide our own hardware?

Participants must provide hardware and software for the evaluation. Participants are responsible for the setup and takedown of the hardware and software at the evaluation. FpVTE 2003 personnel will oversee the setup and takedown, but are not available to physically or technically support that activity. Participants may not participate in FpVTE 2003 by simply sending software in executable form.

Should the participant take the system to the testing place in NIST, including hardware, to have a test?

Yes.

Is it possible to configure our system with just a notebook computer and our software? Or are only systems with dedicated hardware qualified for the test?

The choice of system is entirely up the Participant. Participants may use either standard or custom hardware for the test, subject to space and power restrictions. Such hardware must be sufficient to access and process the FpVTE Evaluation Datasets. The Evaluation Datasets will be provided to Participants on a CD for SST and MST, and on a Universal Serial Bus (USB) Hard Drive for LST. (Participants may request SST or MST Evaluation Datasets on USB instead of CD.)

If we are allowed to do two tests (MST and LST), can we perform MST and LST sequentially within the maximum of 35 (14+21) days? We can do MST and LST on the same hardware. If we can do LST after MST by changing software, we can save hardware components.

LST Participants are encouraged to take both MST and LST on a single system, one after the other. The MST and LST have separate time limits: time saved on one cannot be used for the other.

Do we have to have staff present during the entire multi-week evaluation?

No. The FpVTE Evaluation is designed to test systems running continuously (24 hours per day) over the test period with no substantial user/operator intervention. Participants may wish to have staff present to check on system status, or conduct limited system administration tasks, but only very limited contact with systems is permitted during the test.

Will FpVTE staff sign our NDA (Non-Disclosure Agreement)?

No. FpVTE will evaluate systems as "black boxes" -- we do not want to know proprietary information about the inner workings of the Participants' systems. Please do not send any proprietary information, including source code. FpVTE staff will not disclose information about Participants' system architecture, other than the system descriptions written by the Participants. The responses to the *System Throughput Questionnaire* will not be disclosed.

4 Test Data

What's the sampling resolution of the images?

All images are 500 pixels per inch, 8-bit grayscale images.

What are the extremes of rotation that we can expect in the images? What are the extremes in offset? (Is the core always present in the presented image?) What are the extremes of image sizes?

Please see the revised Test Plan, Section 3, Evaluation Data.

Do the inked card images contain extraneous text, lines, or other marks?

Yes. Images scanned from paper fingerprint cards are only included in LST, not SST or MST.

5 Test Procedures and Methodology

Will a background database of fingerprints be distributed to participants to pre-process/characterize/load before the test itself?

No. All of the fingerprints to be used in the test are Sensitive data and cannot leave the NIST facility.

Given the different roles of the MST and LST, how can the MST be a subset of the LST?

Participants selected to take the LST are strongly encouraged to take the MST as well; participants who choose to do so can take the two tests one after the other, and take the full time period for each test. (Explanation: The LST was originally designed to include the entire MST as a subtest, but to avoid confusion, we are keeping the tests distinct and recommend that LST participants take both tests.)

Are the preliminary throughput requirements in the Test Overview indicative of the test structure?

No. The preliminary throughput requirements shown in the original version of the Test Overview were intended to provide a draft, order of magnitude test size, based on then-available information. They were not intended to provide any insight into the test structure. The actual throughput requirements will be based on the Tentative Participants' responses to the *System Throughput Questionnaire*.

Where can I find more detailed information on the test structure?

The *Test Plan* provides additional information on the test structure. The final test structure and size for SST, MST, and LST will be determined by FpVTE 2003 personnel utilizing information in the Tentative Participants' responses to the *System Throughput Questionnaire*.

Do you evaluate based on time to complete as well as performance accuracy?

Throughput performance will not be measured. We note time to complete the test as well as failure to complete the test. Participants are encouraged to size their hardware and tune their software to make maximal use of the most accurate algorithms, using the entire time period. Rationale: (1) differences in Participants' hardware make resource comparisons impractical; (2) future operational configurations may improve throughput significantly through the use of more and specialized hardware.

FpVTE2003 intends to measure the accuracy of fingerprint binning, screening or filtering systems. Generally speaking, the accuracy of "fingerprint binning, screening or filtering systems" depends on filtering rate. For example, when the filtering rate is 0 % (no substantial filtering), filtering accuracy is 100%. Therefore, it is almost meaningless to measure filtering accuracy without checking filtering rate. Does FpVTE2003 intend to measure trade-off of filtering rate and filtering accuracy on LST?

Not in LST.

We encourage makers of filtering systems (such as those used as stages in an AFIS) to enter them separately in the MST. In MST, accuracy of a filtering system will be measured by the tradeoff between filter reject rate and filter rate.

Why don't you "level the playing field" by making all Participants perform on the same hardware configuration?

FpVTE 2003 attempts to evaluate existing matcher systems as black boxes. Many systems are composed of both hardware and software. Requiring some participants to port their software or to exclude special-purpose hardware (e.g. processing boards), would neither "level the playing field" nor measure existing capabilities.

6 LST-Specific Questions

If a dataset contains cards that have all 10 fingers, can we assume that we can choose how many fingers to be matched and which fingers to be matched?

Yes.

Can we assume all finger numbers are correct, e.g. no finger sequence errors, in all LST cards?

Yes.

FpVTE2003 intends to measure only accuracy and not to measure the total processing time (or speed). Then, it is a reasonable strategy for participants to choose "no filtering to avoid filtering errors" and to choose "matching all available fingers (up to 10 images per card) in order to achieve best possible accuracy". However, this method (no-filtering and all-finger matching) is not recommended on real system design which seeks best cost performance. It is expected that most LST participants will bring in a lot of matching engines to do no-filtering search and all-finger matching. Does FpVTE2003 accept "accuracy-oriented" test system although it could be useless to predict actual operational accuracy?

The LST is specifically designed to have such substantial throughput requirements that no-filtering searches will not complete the test. It is assumed that most Participants will trade off accuracy and throughput so that the evaluation will be completed in 80-90% of the allotted test period. LST Participants are encouraged to also take the MST as one means of demonstrating no-filtering accuracy.

Are we allowed to do the conditional use of secondary matching algorithms based on the first matching results? For 1:Many search, when the candidates of the first match results do not contain any absolute mate (hit), we can automatically activate the secondary matching using more powerful matching algorithm (also more time-consuming) to find mates. This function saves total matching time and it is operationally useful. However, matching scores could fluctuate when data base (background) changes.

Yes, conditional use of secondary matching algorithms is allowed. For a single subtest in LST, a Query dataset is searched against a Target dataset. Within the matrix of scores generated in a single subtest, all the scores MUST be comparable: a higher score MUST mean a higher degree

of similarity. Scores do NOT have to be comparable between different subtests. For example, different subtests can use different scoring methods: the scores when comparing 2-flats against 2-flats do not have to correspond to the scores comparing 10-rolls against 10-rolls.

7 Results

When will the results of FpVTE 2003 be made available to the public?

No later than six months after the conclusion of the evaluation; the evaluation should conclude in November or December 2003.

Will the FpVTE 2003 Evaluation Datasets be made available to the public?

No. The FpVTE 2003 Evaluation Datasets are "Privacy Act or FOIA Protected Information" and cannot be released. Attempting to retain the test data after the completion of the Evaluation is a violation of Federal law.

A6. HOW TO PARTICIPATE

How To Participate in FpVTE 2003

Last updated 13 August 2003

The deadline for registration for Participants was CLOSED on 12 August 2003. No new Participants will be accepted.

Potential participants must fill out the *Application to Participate in FpVTE 2003*, print and sign the form, and send to the location designated on the form.

The signed *Application* must be received by NIST by Tuesday, August 12, 2003.

The *Application to Participate in FpVTE 2003* fully describes the process for participating in FpVTE 2003. A brief overview of the process is as follows:

- Upon receipt of the original signed *Application to Participate in FpVTE 2003* form by the Government, the organization will be classified as a "Tentative Participant".
- Tentative Participants will be granted access to the Participant Area of this website.
- Tentative Participants must respond to the *System Throughput Questionnaire*, answering questions about system purpose, capacity and speed. A Participant's responses to the Throughput Questionnaire will be used by FpVTE personnel to appropriately size the subtests, and to determine in which FpVTE Subtest the Participant's system may participate. The *System Throughput Questionnaire* will be available on the Participant Area of the FpVTE website.
- Tentative Participants must produce properly formatted similarity files. FpVTE 2003 Sample Datasets will be made available to Tentative Participants, who will be required to perform trials using this sample set, at their own facilities, and provide similarity files to the Government.
- If demand for participation exceeds the Government's ability to properly evaluate the technology, the Government may select Participants from the Tentative Participant list. Details of this process are included in the *Application to Participate in FpVTE 2003*.
- FpVTE personnel may allow an organization to enter more than one system in the evaluation if the organization provides a compelling reason, and if space is available.
- Evaluation dates will be provided at a later date. The Government will attempt to accommodate each Participant's needs on the determination of evaluation dates.
- The FpVTE 2003 evaluations will take place at the National Institute of Standards and Technology (NIST), in Gaithersburg, Maryland.
- The FpVTE evaluation period will start no earlier than September and finish no later than December 2003.
- Anonymous participation will not be permitted.
- Participants can withdraw from the FpVTE 2003 evaluations at any time up to two weeks prior to the start of their testing, without their participation and withdrawal being documented in the FpVTE 2003 Evaluation Report. Withdrawals less than two weeks prior to the start of their testing will be documented in the FpVTE 2003 Evaluation Report.

A7. APPLICATION TO PARTICIPATE IN FPVTE 2003

Application to Participate in FpVTE 2003

Last updated 18 July 2003

1. Who Should Participate

1.1. Makers of commercially available fingerprint matching, verification, or identification systems are invited to participate in the Fingerprint Vendor Technology Evaluation 2003.

1.2. In addition, companies, research organizations, or universities that have developed mature prototype or research fingerprint matching, verification, or identification systems are invited to participate.

1.3. Anonymous participation will not be permitted.

2. Evaluation Overview

2.1. The FpVTE 2003 evaluations will take place at the National Institute of Standards and Technology (NIST), in Gaithersburg, Maryland during September – December, 2003.

2.2. FpVTE 2003 will consist of three Tests, the Small-, Medium-, and Large-Scale Tests (SST, MST, and LST). The SST is a subset of the MST. LST participants are strongly encouraged to take the MST.

2.3. The SST and MST will evaluate matching of ***individual*** fingerprint images. This contrasts with the large-scale test (LST), which will evaluate matching of ***sets*** of fingerprint images.

2.4. The processing capacity of a Participant's system will dictate for which of the three Tests the system is qualified.

2.5. The SST and MST will require running continuously (24 hours per day) over a period of approximately two weeks with no substantial user/operator intervention.

2.6. The LST will require running continuously (24 hours per day) over a period of approximately three weeks with no substantial user/operator intervention.

3. Evaluation Procedure

3.1. In order to request participation in FpVTE 2003, potential participants must electronically fill out this form (*Application to Participate in FpVTE 2003*) identifying the Responsible Party and the Point of Contact, print and sign the form, and send to the location designated below.

- The Responsible Party is an individual with the authority to commit the organization to the terms in this document.
- The Point of Contact is an individual with detailed knowledge of the system to be considered for evaluation.

3.2. Upon receipt of the original signed form by the Government, the organization will be classified as a "Tentative Participant". The Government must receive the form by the due date described in the FpVTE 2003 Calendar, as posted on the FpVTE 2003 website at http://fpvte.nist.gov/

3.3. The FpVTE 2003 website at http://fpvte.nist.gov/ will contain a public area accessible by all, and a restricted Participant Area. Tentative Participants and Participants will be granted access to the Participant Area of the FpVTE 2003 website.

3.4. In order to become Participants, Tentative Participants must meet the following requirements.

3.4.a. Tentative Participants must respond to the *System Throughput Questionnaire*, answering questions about system purpose, capacity and speed. A Participant's responses to the Throughput Questionnaire will be used by FpVTE personnel to appropriately size the subtests, and to determine in which FpVTE Subtest the Participant's system may participate. The *System Throughput Questionnaire* will be available on the Participant Area of the FpVTE website.

3.4.b. Tentative Participants must successfully produce similarity files according to defined formats. FpVTE 2003 Sample Datasets and Software will be made available in the Participant Area of the FpVTE 2003 website, or via other suitable manner. Tentative Participants will be required to perform trials using this sample set, at their own facilities, and provide similarity files to the Government. The Government will check these similarity files for compliance. The deadline for delivery of these similarity files will be provided on the website. Should the submitted similarity files not comply with standards, the Government will notify Participants and may allow re-submission of new similarity files to ensure compliance.

3.4.c. Tentative Participants must be selected by the Government to become FpVTE 2003 Participants. It is the Government's intention and desire to select all Tentative Participants as Participants. However, if demand for participation exceeds the Government's ability to properly evaluate the technology, the Government will be required to select Participants from the Tentative Participant list. If this occurs, the Government will request all Tentative Participants to provide the Government with a white paper that will be used as the basis for selection as an FpVTE 2003 Participant. The Government will provide Tentative Participants with the format and requirements for this white paper, if the need arises.

3.5. A list of Tentative Participants, and later, Participants will be made available in the Participant Area of the FpVTE 2003 website.

3.6. FpVTE personnel may allow an organization to enter more than one system in the evaluation if the organization provides a compelling reason, and if space is available. Organizations interested in having more than one system evaluated should still fill out one copy of this form (*Application to Participate in FpVTE 2003*), but one copy of the *System Throughput Questionnaire* for each system to be considered.

3.7. Evaluation dates will be provided at a later date. The Government will attempt to accommodate each Participant's needs on the determination of evaluation dates.

3.8. Participants will be required to submit a five-page (maximum)[1] system description document, in electronic form, on the first day of testing. These documents will be included in the final FpVTE 2003 report that will be released to the public. Failure to provide this document, in its proper form, may result in not being evaluated in FpVTE 2003. This document must adequately address the following topics:

- Overview of the evaluated system(s).
- Component list for the evaluated system(s).
- Detailed cost breakdown of the submitted system(s) (commercial vendors only).
- Details of any modifications required to take FpVTE 2003.

3.9. FpVTE 2003 Participants will not be allowed to comment on their participation in FpVTE 2003 until the FpVTE 2003 Final Report is released.

3.10. Testing activities will be recorded using video cameras for documentation of the evaluations. Footage from this documentation will not be made available to the public without review and comment from any participant that is named in the video.

3.11. Systems being evaluated in FpVTE 2003 shall not be accessible from outside the room in which the evaluation is being conducted. Modem, Internet, or wireless access is expressly prohibited.

3.12. The FpVTE Evaluation is designed to test systems running continuously (24 hours per day) over the test period with no substantial user/operator intervention. Participants shall have very limited contact with their systems during the test: three minutes of supervised and videotaped direct operator access per hour will be permitted for system administration. Greater interaction with the systems during the test will only be permitted for system administration reasons by the express permission of the FpVTE Lead Test Agent, with the following restrictions:

- A written explanation for the need of system administration (such as a system crash) will be signed by the Participant and the FpVTE Lead Test Agent;
- The explanation and the amount of time required will be included in the FpVTE 2003 Final Report;
- All activity will be supervised by and explained to an FpVTE Test Agent;
- All activity will be videotaped.

3.13. Failure to complete the test during the allotted time will be noted in the FpVTE 2003 Final Report. FpVTE personnel will decide, after conclusion of the test, if the partial test results will be reported in the FpVTE 2003 Final Report.

4. Points of Contact

4.1. All correspondence should be directed to fpvte@nist.gov, which will be received by the FpVTE Liaison and other FpVTE personnel.

[1] Two pages extra will be permitted for each additional system

4.2. All responses to correspondence will be posted on the FAQ (Frequently Asked Questions) area of the FpVTE website. Exceptions will be allowed only for extenuating circumstances. Two examples of exceptions are delivery of login information for the Participant Area of the FpVTE website, and resolving Participant specific needs for the on-site portion of the evaluation.

4.3. Interested parties, Tentative Participants, and Participants should not contact any individual member of the FpVTE staff.

4.4. The FpVTE Liaison is the government point of contact for FpVTE 2003.

4.5. The FpVTE Lead Test Agent is the government proctor for the on-site portion of the evaluation.

5. Access to FpVTE 2003 Sample Datasets and Software

5.1. FpVTE 2003 Sample Datasets and Software are supplied to Participants to assist in preparing for FpVTE 2003. These will be made available to Participants in the FpVTE 2003 Participant Area or in an otherwise suitable manner.

5.2. The FpVTE 2003 Sample Datasets are representative of the FpVTE 2003 Evaluation Datasets in format. Image quality, collection device and other characteristics may vary between the Sample and Evaluation Datasets.

5.3. The FpVTE 2003 Sample Datasets and Software include:

- SST/MST Sample Dataset
- LST Sample Dataset
- Scoring code to generate evaluation charts
- Instructions on how to use the software tools
- Documentation on similarity file output requirements for SST/MST, and LST
- Instructions for submission of sample similarity files for Government review

5.4. The FpVTE 2003 Sample Datasets and Software shall not be further distributed, published, copied, or further disseminated in any way or form whatsoever, whether for profit or not. This includes further distributing, copying or disseminating to a different facility or organizational unit in the requesting university, organization, or company. All requests for copies of the FpVTE 2003 Sample Datasets and Software will be forwarded to the NIST FpVTE Liaison.

5.5. All publication or other release of any part of the FpVTE 2003 Sample Datasets and Software, or data derived from using the FpVTE 2003 Sample Datasets and Software, in reports, papers or other documents must first be approved in writing, by the NIST FpVTE Liaison.

5.6. Failure to observe the restrictions on use of the FpVTE 2003 Sample Datasets and Software will result in removal from FpVTE 2003. Offenders may also be subject to civil damages.

6. Access to FpVTE 2003 Evaluation Datasets

6.1. FpVTE 2003 Participants will be given the FpVTE Evaluation Datasets on the day they arrive for actual testing.

6.2. To the extent permitted by law, the FpVTE 2003 Evaluation Datasets will be protected under the Freedom of Information Act (5 U.S.C 552) and the Privacy Act (5 U.S.C. 552a) as applicable.

6.3. The FpVTE 2003 Evaluation Datasets will bear the legend "Notice: May contain Privacy Act or FOIA Protected Information."

6.4. FpVTE 2003 Evaluation Datasets and data derived from the datasets shall not be retained in any way or form whatsoever by Participants after completion of the Evaluation.

6.5. FpVTE 2003 Evaluation Datasets and data derived from the datasets shall not be distributed, published, copied, or disseminated in any way or form whatsoever by Participants.

6.6. Participants shall track all copies of the FpVTE 2003 Evaluation Datasets and return or destroy all copies at the end of the test, prior to leaving NIST.

6.7. The FpVTE Evaluation Datasets will be provided on a Universal Serial Bus (USB) Hard Drive. This will be an IDE hard drive, formatted either NTFS or EXT3 (as requested by the Participant), with one partition, in an external enclosure connected to host computer via a USB port (compatible with both USB 1.0 and USB 2.0). If required, a separate laptop may be used to facilitate transfer to and from the USB hard drive.

6.8. At the completion of the test the Participants will transfer all the required output files from their system onto the original USB hard drive. The USB drive will then be returned to the Government.

6.9. The Government will assure that none of the FpVTE fingerprints, or data derived from the fingerprints, are still resident on the test computer after the completion of the test. Participants will allow the Government to inspect all disks on the system to verify compliance. This inspection will involve, at a minimum, the Government deleting files generated during testing and wiping free space on all disk drives. The Government may choose to remove all files or format all disks, including system disks.

6.10. It is recommended that Participants use separate drives or drive partitions for working space, including database management system (DBMS) data. This is so the areas for the operating system (OS) and fingerprint algorithms are clearly separated from the areas for working space. At the completion of the test, the participant, under supervision, will perform a low-level format on the working space partition of their hard drive. If the working space is not clearly separated by drive or partition, all drives will be formatted. The Government will inspect all disks on the system to verify compliance.

6.11. Failure to observe the restrictions on use of the FpVTE 2003 Evaluation Datasets is a violation of Federal law. Offenders will be subject to criminal penalties.

7. Release of Evaluation Results

7.1. After the completion of the evaluations, the Government will combine all results into a Final Report. The FpVTE 2003 Final Report will contain, at a minimum, descriptive information concerning FpVTE 2003, descriptions of each experiment, evaluation results, and each Participant's five-page system description document.

7.2. A pre-release version of the FpVTE 2003 Final Report will be made available to Participants. Participants will be invited to provide comments which will be included as an appendix to the FpVTE 2003 Final Report. More specific guidance concerning the report and Participant comments will be provided at a later date.

7.3. Participants shall not comment publicly or privately on the pre-release version of the FpVTE 2003 Final Report until it has been released to the public.

7.4. After the release of the FpVTE 2003 Final Report, Participants may decide to use results of these evaluations for their own purposes. Such results shall be accompanied by the following phrase: "Results shown from the Fingerprint Vendor Technology Evaluation 2003 do not constitute endorsement of any particular system by the Government." Such results shall also be accompanied by an Internet hyperlink (URL) to the FpVTE 2003 Final Report on the FpVTE 2003 website.

8. Additional Information

8.1. Any data obtained during these evaluations, as well as any documentation required by the Government from the participants, becomes the property of the Government. Participants will not possess a proprietary interest in the data and/or submitted documentation.

8.2. With the signing of this form, Tentative Participants and Participants attest that they will not file any FpVTE-related claim against FpVTE 2003 Sponsors, Supporters, staff, contractors, or agency of the U.S. Government, or otherwise seek compensation for any equipment, materials, supplies, information, travel, labor and/or other participant provided services.

8.3. The Government is not bound or obligated to follow any recommendations that may be submitted by the Participant. The United States Government, or any individual agency, is not bound, nor is it obligated, in any way to give any special consideration to FpVTE 2003 Participants on future contracts.

8.4. With the signing of this form, Tentative Participants and Participants realize that any test details and/or modifications that are provided in the Participant Area of the FpVTE 2003 website supersede the information on this form.

8.5. With the signing of this form, Tentative Participants and Participants realize that they can withdraw from the FpVTE 2003 evaluations at any time up to two weeks prior to the start of their testing, without their participation and withdrawal being documented in the FpVTE 2003 Evaluation Report. Withdrawals less than two weeks prior to the start of their testing will be documented in the FpVTE 2003 Evaluation Report.

8.6. Please mail the completed and signed form to:

FpVTE 2003 Liaison
National Institute of Standards and Technology
Information Access Division (894)
100 Bureau Drive, Stop 8940

Gaithersburg, MD 20899-8940

9. Request to Participate

Company / Organization Name

9.1. Responsible Party

Title	First Name	MI	Last Name	Suffix
Street/Mailing Address				
City		**State**	**Zip Code**	
Phone Number	**Fax Number**	**Email Address**		

9.2. Point of Contact Check if same as Responsible Party above ☐

Title	First Name	MI	Last Name	Suffix
Street/Mailing Address				
City		**State**	**Zip Code**	
Phone Number	**Fax Number**	**Email Address**		

With my signature, I hereby request consideration as a Tentative Participant and Participant in the Fingerprint Vendor Technology Evaluation 2003, and I am authorizing my company or organization to participate in FpVTE 2003 according to the rules and limitations listed in this document.

With my signature, I also state that I have the authority to accept the terms stated in this document.

SIGNATURE OF RESPONSIBLE PARTY DATE

A8. Calendar

FpVTE 2003 Calendar

Last updated 8 September 2003

July	
Formal FpVTE 2003 announcement	15 July
Application to Participate in FpVTE 2003 available	15 July
Participant Test Overview available	15 July
Participant Test Plan available	24 July
Participant Area of FpVTE website available	28 July
System Throughput Questionnaire available	28 July
August	
Application to Participate in FpVTE 2003 due	12 August
Data Format Specification available	14 August
System Throughput Questionnaire due	19 August
SST Sample Data and Software available	21 August
MST and LST Sample Data available	28 August
September	
Test size and structure announced	5 September
Participation Notification email sent to Tentative Participants (including schedule)	8 September
Response to Participation Notification due	11 September
Sample Data Similarity Matrices due (by email) ***Extended!***	17 September
Last date to drop out anonymously	19 September
Normalization Specification available *(Note: The Normalization software (optional) is due in November, not before the start of the evaluation itself)*	22 September
Test Procedures document available	25 September
Test Period starts	29 September
October	
Test Period	
November	
Normalization software (optional) due	4 November
Test Period ends	21 November

A9. SUPPORTERS & SPONSORS

Sponsors and Supporters

Last updated 13 August 2003

Sponsors

- Justice Management Division, US Department of Justice, IDENT/IAFIS Project
- National Institute of Standards and Technology
- Bureau of Immigration and Customs Enforcement
- Federal Bureau of Investigation
- U.S. Department of State
- U.S. VISIT Program

Supporters

- European Commission Services
- Office of the Chief Information Officer, U.S. Department of Justice
- Royal Canadian Mounted Police
- U.K. Police Information Technology Organisation (PITO)
- U.S. Department of Homeland Security
- U.S. Department of Justice

A10. SYSTEM THROUGHPUT QUESTIONNAIRE

FpVTE System Throughput Questionnaire

1 Background

All Tentative Participants are required to complete the Single Image *System Throughput Questionnaire* (section 2.1). Tentative Participants who are interested in the Large Scale Test (LST) must also complete the LST Section of the *System Throughput Questionnaire* (section 3.2). Tentative Participants considering using different systems should complete this *System Throughput Questionnaire* for ***each*** system submitted for evaluation.

Responses will be used to determine the final test designs, the size and structure of which will be chosen to optimize among competing analysis objectives, available resources, and the need for Participants to complete within the allotted time. Participants' responses to the *System Throughput Questionnaire* will ***not*** be published in the FpVTE Final Report.

Responses to the *System Throughput Questionnaire* are due by August 19. Responses can be emailed to FpVTE@NIST.gov (preferred), or faxed to (301) 975-5287, attn: FpVTE 2003 Liaison.

For background information, please refer to the *Test Overview* and *Test Plan* documents posted at the FpVTE website (http://FpVTE.nist.gov).

2 Single Image Throughput

For this section, assume that you are given a single dataset, which will consist exclusively of single-finger flat images (not segmented slap or rolled images). The images will be images of the right index finger (Finger 02). No other fingers will be included in the test. Each fingerprint will be contained in a separate ANSI/NIST file, with each image in a Type-4 image record (WSQ compressed).

For this section, assume that the single dataset will be both Query set and Target set — in other words, every fingerprint will be compared against every other fingerprint. Self-idents (comparisons of a fingerprint to itself) will be ignored.

Each system must produce a matrix of similarity scores. This matrix is the result of comparing each fingerprint in the Query set with every fingerprint in the Target set. The output format is designed under the assumption that each Query print is compared to every Target print before proceeding to the next Query print.

Participants will be provided time to set up their systems, but the processing itself is required to be ***fully*** automated. In particular, this includes loading the Target set into a database, if needed.

Assume that this test will be conducted over a period of precisely two weeks (1,209,600 seconds).

2.1 Single Image Throughput Questions

Please provide written responses to the following items. Please provide equations and explain calculations.

If you have multiple system configurations that result in different throughputs, please provide responses for each configuration that you are considering using on the test.

1. Identifying information.
    a. Participant name
    b. System name

2. Briefly describe your hardware configuration.
   a. State the number and size of CPUs, memory, special processing boards, etc.
   b. State
      - power requirements (e.g. standard house current, three-phase, high amperage)
      - space requirements (e.g., standard workstation, or 1 rack, with dimensions)
      - setup/packup time requirements (hours).
   c. The FpVTE liaison reserves the right to restrict participation based on power and space requirements.
   d. If you are considering a custom configuration for the test, briefly indicate how the custom configuration differs from a standard configuration, and why a custom configuration is needed.
3. Estimate the time required to compare a dataset of 10,000 flat prints to itself.
   a. Provide separate estimates for pre-processing (characterization) and matching. Formulas are preferred.
   b. Discuss upper and lower bounds on these estimates and the primary source(s) of uncertainty.
4. Performance concerns.
   a. For your system, would the following take roughly equivalent times? (For many 1:1 systems, these are very similar; for a multi-stage 1:n system, these are substantially different.)
      - comparing 1 Query to 10,000 Targets
      - comparing 10,000 Queries to 1 Target
      - comparing 100 Queries to 100 Targets
   b. Identify any factors in the design of the test that are likely to have a great impact on your matcher's throughput performance.
   c. Identify any other factors (perhaps not mentioned in the test description) that pose special concern from a throughput performance perspective.
   d. Clarify the relation between these factors and performance to help us ensure that your matcher can complete the tests within the allocated time.
   e. What additional information would help you size or tune your system to complete the tests within the allocated time?
5. The following assumptions are currently being used to design the MST Test. If you are considering participation in the MST, please comment on your system's ability to perform at this level. Times are real, elapsed time, i.e., actual elapsed time running all processors.
   a. No more than 1 second per image preprocessing (image decompression and characterization)
   b. No more than 1 second per image to load database
   c. No more than 0.01 seconds per comparison (100 image comparisons per second)
   d. The above (a through c) are the driving throughput parameters: other parameters are not significant
   e. Each image in a dataset needs to be characterized only once, though the dataset may be used multiple times, as Query sets and/or as a Target set.
   f. Given the above, MST could contain 10,000 fingerprints:
      - Preprocessing: 1 * 10,000 = 10,000 seconds
      - Loading: 1 * 10,000 = 10,000 seconds

- Match time: 0.01 * 10,000 * 10,000 = 1,000,000 seconds
- Total: 1,020,000 (less than 2 weeks, or 1,209,600 seconds)

6. The following assumptions are currently being used to design the SST Test. If you are considering participation in the SST, please comment on your system's ability to perform at this level. Times are real, elapsed time, i.e., actual elapsed time running all processors.
   a. No more 5 seconds per image preprocessing (image decompression and characterization)
   b. No more than 1 second per image to load database
   c. No more than 1 second per comparison
   d. Given the above, SST could contain 1,000 fingerprints:
      - Preprocessing: 5 * 1,000 = 5,000 seconds
      - Loading: 1 * 1,000 = 1,000 seconds
      - Match time: 1 * 1,000 * 1,000 = 1,000,000 seconds
      - Total: 1,006,000 (less than 2 weeks, or 1,209,600 seconds)

3 Large Scale (Fingerprint Set) Test

For the LST, an XML specification will be provided at the time of the evaluation that defines all subtests. The format of the XML specification is described in *Data Format Specification*, and an example will be provided with the Sample Datasets. The XML specification describes the Query and Target sets, and identifies the corresponding ANSI/NIST files. For each subtest, the system must produce a matrix of similarity scores, i.e., the result of comparing each fingerprint set in the Query Set with every fingerprint set in the Target Set.

Since an AFIS generally filters out many non-mates, similarity scores may not be available for every comparison. Participants nevertheless will be expected to generate a fully-populated matrix of scores, but may fill the majority of the matrix with one or more default values. Participants are advised that the choice of true scores vs. default values will affect evaluation results, and are encouraged to fill the matrix as completely as possible with true scores.

The output format is designed under the assumption that each Query fingerprint set is compared to every Target print before proceeding to the next Query print. It is envisioned (but not required) that the system characterize and load a Target Set, then iterate through all Query prints to produce the similarity matrix for a subtest. In some cases, consecutive subtests will use the same Target Set. Query Sets also may be reused across subtests. One set of images may be used as a Query Set, Target Set, or as both, so the ability to save image characterizations may save processing time.

This test will be conducted over a period of precisely three weeks (1,814,400 seconds).

3.1 Sizing Example for Questionnaire Purposes Only

The following example is given as a basis for discussing sizing assumptions. This example illustrates how the test will be built from subtests, but is ***not*** indicative of the actual test structure. In particular, the number of subtests and the size and composition of the Query and Target sets differ from the actual test. Question 5 in Section 3.2 asks you to provide throughput estimates based on this example.

The example test description shown in Figure 1 contains information similar to what will be provided in the XML test specification. Test output is produced for the "search" steps only. For each subtest, one file containing a vector of similarity scores is created for each ANSI/NIST file (fingerprint set) in the Query set. A similarity matrix is defined by the collection of these files for a subtest. File formats are specified in *Data Format Specification*.

1. Characterize (or preprocess) Dataset A
   a. 20,000 ANSI/NIST files (i.e. fingerprint sets)
   b. 10 fingers per file, finger positions (correctly) noted
   c. Rolled prints, scanned from paper
2. Characterize Dataset B
   a. 10,000 ANSI/NIST files
   b. 4 fingers per file, finger positions noted (left index, right index, left thumb, right thumb)
   c. Livescan images segmented from slap fingerprints
3. Characterize Dataset C
   a. 2,000 ANSI/NIST files
   b. 1 finger per file (left index)
   c. Flat, livescan images
4. Load Dataset A as the Target set
5. Search Dataset A against itself
6. Search Dataset B (against Target Dataset A)
7. Load Dataset B as the Target set (replacing Dataset A)
8. Search Dataset A (against Target Dataset B)
9. Search Dataset B (against Target Dataset B)
10. Load Dataset C as the Target set (replacing Dataset B)
11. Search Dataset C (against Target Dataset C)

Figure 1 Example Test Description

One similarity matrix is produced for each of the five subtests ("search" statements). Figure 2 summarizes the size and structure of the five subtests.

		Query Sets		
		Dataset A · 20,000 fingerprint sets · 200,000 images	Dataset B · 10,000 fingerprint sets · 40,000 images	Dataset C · 2,000 fingerprint sets · 2,000 images
Target Sets	Dataset A · 20,000 fingerprint sets · 200,000 images	Similarity Matrix A-A 400,000,000 scores	Similarity Matrix A-B 200,000,000 scores	
	Dataset B · 10,000 fingerprint sets · 40,000 images	Similarity Matrix B-A 200,000,000 scores	Similarity Matrix B-B 100,000,000 scores	
	Dataset C · 2,000 fingerprint sets · 2,000 images			Similarity Matrix C-C 4,000,000 scores

Figure 2 The example test is comprised of five subtests

3.2 LST Throughput Questions

Please provide written responses to the following items. Please provide equations and explain calculations. If you have multiple system configurations that result in different throughputs, please provide responses for each configuration that you are considering using on the test (or representative extremes).

1. Identifying information.
   a. Participant name
   b. System name
2. Briefly describe your hardware configuration.
   a. State the number and size of CPUs, memory, special processing boards, etc.
   b. State
      · power requirements (e.g. standard house current, three-phase, high amperage)
      · space requirements (e.g., 1 or 2 racks, with dimensions)
      · setup/packup time requirements (hours)
   c. The FpVTE liaison reserves the right to restrict participation based on power and space requirements.

d. If you are considering a custom configuration for the test, briefly indicate how the custom configuration differs from a standard configuration, and why a custom configuration is needed.

3. Estimate the time required to generate the similarity matrix for a dataset of 10,000 rolled 10-print sets, where Query set = Target set.

   a. Provide separate estimates for preprocessing (image decompression and characterization), loading the database, and matching for each subtest. *Formulas are welcome*.

   b. Discuss upper and lower bounds on these estimates and the primary source(s) of uncertainty.

4. Estimate the time required to generate the similarity matrix for a dataset of 10,000 flat 2-print sets, where Query set = Target set.

   a. Provide separate estimates for preprocessing (image decompression and characterization), loading the database, and matching for each subtest. *Formulas are welcome*.

   b. Discuss upper and lower bounds on these estimates and the primary source(s) of uncertainty.

5. Estimate the time required to execute the example test described in section 3.1.

   a. Provide separate estimates for preprocessing (image decompression and characterization), loading the database, and matching for each subtest. *Formulas are welcome*.

   b. Discuss upper and lower bounds on these estimates and the primary source(s) of uncertainty.

6. Performance concerns.

   a. Identify any factors in the design of the test that are likely to have a great impact on your matcher's throughput performance.

   b. We assume that image characterization, database loading, and matching time are the driving throughput parameters; other parameters are not significant

   c. We assume that once all of the images in a dataset have been characterized, the dataset may be used multiple times without re-characterization.

   d. Is image preprocessing (image decompression and characterization) for multi-image fingerprint sets a function of the number of images or the number of subjects? In other words, does preprocessing a 10-image fingerprint set take ten times as long as one fingerprint image, or are the multiple fingers processed in parallel?

   e. Identify any other factors (perhaps not mentioned in the test description) that pose special concern from a throughput performance perspective.

   f. Clarify the relation between these factors and performance to help us ensure that your matcher can complete the tests within the allocated time.

   g. What additional information would help you size or tune your system to complete the tests within the allocated time?

A11. PARTICIPANTS' FAQ

FpVTE 2003: Participants' Frequently Asked Questions

Last updated 22 October 2003

To ask a question, please email us. All responses will be posted to this list: no individual responses will be sent. The newest Q&As are at the beginning of each section.

Please do not share Participants' FAQs outside those portions of your organization that are directly involved with your participation in FpVTE. Participants' FAQs will be published in an Appendix to the FpVTE Final Report.

Note: a separate FAQ regarding questions of general interest is available in the main FpVTE Website.

Data

NEW Is the Subject ID field included in the Evaluation XML as SampleID="", or is the field missing altogether?

The "Subject ID" field that was included in the XML for the sample datasets, IS NOT included in the actual SST, MST or LST data. Instead of
<signature name="d1/MST00001" subject_id="225">
the tags look like this:
<signature name="d1/MST00001">

In the SST and MST Sample Data, the fields in the ANSI/NIST Type-1 record are formatted "1.01:", but in the LST Sample Data, the fields are formatted "1.001:" Which is correct?

Both are correct. The number of leading zeroes in an ANSI/NIST field is not meaningful to software that is fully compliant with ANSI/NIST. The ANSI/NIST spec (Section 7.2.2) states "a field number of '2.123:' is equivalent to and shall be interpreted in the same manner as a field number of '2.000000123:'."
In FpVTE, the Evaluation Data will be formatted in the same way as the corresponding Sample Data:

- In SST Sample, Trivial, and Evaluation Data, the fields in the Type-1 record are formatted "1.01:"
- In MST Sample, Trivial, and Evaluation Data, the fields in the Type-1 record are formatted "1.01:"
- In LST Sample, Trivial, and Evaluation Data, the fields in the Type-1 record are formatted "1.001:"

In Section 3.1 of the Test Plan, it is stated that: "Most datasets are searched against themselves. Obviously such searches generate self-idents, which are ignored." It is understandable that the self-match scores will not be included in the ROC, Rank-1 statistics, etc. However, we suspect that they could be needed in the normalization by the fpvte-nist. At what stage are the self-match scores ignored? Does it mean that we can skip self-matches? Will the self-match scores affect the proposed fpvte-nist score normalization? Can we use a special, but valid value to indicate a self-match score, since all the scores need to be reported?

Self-match scores are completely ignored in analysis and are not used in FpVTE's normalization algorithms. Self-match scores may be used in a Participant's own normalization algorithms. Participants may choose to skip the self-match comparisons. Participants should, however, verify that their systems can compare self-idents (absolutely identical images) without system errors (e.g. overflow).

The SST sample data set contains images of only 3 sizes. Will the actual test contain only these same 3 sizes? If not, can you provide a list of all the sizes that will be present?

The 1,000 flat images in the SST Evaluation Dataset will all be 368 x 368. The flat images in the MST and LST will have the range of sizes noted in the Test Plan.

Can you provide any other information about the data in the Evaluation Datasets?

The following report describes some of the operational data used in the FpVTE Evaluation Datasets:

- M. D. Garris, C. I. Watson, C. L. Wilson, A. Hicklin, "Studies of Fingerprint Matching Using the NIST Verification Test Bed (VTB)," NISTIR 7020 **[5,076K]**, July 2003

The finger numbers of Query Set are all covered by finger numbers of Target Set in the LST Sample data. Can we assume this is true on the real LST test? In the other word, we do not have to worry about the case shown below: Query Set - Finger Numbers 2, 3; Target Set - Finger Numbers 1, 4, 6, 7 (Note: No matching fingers.)

This is not a problem in the LST Evaluation datasets. All Target Sets will contain all 10 fingers in cases except for when 2F (index finger) and 1F (index finger) datasets will will be searched against 2F (index finger) data.

The proper aspect ratio application is needed to be able to match fingerprint images from different scanner hardware. So my concern now becomes a question on how and who normalized the images from multiple vendors to 500 pixels per inch.

The standard specification for fingerprint scanner image quality is the FBI's Image Quality Specification, EFTS Appendix F. The geometric image accuracy limits are stated in the standard. All of the images collected from paper sources were collected on EFTS Appendix F Certified flatbed scanners. All of the livescan slap and rolled images were collected on livescan devices that are compliant with EFTS Appendix F or Appendix G (an earlier, interim standard). The flat images were collected from lower-cost, single finger livescan devices that are not Appendix F compliant, and have greater variance in the stated 500 ppi aspect ratio. The single-finger flat images from those devices are included in the datasets as captured by the devices. A list of products certified as compliance with the FBI's Image Quality Specifications can be found here.

Are all of the prints used on the MST and LST complete prints or are we to assume some are partial prints (latent type)?

No latent fingerprints are included in FpVTE. The fingerprints are of varying quality, and some of the poor quality fingerprints would be considered partial prints.

Can we assume within each data set only contained the same number of finger print images? For example data set B has 4 images, we assume all records in the set B have 4 images.

Yes.

Can we assume within each data set all images belong to given finger positions? For example the data set B has 4 images and 4 images in all records are belong to finger position 1, 2, 6, 7.

No. (See the Test Plan, Section 5.1) A "4S" dataset will contain only ANSI/NIST files that contain 4 segmented slap fingerprint images. Every file contains images for 4 fingers. Not all files will have the same 4 fingers, but the files will be grouped by which fingers are included. For example, a dataset would have all of the 4S files containing Fingers 02,03,04,05 grouped together and labeled (with the Metadata attribute in the Dataset Definition File set to "4S-L-Right", then all of the files containing Fingers 02,03,07,08, (with Metadata set to "4S-L-IM" (Index Middle)) etc. This will be clear in the LST Sample data.

Can you provide the test data in jpg/gif format? If not, do you have conversion software, which converts the ANSI/NIST file to jpg or gif file? If not, do you know where we can get such a conversion software?

All test data will be supplied in ANSI/NIST format, with images compressed using WSQ. NIST has public domain WSQ and ANSI/NIST tools in NIST Fingerprint Image Software (NFIS) (see http://www.itl.nist.gov/iad/vip/databases/defs/nist_nfis.html) A variety of commercial vendors of WSQ tools can easily be found by doing an Internet search for "wsq compression software."

Likewise, Participants seeking ANSI/NIST toolkits can find a variety by searching for "ansi/nist fingerprint toolkit".

Do the images vary in size? What is the minimum size, and what is the maximum size?

The image size varies, as stated in the Test Plan, Sections 3.2 (Flat), 3.3 (Slap), and 3.4 (Rolled).

Is it possible for you to adjust the (white) background area of the images (adding a white frame to the images), so that all are of the same size?

Participants may choose to do this if they desire.

What demographic population is represented by the data sets - specifically are there juvenile records included and if so what age range?

The datasets are sampled from a variety of populations. There are no juveniles in the datasets. Subject age will not be noted in the ANSI/NIST files.

What data will be included in the ANSI/NIST format files?

Impression type (livescan or non-livescan) will be noted for all images. Finger number will ***not*** be noted for SST and MST, but ***will*** be noted for LST. Scanning resolution is set to 19.69 pixels/mm (= 500 pixels/inch) for all images. The XML Dataset definitions will note which images are flats vs. segmented slaps.

Details of the ANSI/NIST fields used will be included in the *Data Format Specification*, which will be made available in the Participant Area of the FpVTE Website.

Test Administration

Please clarify the definitions of "start date" and "arrival date". The start date for LST, for example, is up to three days after the arrival date. Shipped equipment must arrive at NIST at least two business days prior to the start date. Does this mean that LST equipment may arrive on the arrival date?

Shipped equipment must arrive at NIST at least two business days prior to a participant's arrival date. The purpose of the time between the arrival date and the start date is to allow the participant time to set up the equipment.

What information should be included in the Configuration Management Document?

The Configuration Management Document must contain sufficient information to enable the Participant to precisely recreate, at some later date, the system(s) evaluated in FpVTE 2003. Accordingly, the document must unambiguously identify a controlled version that can be reproduced in the future (perhaps from a backup copy). This information should include component sizes, creation/modification dates, and build numbers. Likewise, the version and configuration of system software (including any parameter settings or options) must be documented in the Configuration Management Document. Any Participant with a custom or one-of-a-kind system should be especially careful to delineate every hardware and software component, and all modifications, in the Configuration Management Document so that the system certified by NIST can be precisely recreated in the future.

We understand that Participants are required to submit a System Description Document and a Configuration Management Document on the first day of the evaluation. Will we be permitted to make corrections or revisions after submitting the documents?

Yes. NIST will allow corrections or revisions to the System Description Document and Configuration Management Document up to one week after completion of the Participant's test(s). However, we would expect that System Description Document items such as the component list for the system(s) to be evaluated and details of any modifications required to take FpVTE 2003 would be clearly indicated in the initial submission and require little, if any, revisions.

If I'm doing the MST and LST in series on the same hardware, are you going to wipe my disks between tests?

NIST reserves the right, as part of the system cleaning described in the Test Procedures, to wipe all disks, including system disks, after the MST has completed.

- If the same resources are used for both MST and LST and the actual setup time for LST is very brief, NIST may elect not to wipe all disks, including system disks, after the MST has completed.
- If reconfiguration for the LST (after the completion of MST) will be extensive, the Test Agent will determine the degree to which disks will be wiped.
- If you are using any of the same hardware for both tests, all setup for the second test must be supervised and video-recorded since that hardware contains privacy act data.
- If multiple systems are located in the same room, setup/monitoring of all systems must be supervised by a test agent once the trivial dataset has been released for one of the systems.

Will system setup be supervised by a test agent?

System setup will be supervised by a test agent at all times that Privacy Act data is in the room. For example, if one Participant system has already received the Trivial or Evaluation Datasets, and a second Participant system is to be set up in the same room (whether the system belongs to the same or a different Participant), the system setup will be supervised by a test agent.

What type of disk wiping will be performed at the end of the test?

All disks (including system disk(s)) will be completely wiped at the end of the test to ensure that privacy act data no longer resides on the system. Participants who wish to restore their disks to pre-test state should make backups before the test.

Are the trivial datasets protected by the Privacy Act?

Yes. The trivial datasets are protected, and therefore, any participant interaction with systems must be supervised by a test agent and video-recorded from the time the trivial dataset is released to the participant until all disks are wiped.

As I understand, I'm not allowed to have any removable media in the room with my system once the test begins. What about blank CDR media for copying the results at the end of the test?

Blank CDR media for copying results will be provided to participants.

I just noted that the test procedure requests we arrive at 8am on our scheduled arrival date. Is it acceptable if we arrive at NIST at approximately 9am, as the first flight arrives at BWI at 8:10am?

Yes. There is some flexibility in arrival time. It is not required that participant representatives arrive at 8:00 AM. Please note, however, for scheduling purposes, NIST has included a total of 1 day for system setup and system take down for each SST and MST and 3 days for LST.

The Test Procedures Document says that participants "should provide for automatic monitoring display(s)". We plan to monitor our system simply through the use of text log files. This monitoring will require "keyboard or mouse action" to open these files in a text viewer and scroll through them. Will that be logged every time we monitor our system? Are the event logs going to be published?

Ideally, you would be able to monitor your system without using the keyboard or mouse. You may use the keyboard or mouse to open text files in a text viewer and scroll through them when monitoring your system, but must be prepared to explain what you are going to do to the Test Agent. The Test Agent must give approval before you start such monitoring actions. Participant Representatives are not permitted to view fingerprint images. The Test Agent may elect to log only the first time that keyboard or mouse action is needed for such monitoring. NIST does not plan to publish the entire events log but may include portions if NIST deems appropriate.

Should we be prepared for a power outage?

We (obviously) hope there will not be any power outages. However, in the past two months, there have been non-trivial power outages caused by storms. Systems are required to have an UPS capable of supporting the system through a 5 minute outage, and in the undesirable case of a non-trivial power outage, Participants should have a procedure to start the test up again where it left off.

Should we treat the "Trivial" datasets as if they were real data?

Yes. The results from the Trivial Datasets may be used in post-test analysis.

I'm not quite sure what you want from us for a "System Description Document". We sell a software library. We wrapped a "system" around that library for this test, but that system is not something that we normally sell. A customer can install our software on any PC. For the component list, do you want details about the PC in addition to details about our library? Also, same question for the cost breakdown.

In the System Description Document, you should note any use of custom software (or custom modifications to COTS software), with a short description of what that software does. The Configuration Management Document should include the precise versions of all software and hardware used in the test; if custom software is used, particular care should be taken to make sure that the Configuration Management Document unambiguously refers to the custom software so that the system can be created precisely in the future, and results replicated. For examples of System Description Documents, see Appendix M from the FRVT 2002 Final Report, at http://www.frvt.org/FRVT2002/documents.htm.

After we have set up, is there something we do to validate our setup?

After each Participant's system is set up, the Test Agent will provide "Trivial" Dataset(s), which the Participant will run, creating output similarity matrices and MD5 files. Trivial dataset(s) will have the same structure as the actual Evaluation Dataset(s), but will have significantly fewer ANSI/NIST files, on the order of only dozens of ANSI/NIST files per dataset. Running the trivial dataset(s) will provide reassurance to both the participant and NIST FpVTE personnel that there are no setup or administrative barriers to the running of the test itself.

Can we visually review fingerprint images during the test?

No! The fingerprint images are sensitive data and cannot be displayed for any reason during the test.

Is there a restriction on the number of technicians who can have access to the test system to monitor the test system during the three minutes per hour normal administration period?

We prefer to have one technician per system at a time for routine checking on the system, since we have limited staff to oversee. If issues arise that require more than one technician, please see the FpVTE Test Agent.

What hours will the test facilities be available for equipment setup and packing, starting and stopping tests, and monitoring tests while running?

- The test facilities will be available 9:00 AM through 5:00 PM, Monday through Friday. Depending on the availability of FpVTE personnel, the test facilities may be available as early as 8:00 AM or as late as 6:00 PM on some days.
- The test facilities will generally be unavailable on Saturday and Sunday. Limited visits on weekends can be set up with FpVTE personnel in advance to check on running systems.
- Starting or stopping tests can only take place on Monday through Friday.
- Setting up or packing up equipment can only take place on Monday through Friday.
- The test facilities will have limited availability on Monday, October 13 (Columbus Day). Other than the Participants who are scheduled to set up equipment on that day, access times on Columbus Day should be coordinated in advance with FpVTE personnel.
- The test facilities will be unavailable on Tuesday, November 11 (Veterans Day).

In the Test Plan, Section 5.2 "LST Subtests" states: "The subtests must be performed in row order: all of the tests using A as a target set must be performed first, then the tests using C as a target set, etc. " Does this requirement prevent us from running multiple subtests in parallel?

An LST system may run multiple subtests in parallel. We strongly recommend the stated order to maximize the usability of the results in case of partial completion of the LST. This does not guarantee that partial results will be analyzed. (See the FAQ on "What happens if we do not complete the test on time?")

What happens if we do not complete the test on time?

At the completion time, the FpVTE Test Agent will remove the USB drive or CD from the system and prepare to clean sensitive data from the drives. If a test begins on a Wednesday at 11:00 AM, the output will be taken by the FpVTE Test Agent by 11:00 AM 2 weeks (SST/MST) or 3 weeks (LST) later. If the evaluation is completed earlier, the output will be removed when it is completed. As stated in the Test Plan, "Failure to complete the test during the allotted time will be noted in the FpVTE 2003 Final Report. FpVTE personnel will decide, after conclusion of the test, if the partial test results will be reported in the FpVTE 2003 Final Report."

In the MST, we would like to use two workstations and connect them together via Ethernet. They will not be connected to any outside computer systems; the Ethernet connection is between the two workstations only. Do you allow such internal Ethernet connection?

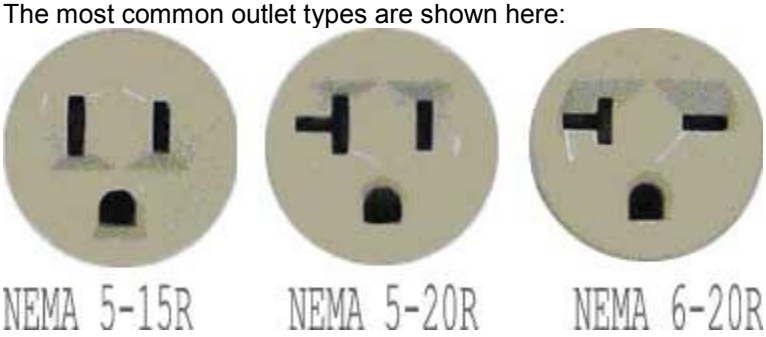
A number of individual workstations/PCs/devices can be networked together to take a single test, and are considered a single system. Systems taking different tests cannot be networked together. (Note: If a single Participant has 2 systems running MST simultaneously, and the 2 systems return 2 sets of results, they are considered distinct systems taking different tests, and cannot be networked together).

If we are only participating in the SST or MST, does the participant need to stay for the full 2 weeks or only until the system completes all the tests?

Just until the test is completed.

The Participation Notification email said that we should note the NEMA receptacle type for the power outlets we need. What do you mean?

The most common outlet types are shown here:



How will the clock change at the end of October be handled?

For Participants running over the weekend of October 25-26, the completion time will be adjusted by an hour due to the Daylight Savings Time clock change.

Can Participants get a formal invitation to FpVTE to facilitate obtaining a U.S. visa?

Please contact the FpVTE Liaison, and we will do our best.

Is it permissible that the three minutes per hour allowed for system administration during the tests be used for starting a new subtest, such as switching from one target or query dataset to another in the LST?

No. Running of subtests should be fully automated. We assume that the running of subtests will be fully automated through scripting.

How much control do the participants have in determining their test start date? From our perspective, some days are preferable to others. We would like to work with NIST to reach a mutually agreeable start date.

Testing will not start before 29 September, and every attempt will be made to complete testing before 21 November. Within that range, we will attempt to make accommodations for Participants' preferences.

What amount of power will be permitted per system?

No system should draw more than 5000 Watts. Any system that has requirements other than 20 Amp/110 Volt outlets (i.e. standard heavy-duty US household circuits) should email us their requirements to verify that we can satisfy them. 220 or 208 Volt single-phase circuits are available with notice.

What amount of space will be permitted per system?

We assume that a system will not contain more than two standard racks of equipment.

Will NIST provide UPS (uninterrupted power supply)?

No. Participants are encouraged to bring their own UPS.

Sample Utilities

The Dataset Validator (validate.pl) does not seem to work properly when switching between big-endian and little-endian systems.

The little-endian logic was incorrect in validate.pl and checksim.pl. This affects similarity files ***generated*** on all little-endian systems (such as a VAX), and not those generated on big-endian systems (such as Windows or other Intel-based systems). A new version is available on the Sample Utilities page.

The script for Dataset Validator (validate.pl on the Sample Utilities webpage) is Unix based; file names and directories are delineated by forward rather than back slashes, etc. Is there a windows based version of the validation program and, if so, how can it be obtained?

The validation program is written in Perl, not a Unix scripting language. It runs correctly without changes on Windows and Linux. It was written on a Windows system, and was extensively tested on both Windows and Linux. In Perl, paths are delineated by forward slashes rather than back slashes.

Sample Datasets

There seems to be one missing definition in metadata.xml:
<name>2S-P-M</name> <num-fingers>2</num-fingers> <fingers>03,08</fingers> <type>Slap</type> <scan>Paper</scan>
Is there any chance that in the real data some metadata will be missing (and I need to figure it from the metadata name)?

That definition has been added to an updated Metadata.xml, which is available on the Sample Data page. This only affects LST Participants. This will not happen in the Evaluation datasets.

A data format issue was discovered in the LST sample datasets. In the first subset of the LST Sample dataset, we noticed that the Image Designation Character (IDC) was set to 0x01 for the two type 4 records in the same NIST file (e.g. L1_00001.an). However, the corresponding IDC's found in the File Content (CNT) 1.003 record are correctly set to 0x01 and 0x02. Is this an error in the data sets? Could there be this kind of inconsistency in the real test data?

In LST Sample Dataset 1 (2F), the IDC was incorrectly set for the second image in each of the ANSI/NIST files. Error checking has been put into place to verify that this cannot happen in the Evaluation Data. A link to an updated version of the dataset can be found on the Sample Data page.

In the LST sample datasets, the same images are used in the 2S, 4S, 8S, and 10S datasets. Will that be true in the Evaluation datasets?

No.

Must the sample output files contain real similarity data? In other words, are you just using these to check the format, or will you be looking at the performance on these data?

We will use the sample output files to validate file formats and directory structures, and to (briefly) review the similarity values for indications of obvious problems such as incorrect polarity. We will not report on performance as shown in the sample output files.

Can the sample output files contain simulated similarity data?

We prefer that the sample output files contain real similarity data. We have extended the deadline for the sample results until 17 September.

Could you clarify the "polarity" field in the similarity matrix? The sample output files have "polarity" set to 1, but the values appear to be similarities. This contradicts the Data Format Specification.

The Polarity value in the Sample Output files was incorrectly set to 1 (Difference), but the values are similarities. The Sample Output files are being updated with Polarity = 0.

What results do you want from the Sample Datasets? How do we return the results from the Sample Datasets?

1. Generate your similarity matrices, MD5 files, and (optionally) Image Quality files in the directory heirarchy defined in the Data Format Specification.

2. Use the Dataset Validator (validate.pl) to validate that your results are compliant with the Data Format Specification.

3. Use ZIP or TAR to bundle the Output and MD5 directory hierarchy into a single file. Make sure that the directory hierarchy is retained, and all .sim, .md5, and .iqm files are included, in their correct directories.

4. Email the ZIP or TAR file to FpVTE@nist.gov

In order to generate similarity files for FpVTE 2003, we must know a "Participant ID" assigned to our system by NIST. This is a sequence of no more than 8 characters. Is this the login name? Is our Company name? Where can we find our Participant ID?

We will send it to you in the Participation Notification email. It is no secret: it is simply the first 7 characters of the company name, all caps, with an "S", "M", or "L" for SST/MST/LST. If the name is shorter than 7 characters, fill with underscores: the "Acme" MST system would use "ACME___M" .

There seems to be a typo in the Metadata.XML file for the entry 4S-L-TI.

It is a typo. The <fingers> field should be 01,02,06,07 (rather than 01,02,03,04). A new Metadata.xml is available on the Sample Data page. This only affects LST Participants.

Several pairs in the MST sample dataset have different "subject_id"s, but appear to be the same finger pairs.

The Sample datasets may include more mates than indicated in the Subject_ID field.

Why isn't the Sample Data a sampling of the Evaluation Data?

We wish this were possible. All of the Evaluation Data is officially labeled as Sensitive. Mishandling of Sensitive data is a Federal crime. The sources of the data cannot make exceptions. This means that we cannot use any of the fingerprints in the FpVTE Evaluation Datasets as samples for distribution.

Can you provide multiple samples of the images that will be used for SST - not just examples of the format, but images that realistically show the range of image quality and rotation that can be expected?

Unfortunately, no.

The sample flat image that is provided in the Test Plan has a line of black pixels across the top. Will this artifact be present in some or all images? Is it possible that similar lines will be found around the edges (or even in the middle of) some or all images?

This artifact is often found in the images collected by some types of single-finger scanners; this will be true for some of the single-finger flat fingerprints in the Evaluation data.

Are the images in the sample data representative of the images in the evaluation data? Does the sample data approximately represent the quality, the anticipated average number of minutia, and/or the range of image size variations to be expected during the test?

No. The file formats of the sample data are accurate representations of what can be expected in the evaluation data. The sample data is provided to support development of required interface modifications to their systems, not for sizing or tuning. The sample data is not necessarily representative of the quality, the anticipated number of minutiae, and/or the range of image size variations to be expected during the test.

The Application (Section 5.4) says "The FpVTE 2003 Sample Datasets and Software shall not be further distributed, published, copied, or further disseminated in any way or form whatsoever, whether for profit or not. This includes further distributing, copying or disseminating to a different facility or organizational unit in the requesting university, organization, or company." The components of our company that are addressing the response & participation in FpVTE are not all co-located. Are we prohibited from sharing the Sample Datasets?

Sample Datasets and Software can be shared by those portions of an organization that are directly involved with the company's technical participation in FpVTE, and only during their Participation in FpVTE.

Data Format Specification

For SST, can we assume that the 1000 images will be named SST00001 through SST01000 and simply process them in numerical order to avoid the complexity of the XML files?

For SST, the ANSI/NIST files will be numbered /datasets/SST/d1/SST00001.an through /datasets/SST/d1/SST01000.an. SST Participants are encouraged to read each XML file. For MST and especially LST, the directory structure is more complicated, and processing the XML is necessary.

What are the reasons we should (or should not) provide Image Quality vectors for the data, since they are optional?

Some of the operational data used is of poor quality. The Image Quality files provide a means for you to note those images that you consider unusable, or of marginal quality. Whether or not you provide Image Quality files, or what portion of the fingerprints you note as unusable, will have no effect on the analysis of your performance.

Why and in which way will the use of default values affect the results? How do you distinguish between a true and default score?

FpVTE Participants are required to report a similarity score for each fingerprint comparison. If for any reason a system does not compute such a number (for example, early stages in an AFIS implementation that drop candidates for efficiency reasons) then it remains the sole responsibility of the Participant to report some "default" score that accurately reflects the degree of similarity. The Participant may decide that different default scores may be appropriate for different images. Determining what default values to report (if any) is entirely up to the vendor. The FpVTE analyses (ROC, for example) will not distinguish between true and default scores: ALL scores are treated as a measure of similarity between images.

How do you provide us with a public key to "MD5?" Will MST CD-R contain it?

MD5 is a hashing algorithm, NOT a digital signature algorithm. It does NOT use keys (public or private). Anyone who performs an MD5 hash on some data will always get precisely the same 128-bit (16 byte) MD5 digest in return. A hashing algorithm is more similar to a checksum than to a digital signature. For a more complete background on hashing algorithms, a good source is the RSA FAQ "2.1.6 What is a hash function?", (http://www.rsasecurity.com/rsalabs/faq/2-1-6.html)

Why are the MD5 files required?

MD5 provides a simple, standard, fast, and robust method to verify that the similarity matrices are not corrupted when they are handed over to NIST.

Can NIST please confirm what ANSI/NIST record types will be used to package the single-flat-image, segmented slaps, and rolled print transactions?

ANSI/NIST Type-4 image records are used to contain all fingerprint images. The type-4 binary Impression Type (IMP) field is set as stated in Table 2 of the FpVTE Data Format Specification.

For segmented slaps used as single images in the MST will the fact that they are segmented slaps be designated in the record (this bears on how expected rotations of such images are treated)?

The Metadata attribute in the XML Dataset Definition File differentiates between Slap and Flat fingerprints. In the MST, Metadata is set to "1S" or "1F". The ANSI/NIST format does not provide a way to distinguish between flat and segmented slap images.

Is it your intention that we have to do every comparison twice (A-B and B-A)? We can find a way that will produce the same score for (Q = A, T = B), and (Q = B, T = A). If this is the case, then, can we only produce (N * (N+1))/2 scores for a set of N prints in the SST and MST? Given two prints A and B, is it expected that score(Query = A, Target = B) be the same as score(Query = B, Target = A)? Our system may not treat the query and target prints symmetrically, since (usually) there can be millions of targets per query.

Background: In the SST and MST, a single data set is compared against itself (i.e. one dataset is used both as Query Set and Target Set). The resulting similarity matrix will include two comparisons for any two fingerprints in the set: A-B (A searched against B) AND B-A (B searched against A). The issue is whether a given system is symmetric or asymmetric: for a symmetric system, A-B and B-A always have the same score, while they would be different for an asymmetric system. Multi-stage systems (i.e. AFIS) are necessarily asymmetric. Non-AFIS systems may be symmetric or asymmetric. Many systems are increasingly asymmetric as the two fingerprints are increasingly different in quality or size, so that a terrible flat compared with a pristine roll will give very different A-B and B-A scores.

Response:

- We require fully-populated QxT similarity matrices
- The contents of the similarity matrices are ENTIRELY up to the Participant.
- We have no opinion on whether symmetry is a good or bad idea.
- If a system is naturally symmetric, then the Participant should do a transpose. (i.e. writing both AxB and BxA for a single comparison)
- Systems that are asymmetric should not mirror similarity matrices

If asymmetry is allowed, can we do N 1:N searches to create the N x N scores needed in the LST and MST? Specifically, all the scores in one row of N scores will be related in terms of the degree of similarity and the largeness of the score. However, scores in different N-sets would not necessarily correlate in a strict sense. However, this should be acceptable, if the asymmetry is allowed.

- Asymmetry is allowed, and is assumed for AFIS makers.
- Doing N 1:N searches is assumed (but not required) for the LST, and is acceptable for the MST.
- In a given similarity matrix, a score must imply the same degree of similarity throughout the matrix.
- Different similarity matrices can have completely unrelated scores.

What does the "d99" mean in the FpVTE Data Format Specification, Figure 5, Section 3.3?

D99 means directory 99. There was a typographic error. "name=d1/LB_99999" should have been "name=d99/LB_99999", and has been changed.

In order to use the internet RFC1321 software for MD5 to generate the required .md5 files, the user (participant) needs to make adjustment to the source code to make it fit into test system. Would this adjustment affect the code's status as 'publicly available MD5 software'?

RFC1321 (MD5) is a commonly accepted standard with many implementations. Generally an integrator will use the md5c.c module without modification, and write custom drivers, replacing the example driver. Compliance with MD5 generally means that the results from the test suite (RFC1321, A.5) correspond to the stated results. In addition, the SST Sample Output includes MD5 files corresponding to each SIM file; Participants should verify that their results are identical.

There is no specification in the FpVTE document regarding procedure to verify MD5 'signature'. If the .md5 file is generated by software described in Question 1 (user-modified public available software, if it is acceptable), would the participant be required to provide a stand-alone software for verification purpose?

We will use the MD5 software included in the Sample Software Utilities to verify the results.

Are there any restrictions for input bitstream to MD5 algorithm?

MD5 can take any type or size of input.

Throughput Questionnaire

Is the system configuration described by the Throughput Questionnaire binding on the vendor or is the vendor allowed to change the configuration to accomplish the test workload or even possible algorithm changes after the sample data are processed and perhaps suggesting such changes?

Participants may reconfigure their planned systems after responding to the System Throughput Questionnaire.

Do you think some guidance could be put out about how much processing speed vendors should plan for?

Not yet. We are waiting to react to the responses from the Throughput Questionnaire before releasing the scale of the tests. That means that we will release the sizes of SST, MST, and LST after we analyze the Throughput Questionnaire responses, and before we schedule tests.

Our system can be configured to process XXXXX matches per second, on up to XXXXX matches per second. What do we use for the Throughput Questionnaire?

First, do not forget preprocessing (decompression and characterization/feature extraction) time, which is substantial for many systems. If you have a range of speeds, please provide a range of answers. If you have an unlimited range, no system is permitted to draw more than 5000 watts, which should define an upper bound.

In the Throughput Questionnaire there's a scenario described in Table 1 that works out to only about XXXX matches/sec over three weeks. The person filling out the questionnaire isn't asked to do anything about this.

Section 3.1 is entitled "Sizing Example for Questionnaire Purposes Only" -- The example in no way describes the LST. LST Question 5 asks them to provide their throughput estimates for that example.

Miscellaneous Questions

In the Application to Participate, Section 8.1 states that any data obtained during evaluation becomes the property of the Government and that the participants will not possess a proprietary interest in the data. We understand that the phrase "data obtained during evaluation" refers only to results of the tests conducted on the participant's system and not to proprietary information that might be provided by a participant in response to the System Throughput Questionnaire, in the System Description Document, or otherwise, provided it is identified by the participant as confidential or proprietary information. Is that correct?

1. The data generated on the participant's system during the evaluation becomes the property of the Government.

2. Responses to the System Throughput Questionnaire will be treated as proprietary and not disclosed.

3. The Participant-provided System Description Document will be published as part of the final FpVTE report, and therefore should contain only publicly releasable information.

4. The Configuration Management Document will be treated as proprietary by NIST and will not be released without the authorization of the Participant. See the Test Plan, Section 7.

Where can I see an example of the 5-page System Description Document we are required to submit?

See the FRVT 2002 Participant Product Descriptions in Appendix M of the FRVT 2002 technical appendices, which can be found at http://www.frvt.org/DLs/FRVT_2002_Technical_Appendices.pdf.

We do not have fixed system configurations, but rather build 1-of-a-kind systems for each of our clients. Are there any problems with this?

We assume that some of the FpVTE Participants' systems will be custom configurations. One point to keep in mind is that every system being evaluated in FpVTE ***must*** be re-creatable in the future. Future evaluations or interested agencies could request that a Participant use precisely the same system as was used in FpVTE and certified by NIST. Participants will be required to submit a Configuration Management Document on the first day of testing. This document will be treated as proprietary by NIST and will not be released without the authorization of the Participant. See the Test Plan, Section 7.

It is suggested to prepare anti-gaming means to "statistically normalized, modified, or adjusted score" such as score comparison of 1:1 matching, e.g. asking participants to provide matching scores for randomly selected 1:1 pairings. These pairings are contained in LST and MST with different ID. If a participant provided a normalized score, this score differed from 1:1 matching score.

A variety of anti-gaming measures are designed into the test.

The Test Plan (in the Section on Normalization) says that "SST and MST results will be analyzed in three ways: Raw (un-normalized) scores will be analyzed" How does FpVTE2003 intend to confirm that submitted scores are raw scores?

The wording was changed to "Participant-provided similarity scores will be analyzed."

LST-Specific Questions

Test Plan (5.2 LST Subtests) says that "Each dataset will be used in multiple subtests. It is assumed that any preprocessing for a dataset will be performed only once, not each time it is used. "
According to the above statement, it seems to imply that the same Query data is used in different subtests. For example, Query data #1 contained in the subtest "10R-L" may be contained in the subtest "1S". Is this true?

No. The same image will ***not*** be included in different datasets in the Evaluation data.
To distinguish between datasets and subtests: 10R-L is a dataset; 10S-L is a dataset. A subtest is when 10R-L (as the query set) is searched against 10S-L (as the target set)
When the Test Plan states that a dataset will be used in multiple subtests, it means that, for example, Dataset-A will be searched against itself, then against Dataset-B.

A12. TEST PROCEDURES

FpVTE Test Procedures Document

Last updated 25 September 2003

1 Introduction

This document describes the procedures that will be followed during the administration of evaluation tests for FpVTE 2003. The FpVTE 2003 consists of the small-scale test (SST), the medium-scale test (MST), and the large-scale test (LST).

For a description of the tests and other background information, please refer to the Test Overview and Test Plan documents posted at the FpVTE website (http://FpVTE.nist.gov).

2 Personnel

The following types of personnel and organizations are involved with FpVTE:

Participant
An organization whose system is being evaluated

Participant Representative
A person representing the Participant organization at the evaluation. A Participant may send up to 3 representatives per system to the evaluation

Point of Contact (POC)
A representative designated by a Participant as the point of contact for a system. The POC will interface with Test Agents when conducting set up, evaluation, and completion of the evaluation test; submitting results; and signing the FpVTE Events Checklist shown at the end of this document. Each system must have a POC; a single individual may be the POC for multiple systems submitted by a single Participant

Lead Test Agent
The government representative designated as the lead individual proctoring the evaluation

Test Agent
A government representative or contractor assisting in the proctoring of the evaluation

3 Test Procedures

The evaluation will proceed according to the procedures detailed below. These procedures are organized into the following timeframes: pretest, arrival, system setup, system checkout, evaluation, return of results, system cleaning, and system take down.

3.1 Pretest

Three pretest activities that are addressed here: system requirements, required Participant documents, and shipping of equipment

3.1.1 System Requirements

Each Participant will provide all hardware, software, spare parts, power strips and other equipment needed for its system. Participants must supply an uninterruptible power supply (UPS) capable of supporting the system for a five minute power outage. Participants should provide virus-scanning software, using the latest definitions, to be run on all non-Unix systems before beginning the evaluation.

All components of each Participant's system must be in accordance with the Test Plan and the responses to the FAQs provided at the FpVTE website.

Systems being evaluated in FpVTE 2003 shall not be accessible from outside the room in which the evaluation is being conducted. Modem, Internet, or wireless access is expressly prohibited. After the Evaluation Datasets have been given to the Participant, all removable media (such as CDs, DVDs, Zip disks, Jaz drives, USB memory sticks, etc.) and all devices connected to the system (such as additional computers, laptops, PDAs or other handheld devices, etc.) are considered part of the system and shall not leave the room without express Government approval. Offenders will be subject to criminal penalties.

Systems should be set up and tested in advance so that no design, coding, or debugging is necessary at the evaluation site. Minor configuration changes such as mapping of USB hard drive letters will be allowed. Systems must support fully automated testing through scripting. Manually loading target sets or manually initiating subtests will not be permitted.

It is recommended that Participants use separate drives or drive partitions for working space, including database management system (DBMS) data. This is so the areas for the operating system and fingerprint algorithms are clearly separated from the areas for working space. At the completion of the test, a Test Agent will, at a minimum, delete files generated during testing and wipe free space on all disk drives and other storage media. If the working space is not clearly separated by drive or partition, all drives will be formatted. A Test Agent will inspect all disks on the system to verify compliance.

3.1.2 Required Participant Documentation

Participants are required to develop a *System Description Document* and a *Configuration Management Document* prior to the evaluation. Electronic versions of these documents will be submitted on the first day of testing. These documents may be provided on a diskette or sent via email.

System Description Document

The *System Description Document* must adequately address the following topics:

- Overview of the system(s) to be evaluated
- Component list for the system(s) to be evaluated
- Detailed cost breakdown of the submitted system(s) (commercial vendors only).
- Details of any modifications required to take FpVTE 2003

The document is limited to five pages for Participants testing a single system. Participants testing multiple systems may include an extra two pages for each additional system. This document will be included in the final FpVTE 2003 report that will be released to the public.

Configuration Management Document

The *Configuration Management Document* must contain sufficient information to enable the Participant to precisely recreate, at some later date, the system(s) evaluated in FpVTE 2003. This document will treated as Proprietary by NIST. It will be archived by NIST and will not be included in the final FpVTE 2003 report. A copy will be provided to the Participant upon request, or to interested Government entities with permission of the Participant. Any Participant with a custom or one-of-a-kind system should be especially careful to delineate every hardware and software component, and all modifications, in the *Configuration Management Document* so that the system certified by NIST can be precisely recreated in the future. The Configuration Management Document does not have a page limit.

Guidelines for Submitting Documents

Participants should follow the following guidelines for submitting the required documents:

- **Word Compatible.** Electronic version of documents can be opened and retain formatting in Microsoft Word.

- **Embed All Fonts**. Not all fonts are available on all machines. If you must use a font that is not standard with Microsoft (for instance, with equations, etc.), you should embed the font in the document.
- **PDF or Hard Copy**. Include either a PDF file or hard copy of your document so your desired layout may be preserved.

3.1.3 Shipping of Equipment

Participants may ship equipment to NIST to arrive up to one week prior to their assigned start date. However, all shipped equipment and parts must arrive at least 2 business days before the assigned start date. If a Participant is sending equipment or parts from outside the U.S., it is solely the responsibility of the Participant to plan for as many days as required for customs and still ensure the equipment and parts arrives at least 2 business days before the assigned start date.

Equipment and parts may be shipped to the following address:

Steve Otto
NIST Bldg 222 Room A-342
100 Bureau Dr
Gaithersburg, MD 20899

NIST will provide suitable storage for shipped equipment, but will not provide personnel to setup or test equipment. Such setup and test activities are the responsibility of Participant Representatives.

3.2 Arrival

Each FpVTE 2003 Participant system has been assigned a date to arrive for the evaluation. The Participant Representatives should arrive at the NIST campus at 0800 EDT on their assigned start date.

Not all Participants will start testing on the same day. Multiple Participants will undergo testing at one time.

Testing will take place in Building 222 at NIST in Gaithersburg, MD. Directions and area information have been provided to the Participants. Upon arrival, Representatives will report to Room A-214.

The POC for each system must identify himself/herself to the Lead Test Agent. A different POC may be assigned after first notifying the Test Agents. The POC should direct all procedural questions to the FvPTE Lead Test Agent.

The test areas open at 0900 EDT. A Test Agent will escort the Participant Representatives to their designated test areas at this time. Multiple Participants may be assigned to one room.

3.3 System Setup

The POC is required to be on site during system setup. Once in the test area, a Test Agent will review the FpVTE 2003 Participant Orientation (provided at the end of this document) with the POC. System setup can be performed during normal government working days, 0900 EDT through 1700 EDT.

The POC will initial the FpVTE Events Checklist to indicate that all Participant Representatives understand and will abide by all procedures, rules, and policies described in the FpVTE Test Procedures, FpVTE Test Overview and Test Plan, the FpVTE Participant Orientation and other documents on the FpVTE website.

The POC will provide the required Participant Documentation to the Test Agent. The POC will initial the FpVTE Events Checklist to indicate that the Participant Documentation has been provided to the Test Agent, and that the Participant system is in accordance with the *System Description Document* and the *Configuration Management Document*.

The Participant Representative sets up the system in the test area where NIST has provided floor space and counter space for the Participant's configuration. NIST will also provide electrical power for each system in accordance with the information provided in the Test Plan, and with individual communications with the Participants that have occurred prior to the evaluation regarding their needs.

NIST will not be responsible for providing any hardware, software, spare parts or other equipment. NIST recommends that each Participant anticipate any need for spare parts and other equipment.

All activities in the testing area will be recorded using video cameras for documentation of the evaluations. Footage from this documentation will not be made available to the public without review and comment from any Participant that is named in the video.

A voice-only telephone may be available for use by Participants. First priority will be given to Participant Representatives setting up equipment on their first day. Second priority will go to other Participant Representatives with system problems.

3.4 System Checkout

After the system has been set up, the system will be checked out by a Test Agent in accordance with the following procedures. The POC is required to be on site during system checkout. System checkout can be performed during normal government working days, 0900 EDT through 1700 EDT.

1. Test Agent inspects the system, and may record information such as available hard drive space.

2. Test Agent provides "Trivial Dataset(s)" on CD or USB hard drive and Participant Representative runs the trivial data on the system. The Trivial Dataset(s) have the same structure as the actual Evaluation Dataset(s) but have significantly fewer ANSI/NIST files (on the order of dozens.) The Trivial Dataset(s) are used to test the system prior to running the evaluation. Like the evaluation dataset(s), the Trivial Datasets are protected under the Freedom of Information Act (5 U.S.C 552) and the Privacy Act (5 U.S.C. 552a) to the extent permitted by law, and will bear the legend "Notice: May contain Privacy Act or FOIA Protected Information." Test Agent monitors the run and makes note of any manual intervention if it occurs before the run is complete.

3. After completion of the run with the trivial data, the POC provides the similarity files, MD5 files, and (optional) IQM file(s) for the trivial data on CD or USB hard drive to the Test Agent.

4. Test Agent copies all the similarity files, MD5 files, and (optional) IQM file(s) from the CD or USB hard drive to the NIST server for storage and compliance checking.

5. Test Agent verifies the similarity files, MD5 files, and (optional) IQM file(s) are in the proper format.

6. The Test Agent and POC acknowledge that the similarity files, MD5 files, and (optional) IQM file(s) for the trivial data are in the proper format.

7. Participant Representatives reinitialize the system, if required.

8. POC acknowledges that system setup is correct and complete.

3.5 Evaluation

Time Limits

Each evaluation test must be completed within the designated time limit (14 days for SST and MST, 21 days for LST). A Participant may be scheduled for more than one test. However, if a Participant does not use all the scheduled time for one test, the unused time cannot be used in another test.

The evaluation begins when the Test Agent releases the CD or USB hard drive containing evaluation dataset(s) to the Participant. The time allotted for each test includes the time necessary to copy the target and query sets from the supplied CD or USB hard drive to the Participant hard drive(s), process the datasets, and produce the required similarity files, MD5 files, and (optional) IQM file(s) in accordance with the Data Format Specification provided on the FpVTE website.

In the event of a power outage that exceeds 5 minutes and the capacity of the UPS, time will be added to the evaluation period of all affected Participants. The amount of time added will equal the amount of time from when the system loses power until the Participant Representative was given the opportunity to restart the system.

Data Provided to Participants

Data will be provided on a CD or USB hard drive. A separate CD or hard drive will be used for each test. For SST and MST, data will be provided on CD unless a specific request has been made prior to the evaluation by the Participant for a hard drive. For LST, data will be provided on USB drives.

Test Start and Monitoring

The POC is required to be on site to start the evaluation. The evaluation can be started during normal government working days only, 0900 EDT through 1700 EDT.

Participants may stay in the designated lounge area or leave the premises when the evaluation test is in progress. However, note that NIST will not be responsible for informing Participants if and when their system crashes or power goes out.

Systems may run continuously during the allotted time, but the hours for access to the testing area will be limited to 0900 through 1700 EDT on normal business days. Limited access may be available on weekends. At the start of the test, the Participant Representative may monitor the system for 30 minutes. After that initial monitoring period, the Participant Representative may monitor the system once each hour for three minutes during access time. ***A Test Agent must be present during all monitoring.***

The Participant's system should provide for automatic monitoring display(s). The Participant Representatives are not permitted to effect any action, including but not limited to any keyboard or mouse action, unless the POC has described the intended monitoring action(s) to the Test Agent and the Test Agent has given approval for the monitoring action(s). The POC will record the description in the FpVTE Events Checklist; the POC and Test Agent will initial the description. The Participant Representative must answer all Test Agent questions regarding actions during monitoring. ***Participant Representatives are not permitted to view fingerprint images.***

Greater interaction with the system during the test will only be permitted for system administration reasons by the express permission of the FpVTE Lead Test Agent, with the following restrictions:

- A written explanation for the need of system administration (such as additional time needed to start system or a system crash) will be signed by the Participant and the FpVTE Lead Test Agent;
- The explanation and the amount of time required will be included in the FpVTE 2003 Final Report;
- All activity will be supervised by and explained to an FpVTE Test Agent;
- All activity will be videotaped.

In the event of an overnight system crash, Participant Representatives will not be allowed to restart their system(s) until 0900 EDT the following normal business day. Participants are encouraged to implement their system(s) in a manner that allows restarting from the point where a crash occurred rather than restarting from the beginning.

Evaluation Procedures

The evaluation of the Participant's system will be conducted in accordance with the following procedures:

1. Test Agent releases CD or USB hard drive containing evaluation data to Participant.

2. The Test Agent tells the POC that no Participant Representative may be in the room with the system without a Test Agent present.

3. POC and Test Agent initial events checklist indicating that the evaluation data set(s) have been released to Participant Representatives. The test begins. Record Date/ Time. The evaluation period should begin on or before 1700 EDT.

4. Participant system processes evaluation data and produces similarity files, md5 files, etc.

5. Participant Representative may monitor the systems once each hour between the hours of 0900 and 1700 EDT, on each normal business day. One exception is at the beginning of the test when the Participant may monitor the system for the first 30 minutes of test processing time.

6. Any additional time permitted for monitoring or system administration will be described in writing, to be included in the FpVTE final report.

7. Any unplanned or unexpected event (e.g., a crash or power failure causing the system to stop performing) shall be described in the Events List.

8. When the test is finished, the reason (e.g., completed or stopped because the maximum time for the test has elapsed) and date/ time will be recorded.

3.6 Return of Results

NIST strongly recommends that the Participant POC be on-site at least one hour prior to the scheduled expiration of time for the test. If the test continues for the full scheduled time, the POC must be on site when the test is scheduled to complete. Otherwise, if the POC is not on site to stop their program from running when the time limit is reached, then the Participant may be disqualified for exceeding the time limit. There is no penalty for test completion without a POC on site if the test completes before the allotted time limit.

At the completion of the Evaluation, if necessary, the Participant Representatives will transfer all required output files from their system to the storage medium used to return the results. SST and MST Participants who received CDs will be required to burn a CD with their output files. The output CD and the Evaluation Dataset CD will be returned to the Government. LST and other Participants who received Evaluation Datasets on a USB will transfer all the required output files to the USB hard drive provided by the Test Agent. The Test Agent will make a backup copy of all data on the CD or USB hard drive. The USB drive will be returned to the Government.

Return of results will be performed in accordance with the following procedures:

1. The Participant Representative copies the output to the CD or USB hard drive(s), if this was not accomplished during the evaluation.

2. The POC returns the CD or USB hard drive(s) to the Test Agent.

3. Test Agent copies all output data from the CD or USB hard drive to the NIST server for storage and compliance checking.

4. Test Agent verifies the output is in the proper format.

5. Test Agent and the POC acknowledge that the output is in the proper format.

6. If the output is not in the proper format or there is a transfer problem, the Test Agent may elect to provide the Participant with a reasonable opportunity to correct the problem. If so, the POC may make corrections and resubmit. If the POC cannot provide the required files in the proper format after a

reasonable time, the Test Agent may elect to have the POC copy all the results in the incorrect format to the destination media. In such a case, NIST, in its sole judgment, may elect to either consider the results in FpVTE 2003 or disqualify the Participant's results. In an unusual case (e.g., where the full time limit for the evaluation period was not used), the Test Agent may elect to consider such a case in a manner similar to a system crash, with the Test Agent allowing Participant interaction with their system.

7. After the sample of similarity files have been successfully verified, the POC and Test Agent initial the FpVTE Events Checklist indicating that CD or USB hard drive has been returned and that the output has been verified to be in the proper format.

3.7 System Cleaning

FpVTE 2003 Evaluation Datasets, Trivial Datasets, and data derived from the datasets shall not be retained in any way or form whatsoever by the Participant after completion of the evaluation. FpVTE 2003 Evaluation Datasets, Trivial Datasets and data derived from the datasets shall not be distributed, published, copied, or disseminated in any way or form whatsoever by Participants. Participants shall track all copies of the FpVTE 2003 Evaluation Datasets, Trivial Datasets and return or destroy all copies at the end of the test, prior to leaving NIST. Failure to observe the restrictions on use of the FpVTE 2003 Evaluation Datasets or Trivial Datasets, or data derived from the datasets is a violation of Federal law. Offenders will be subject to criminal penalties.

The Test Agents will assure that none of the ANSI/NIST data, or data derived from the ANSI/NIST data, are still resident on the Participant's system after the completion of the test. Participants will allow the Test Agents to inspect and modify as needed all disks and other storage media on the system to verify compliance. This will involve, at a minimum, the Government deleting files generated during testing and wiping free space on all disk drives and other storage media. The Government may choose to remove all files or format all disks, including system disks. The Government may also choose to remove and destroy certain storage media that cannot effectively be expunged of data.

The system cleaning will be performed in accordance with the following procedures:

1. Test Agent inspects all hard disks of the Participant systems; deletes all ANSI/NIST data, similarity files, MD5 files, (optional) IQM file(s), and derived files; and then wipes drive free space.

2. The Test Agent, may, at the Test Agent's discretion, perform other activities such as removing additional files, wiping additional space, or formatting disks including system disks.

3. POC and Test Agent sign and date checklist.

3.8 System Take Down

After the system has been cleaned, the Participant Representative(s) may dismantle and remove the system from the test area. Participants may leave NIST once the evaluation is complete and their equipment has been removed from the test area, even if this occurs prior to the expiration of the allotted time for the test.

FpVTE 2003 Participant Orientation

Facilities:

- Show assigned system setup location
- Show lounge location
- Direct to restroom location
- Lounge telephone may be available for voice use only
- Participant Representatives performing setup activities have first priority for telephone use
- Other Participant Representatives with system problems have second priority for telephone use

Preliminary Activities:

- Participant POC must be assigned
- Discuss actions to be taken if an emergency or other unexpected event occurs
- All procedural questions must be directed to FpVTE Lead Test Agent
- Only the Participant POC may ask questions of the FpVTE Lead Test Agent and initial checklist
- Participant POC may change after notifying FpVTE Lead Test Agent
- Participant Representative must submit *System Description Document* for each system to be tested
- Participant Representative must submit *Configuration Management Document* for each system to be tested
- Participant Representative to run virus-scanning software using latest definitions on all non-Unix systems before beginning evaluation
- Participant Representatives must successfully process Trivial Dataset(s) before beginning evaluation

Evaluation Activities:

- Evaluation period begins when Participant Representative receives Evaluation Dataset(s). This should occur before 1700 on the single day of the setup period for SST/MST and before 1700 on the third day of the setup period for LST
- Systems being evaluated shall not be accessible from outside the room in which the evaluation is being conducted
- Evaluation Dataset(s), Trivial Dataset(s) and data derived from the dataset(s) shall not be retained, distributed, published, copied, or disseminated in any way or form whatsoever by Participants
- It is recommended that Participants use separate drives or drive partitions for working space to clearly separate the operating system from the Evaluation Dataset(s), Trivial Dataset(s) and data derived from the dataset(s)

- After the Trivial Dataset(s) and/or Evaluation Dataset(s) have been received by the Participant Representative, all removable media and all devices connected to the system are considered part of the system, and shall not leave the room without express Government approval.

- Systems being tested must be fully automated through scripting – manually loading target sets or initiating subtests will not be permitted

- Viewing fingerprint images will not be permitted at any time

- One Participant Representative will be permitted three minutes of supervised, videotaped, direct operator access per hour during normal work hours Monday through Friday to monitor system status (plus continuous access for the first 30 minutes on the day evaluation begins). The Participant Representative may only monitor system operation. The Participant's system should provide for automatic monitoring display(s). Participant POC is not permitted to effect any action, including but not limited to any keyboard or mouse action, unless the POC has described the intended monitoring action(s) to the Test Agent *and* the Test Agent has given approval for the monitoring action(s). The POC will include the description in the FpVTE Events Checklist and both the POC and Test Agent will initial the description provided in the FpVTE Events Checklist. The Participant Representative may ***NOT*** view any fingerprint images during any access period while the evaluation is in progress.

- Greater interaction during the test will only be permitted for system administration reasons by the express permission of the FpVTE Lead Test Agent, with the following restrictions:

    - A written explanation for the need of system administration (such as a system crash) will be signed by the Participant POC and the FpVTE Lead Test Agent;

    - The explanation and the amount of time required will be included in the FpVTE 2003 Final Report;

    - All activity will be supervised by and explained to an FpVTE Test Agent;

    - All activity will be videotaped.

- Participant Representatives may stay in the lounge area between monitoring periods or leave the premises, but the FpVTE team will not notify them of crashes or power outages

- Discuss procedure for Participant Representative and Test Agent to meet for hourly monitoring

- Participant not present when their evaluation period ends may be disqualified unless they have already submitted results

Cleanup Activities:

- Evaluation period ends 14 days (SST/MST) or 21 days (LST) after Participant Representative receives the Evaluation Dataset(s) – results may be submitted any time before this period ends

- At the completion of the evaluation, Participant Representatives will transfer all required output files from their system to the storage medium (CD or USB hard drive) used for the Evaluation Dataset(s) and return the output media, Evaluation Dataset(s) media, and Trivial Dataset(s) media to the Government

- Test Agents must make backup of results, inspect systems, delete Evaluation Dataset(s), Trivial Dataset(s) and data derived from the dataset(s), and clean systems after results are submitted

A13. FPVTE EVENT CHECKLIST

FpVTE 2003 Events Checklist

Participant Name: _____
Test: _____ **Configuration:** _____
Participant Representatives (Indicate POC) : _____
_____

Event	Test Agent Initials	Participant Initials	Date/ Time
POC agrees and acknowledges all Participant Representatives understand and will abide by all procedures, rules, and policies described in the FpVTE Test Procedures, FpVTE Participant Orientation, and the FpVTE website			
POC acknowledges Participant system is in accordance with the *System Description Document* and the *Configuration Management Document*			
Participant Representative runs Trivial Dataset(s) on the Participant's system. Test Agent monitors the run and makes note of manual intervention, if any, between the start and completion of the run			
Test Agent copies all the similarity files, MD5 files, and (optional) IQM file(s) from run with the trivial, dataset(s) to the NIST server. Test Agent and POC verify and acknowledge the similarity files, MD5 files, and (optional) IQM file(s),produced by the run with the Trivial Dataset(s) are in the proper format			
Participant Representatives reinitialize the system, if required. POC acknowledges that the system setup is correct and complete			
Test Agent provides CD or USB hard drive to the POC. Test begins- Record Date/ Time			

Unplanned Event #1- Describe (attached additional sheet(s), if necessary, each signed by POC and Test Agent) or Record "None" _____ _____ _____ _____ _____ _____ _____			
Unplanned Event #2- Describe (attached additional sheet(s), if necessary, each signed by POC and Test Agent) or Record "None" _____ _____ _____ _____ _____ _____ _____			
Unplanned Event #3- Describe (attached additional sheet(s), if necessary, each signed by POC and Test Agent) or Record "None" _____ _____ _____ _____ _____ _____ _____			

Test Finished- Record Date/ Time, Record Reason (e.g., Completed or Stopped): _____			
Test Agent copies all the similarity files, MD5 files, and (optional) IQM file(s) from the CD or USB hard drive to the NIST server. Test Agent and the POC verify and acknowledge similarity files, MD5 files, and (optional) IQM file(s) are in the proper format			
System hard drives inspected, free space wiped, other cleaning activities performed as warranted			
Test Agent and POC acknowledge cleaning complete			
Test Agent Signature / Date/ Time			
Participant Representative Signature / Date/ Time			

A14. DATA FORMAT SPECIFICATION

FpVTE Data Format Specification

Last updated 17 September2003

1 Introduction

Systems are required to perform all tests without manual intervention. All processing, from start to finish, must be fully automated. In order the test process to run smoothly, Participants need to know precisely the format of all test data provided, what data to produce as output, and the format of that output.

The FpVTE Sample Datasets will serve as examples of the formats defined here. The Sample Datasets will be made available on a schedule reported on the FpVTE Calendar (see http://fpvte.nist.gov). Software utilities will also be provided to verify format compliance.

This specification describes the required input and output files and formats. Participants are required to submit to NIST their output from the FpVTE Sample Datasets on the schedule reported on the FpVTE Calendar. Output includes all similarity files and optionally, Image Quality Metric (IQM) files, in properly named files and directory hierarchy.

For background information, please refer to the Test Overview and Test Plan documents posted at the FpVTE website (http://FpVTE.nist.gov).

2 File Types

The following file types are discussed here:

Files Provided to Participants

Test Definition
(SST-Def.xml, MST-Def.xml, or LST-Def.xml) XML file containing the definitions for subtests. See Section 3.2.

Dataset Definition
(*dataset*.xml) XML file containing the definition for a dataset (one XML file for each dataset). See Section 3.3.

Metadata Definition
(metadata.xml) XML file containing the definitions of fingerprint metadata. See Section 3.4.

ANSI/NIST
(*.an) ANSI/NIST fingerprint file provided to Participants, containing one fingerprint image (SST/MST), or a set of fingerprint images (LST). See Section 3.6.

MD5 ***NEW***
(*.md5) File containing 128-bit digital hash provided to Participants using publicly available MD5 software to verify data integrity. See Section 3.7.

Files Created by Participants

Similarity File
(*.sim) Binary file created by Participants to store similarity scores. See Section 4.2

Image Quality Metric
(*.iqm) Binary file ***optionally*** created by Participants to store image quality metrics. See Section 4.3.

MD5

(*.md5) File containing 128-bit digital hash created by Participants using publicly available MD5 software to verify data integrity. See Section 4.4.

3 Data Provided to Participants

3.1 Directory Structure

All test data will be provided to each Participant on one or more compact disks (CD-R) or a USB hard drive. As provided, the disk(s) will contain all data required for the test. Participants must return a disk containing their test results. This may be a CD-R or the USB hard drive. Figure 1 depicts the contents of the Data and Results CD-Rs used by SST and MST Participants. Figure 2 depicts the complete USB hard disk contents as returned by Participants on the LST. As provided to Participants, the disk will contain the following:

- A single Test Definition File (SST-Def.xml, MST-Def.xml, or LST-Def.xml) located in the root directory. The actual SST-Def.xml file is shown in Figure 3. An example LST-Def.xml file is shown in Figure 4.
- One Dataset Definition File (*dataset*.xml) for each dataset located in the directory containing the ANSI/NIST files for that dataset. SST and MST each have only one dataset; LST has multiple datasets. An example of this file is shown in Figure 5.
- A "datasets" directory containing one subdirectory for each dataset. These subdirectories are named SST in Figure 1; and A, B, and C in Figure 2.
    - Each dataset directory (e.g., SST or A, B, C) will contain subdirectories d1, d2, …, dn with no more than 1500 ANSI/NIST files in each subdirectory.
- A "data_md5" directory containing exactly the same directory structure as the datasets directory, but with *.md5 files instead of *.an files **NEW**

Participants are responsible for creating the /output and /md5 directory structures. For SST, the exact structure is shown on the right side of Figure 1; MST is identical, except that every occurrence of "SST" is replaced by "MST". LST is analogous, as shown in Figure 2. Note that the /md5 directory tree has exactly the same structure as the /output directory tree, but is not shown in Figure 2.

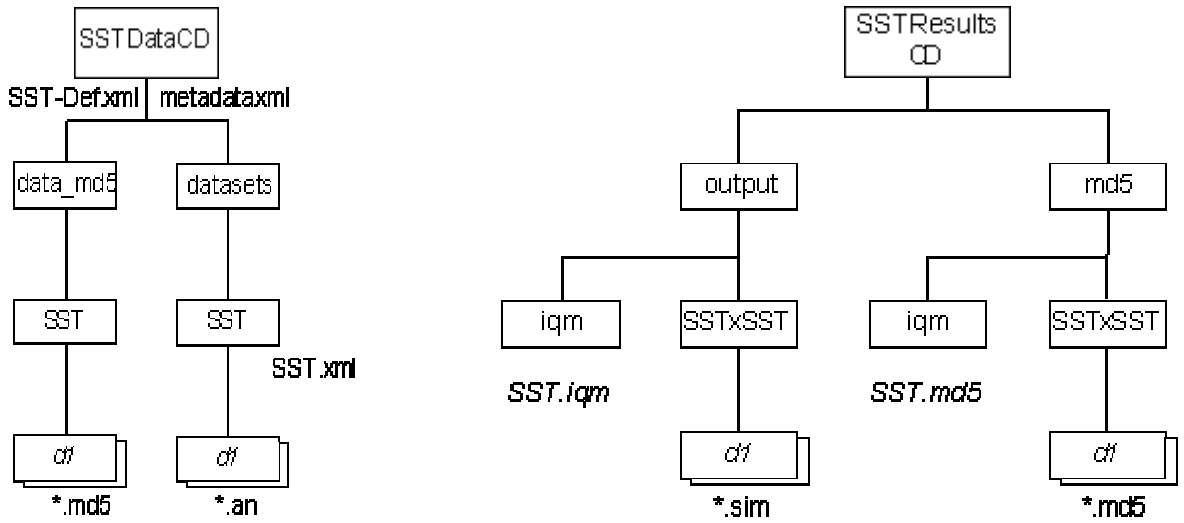


Figure 1 SST/MST Directory Structure and Filenames **NEW**

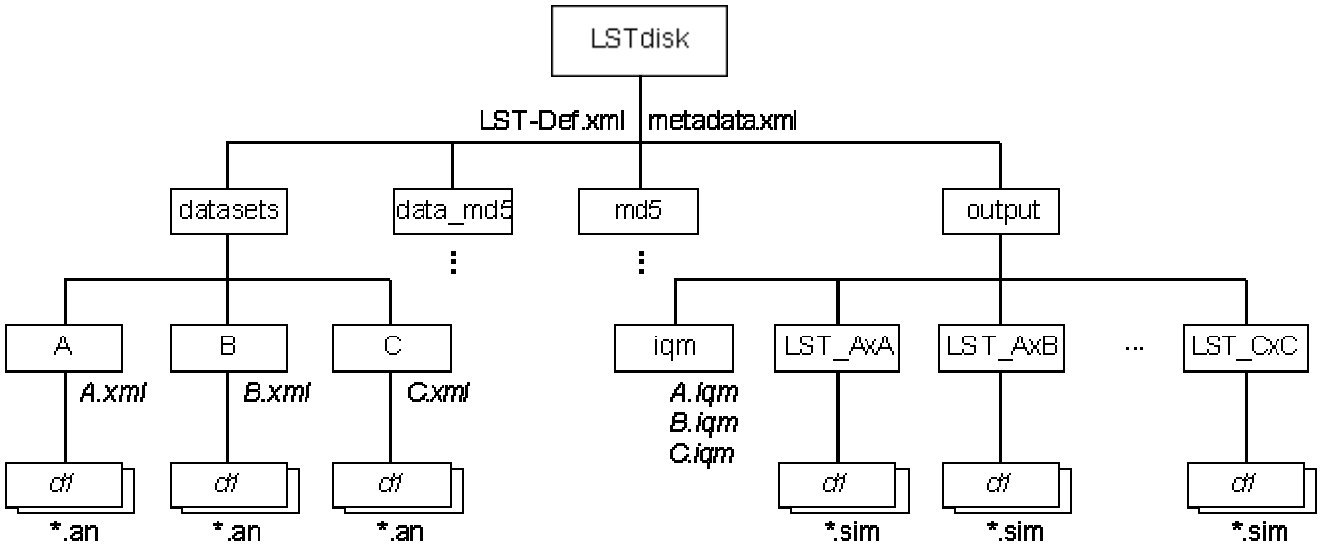


Figure 2 LST Directory Structure and Filenames **NEW**

3.2 Test Definition File

The Test Definition File consists of a series of subtest specifications, each one naming the subtest, QuerySet, TargetSet, and output directory.

For SST and MST, this file is very simple, and will identify the one dataset which serves as both QuerySet and TargetSet, as shown in Figure 3. The MST Test Definition File will be identical to the SST Test Definition File except that every occurrence of “SST” is replaced by “MST”.

```
<?xml version="1.0" ?>
<test name="SST">
  <subtest>
    <name>SSTxSST</name>
    <queryset>/datasets/SST/SST.xml</queryset>
    <targetset>/datasets/SST/SST.xml</targetset>
    <outdir>/output/SSTxSST</outdir>
  </subtest>
</test>
```

Figure 3 SST Test Definition File

For LST, the Test Definition File will specify tests in an order designed to minimize database loads (i.e., QuerySets will change first). LST Participants are required to perform subtests in the specified order to facilitate analysis if not all subtests are completed within the allotted time. Figure 4 shows an example of an LST Test Definition File. Note that this is an example: the actual file will contain many more subtests.

```
<?xml version="1.0" ?>
  <test name="LST">
    <subtest>
      <name>LST_AxA</name>
      <queryset>/datasets/A/A.xml</queryset>
      <targetset>/datasets/A/A.xml</targetset>
      <outdir>/output/LST_AxA</outdir>
    </subtest>
    <subtest>
      <name>LST_BxA</name>
      <queryset>/datasets/B/B.xml</queryset>
```

```
      <targetset>/datasets/A/A.xml</targetset>
      <outdir>/output/LST_BxA</outdir>
    </subtest>
    <subtest>
      <name>LST_AxB</name>
      <queryset>/datasets/A/A.xml</queryset>
      <targetset>/datasets/B/B.xml</targetset>
      <outdir>/output/LST_AxB</outdir>
    </subtest>
    <subtest>
      <name>LST_BxB</name>
      <queryset>/datasets/B/B.xml</queryset>
      <targetset>/datasets/B/B.xml</targetset>
      <outdir>/output/LST_BxB</outdir>
    </subtest>
    <subtest>
      <name>LST_CxC</name>
      <queryset>/datasets/C/C.xml</queryset>
      <targetset>/datasets/C/C.xml</targetset>
      <outdir>/output/LST_CxC</outdir>
    </subtest>

    <!--actual file will contain many more subtests -->

  </test>
```

Figure 4 Example of an LST Test Definition File

3.3 Dataset Definition File

The <queryset> and <targetset> elements in the Test Definition Files (SST-Def.xml, MST-Def.xml, or LST-Def.xml) are references to Dataset Definition Files. Dataset Definition Files are XML files that describe the datasets, as shown in Figure 5. The format of these files conforms to the standard defined in the HumanID Evaluation Framework (HEF) (see http://frvt.org/DLs/AVBPA-2003.pdf).

```
<?xml version="1.0"?>
<signature-set name="B" metadata="10R">
  <signature name="d1/LB_00001" subject_id="Subj_06538">
    <sigmember>
      <dataset>
         <file name="/datasets/B/d1/LB_00001.an" metadata="10R-L"/>
      </dataset>
    </sigmember>
  </signature>
  ...
  <signature name="d99/LB_99999" subject_id="Subj_01667">
    <sigmember>
      <dataset>
         <file name="/datasets/B/d99/LB_99999.an" metadata="10R-P"/>
      </dataset>
    </sigmember>
  </signature>
</signature-set>
```

Figure 5 Dataset Definition File

Note on terminology: the terminology used in HEF XML tags does not correspond to that used in FpVTE. In particular, note that FpVTE and HEF uses "dataset" in different ways. "Dataset" (in FpVTE) corresponds to <Signature-Set> (in HEF).

Tags

For FpVTE 2003,

- each Dataset Definition File will contain multiple <signature> elements;
- each <signature> will contain exactly one <sigmember>;
- each <sigmember> will contain exactly one <dataset>; and
- each <dataset> will contain exactly one <file>.

Attributes

Each HEF XML tag (e.g., <signature> or <sigmember>) may have multiple attributes (e.g., name="B").

- Each <signature-set> tag will have the following attributes:
    - **Name**. This attribute will contain a string specifying the name of an ANSI/NIST file. This string will specify the path to the file beginning with "/datasets/".
    - **Metadata**. This attribute indicates what type of data is contained in the entire collection of data. The attribute specifies a name (e.g., "10R") that serves as an index into the Metadata Definition File, which will contain a detailed description of "10R" data. The Metadata Definition File is described in Section 3.4.
        - Note that there are Metadata attributes for ***both*** the <signature-set> and <file> tags: the Metadata attributes for <file> tags are either identical to, or more specific than, the Metadata attributes for <signature-set> tags.
        - For example, in Figure 5, the Metadata attribute at the <signature-set> level is 10R (10-print Rolled), while the <file> level Metadata attributes are 10R-L (10-print Rolled Livescan) and 10R-P (10-print Rolled Paper).
- Each <signature> tag of a Dataset Definition File will have the following attributes:
    - **Name**. This attribute will contain a string specifying the name of a similarity file to be created by the Participant. The name will include a relative path to the file and the basename, but not the file suffix. The complete path must be formed from the <outdir> element of the Test Definition File for this subtest, followed by the name attribute of this <signature>. For example, the first output file for subtest LST_BxA would be /output/LST_BxA/d1/LB_00001.sim. The path prefix is specified in Figure 4 as <outdir>/output/LST_BxA</outdir>, and the suffix is specified in Figure 5 as name="d1/LB_00001".
    - **Subject_ID** (only included in Sample Data). This attribute is included in the Sample Data to indicate which fingerprints are mated (i.e., share the same Subject ID). Obviously, the Subject_ID will not be included in the Evaluation Data!
- Each <file> tag will have the following attributes:
    - **Name**. This attribute will contain a string specifying the name of an ANSI/NIST file. This string will specify the path to the file beginning with "/datasets/".

- **Metadata**. This attribute indicates what type of data is contained in a file. The attribute specifies a name (e.g., "10R-L") that serves as an index into the Metadata Definition File, which will contain a detailed description of "10R-L" data. In any one Dataset Definition file, all <file> elements having the same metadata attribute will be listed consecutively. The Metadata Definition File is described in Section 3.4.

3.4 Metadata Definition File

Each fingerprint or fingerprint set has associated metadata, or information about the fingerprints. The Metadata Definition File defines named collections of metadata. It will be named "metadata.xml".

```
<?xml version="1.0"?>
<metadata-set>
  <metadata>
    <name>10R</name>
    <num-fingers>10</num-fingers>
    <fingers>01,02,03,04,05,06,07,08,09,10</fingers>
    <type>Roll</type>
  </metadata>
  <metadata>
    <name>10R-P</name>
    <num-fingers>10</num-fingers>
    <fingers>01,02,03,04,05,06,07,08,09,10</fingers>
    <type>Roll</type>
    <scan>Paper</scan>
  </metadata>
  <metadata>
    <name>4S</name>
    <num-fingers>4</num-fingers>
    <type>Slap</type>
  </metadata>
  <metadata>
    <name>1F</name>
    <num-fingers>1</num-fingers>
    <type>Flat</type>
  </metadata>
  <metadata>
    <name>1S</name>
    <num-fingers>1</num-fingers>
    <type>Slap</type>
  </metadata>
  <metadata>
    <name>4S-L-TI</name>
    <num-fingers>4</num-fingers>
    <fingers>01,02,03,04</fingers>
    <type>Slap</type>
    <scan>Live</scan>
  </metadata>
  <metadata>
    <name>4S-L-IM</name>
    <num-fingers>4</num-fingers>
    <fingers>02,03,07,08</fingers>
    <type>Slap</type>
    <scan>Live</scan>
  </metadata>

     <!--For LST, the actual file will contain many more metadata
```

```
descriptions -->
           <!--For SST, only one metadata description, 1F, will be used -->
           <!--For MST, three metadata descriptions, 1, 1F and 1S, will be
used -->

      </metadata-set>
```

Figure 6 Example Metadata.xml

The characteristics associated with each metadata attribute found in Dataset Definition File are specified in Metadata Definition File. The following list describes the elements specified in Metadata Definition File. Note that some information is specified redundantly for convenience.

- **Name**. This field will contain the string identifying the metadata.
- **Num-fingers**. This field will contain a number specifying how many fingerprints are contained in the ANSI/NIST file. <num-fingers> can be deduced from <fingers>.
- **Fingers**. The field will contain a comma separated list of two-digit finger codes (e.g., “01,02”, not “1,2”). The codes will be listed in increasing order.
- **Type**. This field will contain “Roll”, “Flat”, or “Slap”, indicating whether the fingerprint images are rolled, flat, or segmented slaps.
- **Scan**. This field will contain either “Live”, or “Paper”, indicating whether the fingerprint images are livescan or scanned from paper.

Every named group of metadata may not have all elements. For example, “4S”, which would be used at the <signature-set> level in the Dataset Definition Files, simply indicates 4 slap fingerprints, with Fingers and Scan undefined. Individual files within that Dataset Definition File may use 4S-L-TI or 4S-L-IM, fully defining all elements.

3.5 Differences among the Tests

SST/MST: Participants must search each print in the Queryset dataset against every print in the (identical) Targetset dataset, producing the corresponding similarity files. The entire test will consist of a single subtest.

The data will be provided on one or more compact disks (CD-R); USB drives can be used instead if requested by the Participant. Participants receiving data on a CD-R will return only the output and md5 directories (Figure 1, right side) on a separate CD-R.

LST: Test data will be provided to each Participant on a USB hard drive. As provided, the disk will contain all data required for the test. When the disk is returned, it must additionally contain the Participant’s test results in “output” and “md5” directories as shown in Figure 2.

3.6 ANSI/NIST files

Each fingerprint (SST or MST) or fingerprint set (LST) will be contained in a separate ANSI/NIST format file. The ability of Participants to read ANSI/NIST files is a fundamental requirement of FpVTE 2003.

Each ANSI/NIST file will contain

- one type-1 record, and
- one type-2 record , and
- either
    - exactly one type-4 record (for SST and MST), or

- between one and ten type-4 records (for LST)

Table 1 shows the fields that will be present in Type-1 records. The contents of the Type-2 record can be ignored. Since a type-2 record is required by some parsers, a record that only includes the LEN and IDC fields is provided. For SST and MST, each ANSI/NIST file will contain exactly one Type-4 record (containing a single fingerprint image). For LST, each ANSI/NIST file will contain between one and ten Type-4 records (a set of fingerprint images collected from one person at one time). Table 2 shows the fields that will be present in Type-4 records. All images are 8-bit grayscale, 500 ppi, using WSQ compression. The WSQ compression rates used vary. For LST, all finger positions will be labeled.

Note: The FBI's Electronic Fingerprint Transmission Specification (EFTS) is based on ANSI/NIST. Fingerprint files that are EFTS compliant are necessarily ANSI/NIST compliant.

File names will be of the form DDDnnnnn.an (e.g., MST00001.an or LB_12345.an):

- The DDD portion of the file name identifies the dataset. It will be "SST", "MST" or, for LST, a one or two character dataset identifier followed by an underscore.
- The nnnnn portion of the file name is a unique index number. These index numbers are used to identify the query and target in the similarity matrix. (See Section 4.2).
- The file extension, "an", stands for ANSI/NIST.

Field #	Field Name	Value	Description
1.001	LEN	(varies)	Length
1.002	VER	0300	ANSI/NIST version (1-2000)
1.003	CNT	(varies)	Contents
1.004	TOT	FPVTE	Type of transaction
1.005	DAT	(varies)	Date
1.007	DAI	000000000	default value for mandatory field
1.008	ORI	000000000	default value for mandatory field
1.009	TCN	filename	e.g. "SST00001.an"
1.011	NSR	19.69	scanning resolution of 19.69 pixels per mm = 500 pixels per inch
1.012	NTR	19.69	Transmission resolution of 19.69 pixels per mm

Table 1 Fields Present in Type-1 Records

Field Name	Value	Description
IMP	0-3	IMP (Impression Type) will be set to 0 Livescan plain (for flats or slaps) 1 Livescan rolled 2 Non-Livescan plain (for flats or slaps)

		3 Non-Livescan rolled
FGP	0-10	FGP (Finger Position) will be set to 0 (unknown) for SST and MST 1-10 (actual finger number) for LST. Note that all segmented slaps in LST have FGP set to the correct finger number. The finger codes 11-14 (plain thumbs and simultaneous slap images) are not used.
ISR	0	Image scanning resolution (0 denotes 500 dpi)
HLL	150-800	width in pixels
VLL	150-750	height in pixels
GCA	1	Grayscale compression algorithm (0 = uncompressed; 1=WSQ)

Table 2 Fields Present in Binary Type-4 Records

3.7 MD5 Digital Hashes NEW

An MD5 digital hash file will be provided to Participants for each provided ANSI/NIST file. Participants may ***optionally*** use these MD5 files as a means of verifying that the ANSI/NIST files were correctly copied onto their systems.

Each MD5 file will have the same basename as the file it signs, and the paths to a file and its MD5 hash will be the same, except that the one will begin "/datasets" and the other will begin "/data_md5". Each MD5 file will have the ".md5" filename extension. So, for instance, the ANSI/NIST file named "/datasets/B/d1/LB_00001.an" will have a corresponding MD5 hash file named "/data_md5/B/d1/LB_00001.md5".

MD5 is a message-digest algorithm developed by Professor Ronald L Rivest of MIT. Description and source code for the MD5 algorithm can be found as Internet RFC 1321 (http://www.faqs.org/rfcs/rfc1321.html). Numerous alternative implementations are publicly available.

4 Data Returned for Analysis

This section describes the data to be returned by Participants at the end of the testing period.

4.1 Media

Participants who receive data on USB drives will return results on the same USB drive.

Participants who receive data on CD will return results on a single new CD.

File names are restricted to 8.3 format (i.e., "abcdefgh.abc").

4.2 Similarity Matrix

This section defines the binary format that the Participant's fingerprint system must output.

The overall requirement for a specific test is that if there are **T** Targets and **Q** Queries, then a participant's code must produce **Q** similarity files. Each similarity file must contain **T** similarity or distance scores. The matrix of **TQ** values is referred to as a similarity matrix although it is not stored as a single file.

For a TargetSet of size **T**, each similarity file must contain precisely 4T + 60 bytes, as shown in Table 3. Each file has a 52 byte header, followed by as many similarity or distance scores as there are Targets in the TargetSet, and a final 8 byte footer. The following bullets describe the various fields:

- **File Type**. Often referred to as a "magic number," this sequence of 8 characters identifies the file type. This field is used by automated tools to determine how to parse the file. For FpVTE 2003, this is set to the constant "FPVTE_03"

- **Participant ID**. A sequence of 8 characters assigned to the Participant. Participants with multiple systems will be given a unique identifier for each system.

- **QuerySet**. A sequence of 8 characters that names the QuerySet. When the name of the QuerySet is less than 8 characters, the QuerySet name must be padded on the right with blanks (as a suffix).

- **TargetSet**. A sequence of 8 characters that names the TargetSet. When the name of the TargetSet is less than 8 characters, the TargetSet name must be padded on the right with blanks (as a suffix).

- **Query ID**. The basename of the ANSI/NIST Query file (i.e., all but the ".an" suffix). When the basename is less than 8 characters, it must be padded on the right with blanks (as a suffix).

- **Endian Indicator**. A value for testing the byte order (endian-ness) of the data, used to ensure that when similarity files are written and read across architectures, different byte orderings can be corrected for. Either Big or Little Endian byte ordering must be used consistently throughout all similarity files returned for a test.

- **Number of Scores**. A count of the number of similarity or distance values. This equals the number of ANSI/NIST files in the TargetSet.

- **Polarity**. Matcher scores may be expressed on an increasing or decreasing scale. A *large similarity* score implies sameness of identity of the subject appearing in the Query and Target, whereas a *small distance* score implies sameness of identity of the subject appearing in the Query and Target. This concept is termed polarity and must be recorded in all similarity files as discussed above. The permissible values are 0 for similarity values and 1 for distances. For a single system, all files must be of the same polarity.

- **Score**. The bulk of the data is **T** binary floats. It is imperative that the **i**-th element of the similarity data corresponds to Target **i**, where **i** is the unique index number embedded in the name of the ANSI/NIST file. Note that each *dataset*.xml will list files in numeric sequence; the first index number will be 00001; and there will be no gaps in the numbering. Any reordering or missing values in the output will make analysis of results impossible. Scores may be any values that can be represented as floating point numbers. Do not use IEEE 754 special values such as plus or minus infinity, negative zero or NaN (Not a Number).

- **File Type**. The file is terminated with a repeat of the File Type.

Description	Value	Data type	Number of items	Total Bytes
File Type	FPVTE_03	char	8	8
Participant ID	[assigned]	char	8	8
QuerySet	[dataset name]	char	8	8
TargetSet	[dataset name]	char	8	8

Query ID	Query filename (no extension)	char	8	8
Endian Indicator	0x12345678	unsigned int	1	4
Number of Scores	**T**	unsigned int	1	4
Polarity	0 or 1	unsigned int	1	4
Score	[score]	float	1	4
…	…	float	**T - 2**	**4(T - 2)**
Score	[score]	float	1	4
File Type	FPVTE_03	char	8	8

Table 3 Contents of Binary Similarity Files

All numeric values must be reported in IEEE 754 format that is used on Intel based PCs, and many UNIX platforms. Participants with any concerns as to their floating point formats should email their concerns to FpVTE 2003 (fpvte@nist.gov).

Strict adherence to this format is mandatory.

4.3 Image Quality (optional)

Participants may optionally produce a vector of image quality metrics for each dataset. If provided, the image quality metrics can be used to note which fingerprints a Participant's system would have rejected due to poor image quality (e.g. Failure To Enroll, or FTE).

These files have nearly the same binary format as the similarity files (Table 4): the value of the File Type differs; the TargetSet and Query ID fields are missing; there is an additional failure-to-enroll (FTE) threshold value; and, rather than **T** similarity scores, there are **Q** image quality measures.

For LST, the name of each IQM file derives from the name of a dataset. As illustrated in section 3, all IQM files for one dataset will be stored together in the directory, in files named /output/iqm/*dataset*.iqm.

For SST and MST, a single file named SST.iqm or MST.iqm is written to the root directory.

For Image Quality Files, a Polarity of 1 means that image quality improves as values increase, and a Polarity of 0 means the opposite.

The FTE threshold is an IQM value below which (for Polarity=1) images would be considered unsatisfactory for enrollment.

Description	Value	Data type	Number of items	Total Bytes
File Type	FPVTEIQM	char	8	8
Participant ID	[assigned]	char	8	8
Dataset	[dataset name]	char	8	8
Endian Indicator	0x12345678	unsigned int	1	4

Number of IQMs	**Q**	unsigned int	1	4
Polarity	0 or 1	unsigned int	1	4
FTE Threshold	1.0	float	1	4
IQMs	0.8	float	1	4
…	…	float	**Q - 2**	**4(Q - 2)**
IQMs	7.0	float	1	4
File Type	FPVTEIQM	char	8	8

Table 4 Contents of Binary Image Quality Metric Files

4.4 MD5 Hashes

Participants will produce an MD5 digital hash for each Similarity File and for each IQM file as a means of verifying data integrity. MD5 is a message-digest algorithm developed by Professor Ronald L Rivest of MIT. Description and source code for the MD5 algorithm can be found as Internet RFC 1321 (http://www.faqs.org/rfcs/rfc1321.html). Numerous alternative implementations are publicly available.

Each MD5 file will have the same basename as the file it signs, and the paths to a file and its signature will be the same, except that the one will begin "/output" and the other will begin "/md5". Each MD5 file will have the ".md5" filename extension. So, for instance, the similarity file named "/output/LST_BxA/d1/LB_00001.sim" will have a corresponding signature file named "/md5/LST_BxA/d1/LB_00001.md5".

A15. NORMALIZATION SPECIFICATION

FpVTE 2003 Normalization Specification

Last updated 19 September 2003

1 Introduction

In MST and SST, Participants may ***optionally*** provide a compiled software object that performs normalization for use in post-test analysis. The format of the normalization software is defined in this document.

LST Participants do not provide normalization software.

Normalization is introduced in the *FpVTE 2003 Test Plan (Section 6.1)*. Briefly, normalization is a post-test analysis procedure performed by NIST after similarity files have been submitted. During analysis, the similarity matrix for MST (or SST) may be partitioned (e.g., by capture device, subject's gender, or a wide variety of other characteristics) in order to evaluate accuracy over specific subpopulations (subsets of the data).

MST or SST Participants may elect to submit software that "normalizes" the distribution of similarity scores for a subpopulation prior to each analysis. Participants who elect to provide normalization option must provide to NIST a single archive file containing the normalization subroutines.

Whether or not Participants provide normalization software, one of the FpVTE analyses will include normalizing all Participants' results using FpVTE normalization methods.

For background information, please refer to the Test Overview and Test Plan documents. The schedule for submitting normalization software is reported on the FpVTE Calendar. Note that normalization software is not due until the Evaluation itself is nearly complete.

2 Requirements

Participants submit one or two normalization subroutines, and a short test program, as described below. The subroutines must be compiled, but not linked. The resulting object file(s) must be packaged as a single static library named *ParticipantID*.a (where *ParticipantID* is the 8-character string provided by NIST, used in the output similarity matrices).

1. **Normalization Functions.** Either or both of two normalization functions (F1 and F2) may be submitted. Normalization is performed by FpVTE analysts to adjust scores over a subset of the Target Set (called a "Gallery"). FpVTE analysts will extract from the similarity files those scores corresponding to a Gallery, then run a normalization function to adjust the scores.

- F1 takes as input the scores for a single query against the entire Gallery. F1 produces normalized scores for one query against the Gallery.

- F2 takes as input not only the scores for a single query against the entire Gallery, but also the entire square matrix of similarity scores for the Gallery (i.e., for all queries against the entire gallery). F2 produces normalized scores for one query against the Gallery.

2. **Test Program**: The test program should be based on that shown in Figure 4 , producing no more than a few lines of text output that can be quoted in an email message to confirm that the FpVTE Analysts successfully linked and executed the submitted subroutine(s). The test program must be written in C, must not exceed 100 lines, and must be submitted as source code.

3. **Function Prototypes**: The normalization functions should be written in C (ISO/IEC 9899:1990). Other languages may be used only if the call semantics are identical to those for C. Particularly C++ must not be used as is (unless explicitly using C calling conventions), because of nonstandardization of function name mangling. The prototypes are specified in Figure 1 .

```
void F1(const unsigned int g,      const float* column_in,
float* column_out);

void F2(const unsigned int g,     const float* matrix_in,      const
float* column_in,        float* column_out);
```

where

- g is the size of the gallery (i.e., number of similarity scores);
- matrix_in is a pointer to a two-dimensional array (g*g*sizeof(float) bytes) containing Participant-provided similarity scores;
- column_in is a pointer to a one-dimensional array (g*sizeof(float) bytes) containing Participant-provided similarity scores; and
- column_out is a pointer to a one-dimensional array of memory (g*sizeof(float) bytes allocated by the caller) where the normalized similarity scores are to be written.

Figure 1 Required Function Prototypes

4. **Portable Object Files**: The normalization functions must successfully link and execute on the FpVTE 2003 analysts' computers used to perform the scoring. The object code will be linked into programs that run on 32-bit Intel-based machines running the Red Hat Linux operating system (version 7.x).

Note: To minimize interoperability problems, we recommend using a recent Linux distribution such as RedHat 7.x, Mandrake 8.x, SuSE 8.x, or Gentoo 1.x.

As illustrated with an example in Figure 5 , *ParticipantID*.a is a static library. A static library is a collection of ordinary object files, normally created using the ar (archiver) program. ELF (Executable Linking Format) is the standard object file format on many current Unix platforms (including Solaris, SVR4, Linux, and some Berkeley Software Distribution operating systems). The ELF standard defines a portable object file format that works on 32-bit Intel Architecture environments for a variety of operating systems. Statically linked executables are usually cross-compatible for all ELF versions (dynamically linked, shared libraries are not).

The normalization code should be self-contained. Any non-standard library code should be included. Private functions and variables should be declared static in a participant's code.

Note that neither g++ nor gcc running under the Cygwin package on non-Linux platforms produces acceptable object files.

5. **Limited Resources**: NIST reserves the right to exclude the results of normalization for a Participant if the normalization function consumes excessive resources (e.g., processing time or memory). Use of normalization cannot cause a significant delay in the scoring process. Note, to process a partition of 1,000 images by 1,000 images will require calling the normalization routine 1,000 times; each call will process 1,000 similarity scores. NIST may choose to report on resource consumption of the normalization algorithms.

6. **No Side-Effects**: The normalization functions must have no side-effects (such as reading or writing files, or retaining information from one invocation to another). Significant memory leaks may also disqualify a normalization algorithm.

7. **No Source Code**: For intellectual property reasons Participants must not, at any time, submit source code for the normalization algorithms to NIST. This rule does not apply to the test program, which should not contain proprietary information.

3 Example Code

The following Figures show example code for the normalization functions F1 and F2; a main driver program that links to F1; and Linux/Unix commands to build, archive and link the example code. Note that this example normalization code does not necessarily perform a useful function – it is provided only to illustrate how the objects are built and integrated.

```
/* f1.c
 * Example F1 normalization algorithm
 */
void F1(const unsigned int g,
        const float   *column_in,
        float         *column_out)
{
    unsigned int i = 0;
    float max = column_in[0];
    float min = column_in[0];
    for (i = 1; i < g; i++)
    {
        if (column_in[i] > max) max = column_in[i];
        if (column_in[i] < min) min = column_in[i];
    }
    for (i = 0; i < g; i++)
        column_out[i] = (column_in[i] - min) / (max
  - min);
}
```

Figure 2 Example F1

```
        /* f2.c
         * Example F2 normalization algorithm
         */
        void F2(const unsigned int g,
                const float *matrix_in,
                const float *column_in,
                float *column_out)
        {
            unsigned int i = 0, j = 0;
            float max = matrix_in[0];
            float min = matrix_in[0];
            for (i = 0; i < g; i++)    /* for each Query
          */
                for (j = 0; j < g; j++)    /* against
          each Target */
                {
                    if (matrix_in[i* g + j] > max)
                        max = matrix_in[i* g + j];
                    if (matrix_in[i* g + j] < min)
                        min = matrix_in[i* g + j];
                }
            for (j = 0; j < g; j++)
                column_out[j] = (column_in[j] - min) / (max
          - min);
}
```

Figure 3 Example F2

```
        /* main.c
         * Example test program that demonstrates invocation
          of F1()
         */
        #include <stdio.h>
        int main()
        {
            void F1(unsigned int numScores, float *input,
          float *output);
            unsigned int i;
            double t;
            double mse = 0.0;
            double rms;
            /* Participant inserts suitable values here:
          */
            float input[] = {0.2, 0.4, 0.8, 0.3, 0.5, 0,8,
          1.0, 0.6};
            float expected_output[] =
                 {0.025, 0.05, 0.1, 0.0375, 0.0625, 0.0,

          1.0, 0.125};
            float actual_output[8];
            F1(8, input, actual_output);
            for (i = 0 ; i < 8 ; i++)
            {
               t = (double)actual_output[i] -
(double)expected_output[i];
               mse += t * t;
            }
            rms = sqrt(mse);
            fprintf(stderr, "rms is %f\n", rms);
            return 0;
        }
```

Figure 4 Example test program that invokes F1

```
% gcc -c f1.c % file f1.o f1.o: ELF 32-bit LSB relocatable, Intel
80386,
        version 1, not stripped % ar r PARTICIP.a f1.o % gcc -c f2.c %
ar r PARTICIP.a
        f2.o % nm PARTICIP.a f1.o: 00000000 T F1 00000000 t
gcc2_compiled. f2.o:
        00000000 T F2 00000000 t gcc2_compiled.

% gcc main.c -static -lm PARTICIP.a   -o testF1



% testF1



rms is 0.000000
```

Figure 5 Commands to build and test the example code

In Figure 5 , the -static option is used to prevent linking with shared libraries; the -lm option is used to link with the math library, which defines the sqrt function needed by main.c.

4 References

[1] P. J. Phillips, H. Moon, S. A. Rizvi, and P. J. Rauss. The FERET Evaluation Methodology for Face Recognition Algorithms. IEEE Trans. Pattern Analysis and Machine Intelligence, 22: pp. 1090-1104, 2000.

Available on-line: www.itl.nist.gov/iad/humanid/feret/doc/FERET_PAMI_Oct_2000.pdf

A16. SAMPLE DATA

FpVTE 2003 Sample Data

Last updated 3 October2003

The FpVTE Sample Datasets are provided as examples of the formats defined in the Data Format Specification.

It is important to note that the ***formats*** of the Sample Datasets are representative of the formats of the Evaluation Datasets, but the fingerprints in the Sample Datasets should ***not*** be taken as representative of the Evaluation Datasets. The number of files, the distribution/frequency of mates and non-mates, and quality/characteristics of the images are distinctly different between the Sample and Evaluation Datasets.

FpVTE Sample Data includes XML and AN (ANIST/NIST) files, in directory structures specified in the Data Format Specification:

- SST Sample Data (download below; 11Mb zip file)
- MST Sample Data (will be mailed on CD-ROM)
- LST Sample Data (will be mailed on CD-ROM)

FpVTE SST Sample Output includes sample output for the SST Sample Data, serving as a model for the output Participants are expected to produce. The SST Sample output includes .sim, .iqm, and .md5 files. Sample output will not be produced for the MST and LST Sample Data. (download below; 0.7Mb zip file)

Downloads

- SST Sample Data (11Mb zip file)
- SST Sample Output (0.7Mb zip file) (updated 8 Sept: polarity in all *.sim files changed from 1 to 0, associated *.md5 files updated)
- Metadata.XML file (updated 16 Sept.) (The Metadata type 2S-P-M has been added.)
- LST Sample Dataset 1 (2F) (10Mb zip file; updated 12 September.) In the LST Sample Data CD, the Image Designation Characters (IDCs) in the type 4 records for the second image in each file were incorrectly set to (binary) 01 instead of (binary) 02. This update corrects that problem.
- ANSI/NIST file with a blank image (1F) **NEW**

Comparison of Sample Datasets and Evaluation Datasets

The Sample Datasets include fingerprints that are generally similar to those in the Evaluation Datasets, but are not strictly representative of the Evaluation Datasets. The file formats, directory structures, and metadata are fully representative of the Evaluation Datasets.

The reason for this is that all of the Evaluation Data is officially labeled as Sensitive, and cannot under any circumstances be released. This means that we cannot use any of the fingerprints in the FpVTE Evaluation Datasets as samples for distribution.

The following statements provide some guidance in comparing the the Sample Datasets with the Evaluation Datasets:

- Flats
    - The model of scanner used to collect the Sample flat fingerprints is the same model used to collect many or most of the Evaluation flat fingerprints.

  - The flat fingerprints in the Sample Datasets have greater extremes of rotation than do those in the Evaluation Datasets.

- Slaps
  - The slap fingerprints in the Sample and Evaluation datasets were all segmented using the same process. The image sizes and degree of rotation are comparable for the slap fingerprints in the Sample and Evaluation datasets.
  - The slap fingerprints in the MST and LST Sample Datasets were all scanned from paper cards.
  - The slap fingerprints in the MST Evaluation Dataset are all from livescan sources.
  - The slap fingerprints in the LST Evaluation Datasets are from paper and livescan sources. The Sample slap fingerprints are representative of the LST Evaluation slap fingerprints from paper sources.

- Rolls
  - The rolled fingerprints in the LST Sample Datasets were all scanned from paper cards.
  - The rolled fingerprints in the LST Evaluation Datasets are from paper and livescan sources. The Sample rolled fingerprints are representative of the LST Evaluation rolled fingerprints from paper sources.

- Mate relationships
  - The mate relationships in the Sample datasets do not in any way correspond to the mate relationships in the Evaluation datasets.

- File formats
  - The sole difference in the file formats between the Sample and Evaluation datasets is that the *subject_id* attribute in the <*signature name*> tag is included in the Sample Dataset Definition Files (to indicate mate relationships), but is not included in the Evaluation datasets.

A17. SAMPLE UTILITIES

FpVTE 2003 Sample Utilities

Last updated 16 September 2003

1 Introduction

The FpVTE Sample Utilities are designed to verify compliance of output files with the formats defined in the Data Format Specification.

Participants must use the Dataset Validator (validate.pl) to validate their results from the Sample Datasets before sending them to NIST.

For background information, please refer to the Data Format Specification.

Each tool is provided as C or Perl source code. The C programs are also distributed as Windows executables. Participants are free to use the source code as a basis for developing custom solutions for FpVTE 2003, but FpVTE assumes no responsibility for such use – whether any code is used in part or in its entirety.

Note: Tool development and testing was performed in the Cygwin environment under Windows 2000, using gcc version 3.2 20020927 (prerelease), and Perl v5.8.0 built for cygwin-multi-64int. These tools were designed to be portable and should work without modification on a variety of platforms. [Limited testing under gcc version 2.96 20000731 (Red Hat Linux 7.1 2.96-98); Perl v5.6.0 built for i386-linux]

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2 Installation

Extract all files to new folder on hard drive.

Install Perl, if necessary (e.g., from www.cpan.org)

For non-Windows systems, rebuild executables.

Ensure that validate.pl is kept in the same directory as MD5Hash.exe and checksim.pm.

3 Similarity Matrix Checker

Files provided:

checksim.c	C implementation (source code)
checksim.exe	C implementation (Windows 32-bit executable)
checksim.pl	Perl implementation
checksim.pm	Supporting Perl module

Description:

These utilities read binary similarity files and IQM files. The C and Perl implementations are provide roughly equivalent functionality. The Perl implementation provides some command line options (silent, summary, and verbose output), and performs a slightly more thorough check of

compliance with the Data Format Specification. The two implementations demonstrate different ways of reading the data. Each tool produces a text format summary of the file contents.

Representation:

These utilities validate most of the format specification, but are not 100% thorough (e.g., there is no test for special floating point values, and there is no test for correspondence of the data to a test). The Perl version has more options than the C code does.

Limitations:

Limited testing has been performed on these tools.

Usage (C version):

checksim.exe simFile (e.g., checksim.exe SST00001.sim)

Usage (Perl version):

Usage: checksim.pl [option] simFile
-s validate silently (only report failures)
-v print all scores
-h show options

Download:

checksim_utilities.zip (53k Zip file; updated 16 Sept. 2003) **NEW**

```
File Type       "FPVTEIQM"
Participant     "Mitretek"
QuerySet        "SST     "
Endian          12345678
NumScores       390
Polarity        1
Threshold       1.000000
1               1.000000
2               1.000000
3               1.000000
...
388             1.000000
389             1.000000
390             0.000000
File Type       "FPVTEIQM"
** PASSED **
```

Figure 1 checksim default output for SST.iqm

Figure 1 shows the output produced by checksim.pl when run on the file SST.iqm. Notice that only the first three and last three IQM values are printed.

4 MD5

Files provided:

MD5Hash.exe (Windows executable), md5hash.c, mddriver.c, md5.c, md5.h, global.h; RFC1321.txt.

Description:

Calculates the md5 hash of a file (i.e., of the file contents)

Representation:

Source code taken from http://www.faqs.org/rfcs/rfc1321.html without modification (mddriver.c, md5.c, md5.h, & global.h).

The md5hash.c driver program is a simplified version of the mddriver.c code included in RFC1321. md5hash.c hashes an input file and creates an output file that just contains the binary 16-byte MD5 digest.
If a different MD5 implementation is used, it should be compared with the output of MD5Hash.exe

Usage:

MD5Hash.exe inputfilename outputfilename (e.g. MD5Hash.exe SST00001.sim SST00001.md5)

Download:

MD5_Sample.zip (36k Zip file)

5 Dataset Validator

Files provided:

validate.pl (supporting files: checksim.pm, MD5Hash.exe)

Description:

This tool reads the entire directory structure of data provided to Participants and the results returned by Participants, checking the entire collection for consistency and compliance with the Data Format Specificiation. Optionally, this tool may be used to check only the data provided to Participants; to illustrate processing steps that might be performed; or to create the required output directories. The directory structure is checked, as well as the presence of all files, and the formats of SIM, IQM, and MD5 files.

Representation:

A revised version of this tool may be used to validate Participant data at the end of the test. Participants can expect this tool to be able to read the XML files and terminate successfully. The actual steps taken by this tool and the processing it may suggest performing (such as characterizing images, loading databases, and writing files) are not required. These steps are merely illustrative of what might be done.

Usage:

validate.pl [options] InDirectory [OutDirectory]

- -t only validate data provided to Participants
- -i illustrate processing steps
- -v illustrate processing steps verbosely
- -V illustrate processing steps VERY verbosely (each file)
- -d create output directories

validate.pl is invoked from the command line with one or more arguments. Referring to Figures 1 and 2 of the Data Format Specification document, InDirectory identifies the directory that contains metadata.xml and xST-def.xml (i.e., ../datasets). Outdirectory identifies the directory that contains the output and md5 directories. Outdirectory only needs to be specified when the selected option requires an output directory (i.e., not for –t, -i, -v, or -V) and when the output directory it is not the same as InDirectory.

Download:

validate.zip (27k Zip file; updated 16 Sept. 2003) **NEW**