MINEX II Phase IV

Request for comment on Test Design

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Background

MINEX II has produced two prior reports[1] documenting the accuracy and speed of the match-on-card implementations[2]. The algorithms run on ISO/IEC 7816 conformant integrated circuit cards, and they match ISO/IEC 19792-2 compact-format fingerprint minutiae fields.

Audience

The document is circulated to parties interested in match-on-card biometrics, and specifically to prospective participants in Phase IV of the MINEX II test of on-card comparisons. Potential users of match-on-card technologies may also be interested.

Purpose

This document is circulated as a request for comments on new proposed technical aspects of the MINEX II evaluation. The existing evaluation is document in the MINEX II API and CONOPS[3].

Proposed modifications in test execution and reporting

Any party wishing to provide opinions on the entries in Table1 are invited to send these to patrick DOT grother AT nist DOT gov

#	Area	Specifics
1.	Template generators	The interoperability matrices in the MINEX II reports have been restricted to templates generated by the following companies' implementations: Cogent A, Dermalog B, Bioscrypt C, Sagem Morpho D, Neurotechnologija E, Innovatrics F, NEC G, Cross Match Technologies N, L1/Identix, Precise Biometrics 1D, XTec 1F, SecuGen 1G, BIO-key International 1J, Motorola 1L, Aware 1M, Sonda Technologies 1N, Neurotechnologija 1T, Aware 1Y, ImageWare 2A There has been a request to extend this to use all of those listed here: http://fingerprint.nist.gov/minex/Results.html Any views?
2.	DET reporting	Prior MINEX II reports have included DET characteristics for MOC implementations comparing minutia templates prepared using specific template generators. Dependencies on precisely which combination of generators has led to contention in which algorithm can claim to be the "most accurate". NIST received a proposal to report a DET as follows. Use all K template generators used in the MINEX evaluation[4] (which do not report minutia quality values) and pool all comparison scores in the DET computation. Thus if the previously reported DETs included N ~ 120,000 genuine comparisons and M ~ 1,200,000 impostor comparisons, the new DET would be based on KN and KM comparisons.

[1] The reports document, respectively, Phases II and III, of the MINEX II evaluation. The reports are linked from http://fingerprint.nist.gov/minexII

[2] While *match-on-card* is a trademarked term, it is used here as a synonym for the term *on-card comparison*. The entire MINEX II evaluation considers standards-compliant cards and data records, and has thus far avoided proprietary data.

[3] See http://fingerprint.nist.gov/minexII/nistir_7485.pdf.

[4] See http://fingerprint.nist.gov/minex

		This represents the situation in which a MOC application is used in a federated application in which templates from K different organizations are used in equal number. The purpose is to give a more robust, vendor neutral, statement of accuracy. The range of accuracies [max/min/mean] could be displayed also.
3.	Zonal Quality Mask	Should the record include the regional quality mask described in Appendix A? Would accuracy improve? Would you provide a template generator that computed zonal quality? Implementation: The INCITS 378 standard does not include zonal quality masks. The ISO/IEC 19794-2 standard does. MINEX II would likely borrow the ISO record structure for the test and integrate with INCITS 378. The card DO is standardized already.
4.	Threshold	If the test plan required you to state a threshold (in email to NIST) that you believe, a priori, will produce FMR less than or equal to 10^{-4} would you be able to do so?
5.	Impostor distribution stability	The MINEX 04 test reported results for fixed threshold[5] and showed that FMR has some dependency on the producer of the templates. Do you have views on whether impostor distribution stability should be included in MINEX II analyses?
6.	Cost model	The existing MINEX II protocol has ignored the actual decision returned by a card executing a VERIFY command. Instead accuracy has been computed entirely from the similarity scores required to be computed by the card. The proposal is to require participants to report similarity scores *and* decisions, with the objective of minimizing the cost of hypothetical single finger financial services authentication application. The cost function would be $C = P \cdot CFNM \cdot FNMR + (1-P) \cdot CFM \cdot FMR$ Where P, the prior probability of a genuine comparison, is set at 0.999 CFNM, the cost of a false non-match, is set at 1, and CFM, the cost of a false match is set at 10000 This means that an explicit match / non-match decision is required for each trial. Explicit decisions are required because the task of determining appropriate decision thresholds is a necessary part of any 1:1 system. Comments on whether to do this, on the functional form, and on the values of the costs and priors, are welcome.
7.	Properties of minutia detector	**Question to NIST:** Are there some other rules which needs be met in order for a Ongoing MINEX approved extractor be considered for the MINEX II? **Answer:** The extractors in MINEX II differ from MINEX 04 / Ongoing MINEX in that they should report minutia quality values.
8.	Which extractor is the default.	**Question to NIST:** We are also a bit curious as to how the fallback extractor is chosen – that is the extractor used by matchers submitted that are not providing their own extractor. Will this extractor be updated to the next MINEX II round? **Answer:** The question refers to the minutia extractor used during the authentication attempt. In the first public MINEX II report MX2D was used because it was the only extractor submitted. In the revision of that report[6], the MX2D (Sagem) was used, and occasionally supplemented with MX2T

[5] See Table 10 the March 2006 MINEX 04 report, *Performance and Interoperability of the INCITS 378 Fingerprint Template NISTIR 7296*. Linked from http://fingerprint.nist.gov/minex

		(Cogent). For the upcoming Phase IV, the appropriate uses of multiple extractors would be 1. To pool the templates as in row 2 above. 2. To compare performance of those generators. Responses are welcome.

Appendix A - Zonal Quality Specifications

The PC would make a INCITS 378 record that augmented with the zonal quality structure shown in this ISO/IEC 19794-2 record.

	Field name and ISO/IEC 19794-2:2005 clause numbers in parentheses	Values Allowed	Informative Remarks
1.	Format Identifier (7.3.1)	0x464D5200	i.e. ASCII "FMR\0"
2.	Version Number (7.3.2)	0x20323000	i.e. ASCII " 20\0".
3.	Record Length (7.3.3)	$32 \leq L \leq 800$	26 record header + 4 view header +2 extended data length + 6K. Max K is 128
4.	Capture Equipment Certifications (7.3.4)	0	
5.	Capture Device Type ID (7.3.5)	0	
6.	Size of Scanned Image in x direction (7.3.6)	MIT	Inherited directly from input data
7.	Size of Scanned Image in y direction (7.3.7)	MIT	
8.	X (horizontal) resolution (7.3.8)	197	
9.	Y (vertical) resolution (7.3.9)	197	
10.	Number of Finger Views (7.3.10)	1	
11.	Reserved Byte (7.3.11)	0	
12.	Finger Position (7.4.1.1)	MIT	Inherited directly from input data
13.	View Number (7.4.1.2)	0	
14.	Impression Type (7.4.1.3)	0 or 2	Inherited directly from input data
15.	Finger Quality (7.4.1.4)	MIT	Inherited directly from input data
16.	Number of Minutiae (7.4.1.5)	$0 \leq K \leq 128$	K minutiae data blocks
17.	Minutiae Type (7.4.2.1)	01b, 10b, or 00b	
18.	Minutiae Position (7.4.2.2)	MIT	
19.	Minutiae Angle (7.4.2.3)	MIT	
20.	Minutiae Quality (7.4.2.4)	0, $1 \leq Q \leq 100$	0 = unsupported
21.	Extended Data Block Length (7.5.1.1)	≥ 0	Either 0 for no extended data, or the length of a zonal quality block
22.	Extended Data Area Type Code (7.5.1.2)	0x0003	Optional, only present if (7.5.1.1) is > 0.
23.	Zonal Q. Cell Width and Height (7.5.4.1)	$1 \leq NPIX \leq W$	Optional, only present if (7.5.1.1) is > 0.
	Zonal Q. Cell Width and Height (7.5.4.1)	$1 \leq NPIX \leq H$	Optional, only present if (7.5.1.1) is > 0.
24.	Zonal Q. Cell Quality Info. Depth (7.5.4.2)	1, 2, 4, 8	Optional, only present if (7.5.1.1) is > 0. This value shall not be 0.
25.	Zonal Q. Cell Quality Data (7.5.4.3)		Optional, only present if (7.5.1.1) is > 0.
MIT = mandatory at time of instantiation			

The information shown in blue would be sent to the card as:

[6] See *MINEX II Performance of Fingerprint Match-on-Card Algorithms* Phase II / III Report NIST Interagency Report 7477 (Revision I) linked at http://fingerprint.nist.gov/minexII/minex_report.pdf

Table 1 – ISO/IEC 19794-2 minutiae template DO

Tag	L	Value						Comment
'7F2E'	L1	Biometric data template						
		Tag	L	Value				
		'81'	L2	Finger minutiae data				
				Field	Size (bits)	Valid Values		
				X coordinate	8	[0,255]		S instances
				Y coordinate	8	[0,255]		
				Minutiae type	2			
				Minutiae angle	6	[0,63]		
		'94'	L3	Zonal Quality Data	5+var	See Table 2		0 or 1 instances

Table 2 – Zonal quality data

	FIeld	Length (bytes)	Values Allowed	Informative Remarks
1	Horizontal Resolution of the Quality Map (8.4.1.1.2)	1		See Note 1 and Example 1
2	Vertical Resolution of the Quality Map (8.4.1.1.2)	1		
3	Quality Map Width (8.4.1.1.3)	1		# cells in x horizontal direction
4	Quality Map Height (8.4.1.1.3)	1		# cells in y vertical direction
5	Cell Quality Information Depth (8.4.1.1.4)	1	1, 2, 4, 8	Not 0.
6	Cell Quality Data (8.4.1.1.5)	L		Packed bits

NOTE The first draft Technical Corrigendum 1, SC37N2119 has one field for cell quality resolution, i.e. it assumes the x-y resolutions are equal. However, the ISO/IEC 19794-2:2005 record standard allows different cell resolutions in x and y. Therefore, if the process of converting ISO/IEC 19794-2 record to compact-card templates is to become viable operationally, then card zonal quality data needs to support anisotropic resolutions.

EXAMPLE If the horizontal cell dimension in a ISO/IEC 19794-2 zonal quality block (clause 7.5.4.1 of ISO/IEC 19794-2:2005) is 20 pixels, and the corresponding horizontal resolution is 197 pixels per centimeter (clause 7.3.8 of ISO/IEC 19794-2:2005), then the value of the entry on line 1 of this table (i.e. the number of cells per decimeter) will be round(10 * 197 / 20) = 99, where the rounding operator is nowhere standardized.