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Fingerprint
identification for
PC and Web
solutions

VeriFinger SDK



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Fingerprint identification for PC and Web solutions

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VeriFinger is a fingerprint identification technology intended for biometric systems developers and integrators. The technology assures system performance with fast, reliable fingerprint matching in 1-to-1 and 1-to-many modes.

VeriFinger is available as a software development kit that allows development of PC- and Web-based solutions on Microsoft Windows, Linux and Mac OS X platforms.

- 1000+ end-user product brands in 98 countries used the VeriFinger algorithm over the past 13 years.
- Full NIST MINEX certification and Fingerprint Verification Competition (FVC) awards since 2000.
- Fast rolled and flat fingerprint matching that is tolerant to fingerprint translation, rotation and deformation.
- Compact fingerprint template and unlimited database size.
- Available as multiplatform SDK that supports multiple scanners and multiple programming languages.
- Reasonable prices, flexible licensing and free customer support.



VeriFinger algorithm features and capabilities

All performance tests were made on Intel Core2 processor with 4 cores running at 2.66 GHz.

In 1998 Neurotechnology developed **VeriFinger**, a **fingerprint identification algorithm** designed for biometric system integrators. Since that time, Neurotechnology has released more than 10 versions of the VeriFinger algorithm, providing the most powerful fingerprint recognition algorithms to date.

The latest VeriFinger 6.3 version is **NIST MINEX compliant**, as it is based on the MegaMatcher fingerprint identification engine that has been certified by NIST for use in personal identity verification (PIV) program applications.

The VeriFinger algorithm follows the commonly accepted fingerprint identification scheme, which uses a set of specific fingerprint points (minutiae) along with a number of proprietary algorithmic solutions that enhance system performance and reliability. Some are listed below:

- **Rolled and flat fingerprints matching.** The VeriFinger algorithm matches flat-rolled, flat-flat or rolled-rolled fingerprints with high reliability, as it is tolerant to fingerprint deformations. Rolled fingerprints have much bigger deformation due to the specific scanning technique (rolling from nail to nail) than those scanned using the “flat” technique. Conventional “flat” fingerprint identification algorithms usually perform matching between flat and rolled fingerprints less reliably due to the mentioned deformations of rolled fingerprints.
- **Tolerance to fingerprint translation, rotation and deformation.** VeriFinger’s proprietary fingerprint template matching algorithm is able to identify fingerprints even if they are rotated, translated, deformed and have only 5 - 7 similar minutiae (usually fingerprints of the same finger have 20 - 40 similar minutiae)) and matches 3,000 – 56,000 flat fingerprints per second (see technical specifications for more details).
- **Faster matching using pre-sorted database entries.** For some identification tasks VeriFinger’s effective matching speed can be increased to **15,000 – 70,000** fingerprints per second (on one processor core) by pre-sorting database entries using certain global features. Fingerprint matching is performed first with the database entries having global features most similar to those of the test fingerprint. If matching within this group yields no positive result, then the next record with most similar global features is selected, and so on, until the matching is successful or the end of the database is reached. In most cases there is a fairly good chance that the correct match will be found at the beginning of the search. As a result, the number of comparisons required to achieve fingerprint identification decreases drastically, and correspondingly, the matching speed increases. See technical specifications for more details.
- **Identification capability.** VeriFinger functions can be used in 1-to-1 matching (verification), as well as **1-to-many** mode (identification).
- **Image quality determination.** VeriFinger is able to ensure that only the best quality fingerprint template will be stored into database by using fingerprint image quality determination during enrollment.
- **Adaptive image filtration.** This algorithm eliminates noises, ridge ruptures and stuck ridges for reliable minutiae extraction – even from poor quality fingerprints – with a processing time of 0.1 - 0.2 seconds (for flat fingerprints).
- **Features generalization mode.** This fingerprint enrollment mode generates the collection of generalized fingerprint features from a set of fingerprints of the same finger. Each fingerprint image is processed and features are extracted. Then the features collection set is analyzed and combined into a single generalized features collection, which is written to the database. This way, the enrolled features are more reliable and the fingerprint recognition quality considerably increases.
- **Scanner-specific algorithm optimizations.** VeriFinger includes algorithm modes that help to achieve better results for the supported fingerprint scanners.



Contents of VeriFinger 6.3 Standard SDK and Extended SDK

VeriFinger SDK is based on VeriFinger fingerprint recognition technology and is intended for biometric systems developers and integrators. The SDK allows rapid development of biometric applications using functionality from the VeriFinger algorithm for Microsoft Windows, Linux and Mac OS X. VeriFinger can be easily integrated into the customer's security system. The integrator has complete control over SDK data input and output.

The following VeriFinger 6.3 SDKs are available:

- **VeriFinger 6.3 Standard SDK** is intended for PC-based biometric application development. It includes Fingerprint Matcher and Extractor component licenses, programming samples and tutorials, fingerprint scanner support modules and software documentation. The SDK allows the development of biometric applications for Microsoft Windows, Linux or Mac OS X operating systems.
- **VeriFinger 6.3 Extended SDK** is intended for biometric **Web-based** and network application development. It contains all features and components of the Standard SDK. Additionally, the SDK includes Fingerprint Client component licenses, sample client applications, tutorials and a **ready-to-use matching server** component.

The table below compares VeriFinger 6.3 Standard SDK and VeriFinger 6.3 Extended SDK.

	VeriFinger 6.3 Standard SDK	VeriFinger 6.3 Standard SDK
Component licenses that are included with a specific SDK		
• Fingerprint Extractor	1 license	1 license
• Fingerprint Client		3 licenses and 1 concurrent license
• Fingerprint Matcher	1 license	1 license
• Matching Server		+
Additional component licenses that can be purchased by specific SDK customers		
• Fingerprint Extractor	+	+
• Fingerprint Segmenter		+
• Fingerprint BSS		+
• Fingerprint WSQ		+
• Fingerprint Client		+
• Fingerprint Matcher	+	+

VeriFinger 6.3 SDK includes programming samples and tutorials that show how to use the components of the SDK to perform fingerprint template extraction or matching against other templates. The samples and tutorials are available for these programming languages and platforms:

	Microsoft Windows 32 & 64 bit	Linux 32 & 64 bit	Mac OS X
Programming samples			
• C/C++	+	+	+
• C#	+		
• Sun Java 2	+		
• Visual Basic .NET	+		
• Delphi	+		
Programming tutorials			
• C	+	+	+
• C#	+		
• Visual Basic .NET	+		
• Delphi	+		



Biometric Components Description

Fingerprint Extractor

Fingerprint Extractor creates fingerprint templates from fingerprint images. Image quality control can be applied to accept only good quality fingerprint images.

The Fingerprint Extractor can generalize a fingerprint template from several fingerprint images to improve the template's quality.

See "technical specifications" section for the template extraction speed, the size of fingerprint template and the requirements for fingerprint image size and resolution.

One Fingerprint Extractor license is included with VeriFinger 6.3 Standard SDK and VeriFinger 6.3 Extended SDK. More licenses for this component can be purchased any time by VeriFinger 6.3 SDK customers.

Fingerprint Segmenter

The Fingerprint Segmenter components separates fingerprints if an image contains more than one fingerprint. This component enables Fingerprint Extractor component to process fingerprints from scanned **tenprint** card or image captured using scanners that allow to scan two or more fingers at once.

The component can be used from **C/C++** and **C#** applications on all supported platforms. **.NET wrappers** of Windows libraries are provided for .NET developers.

The Fingerprint Segmenter licenses can be purchased anytime by VeriFinger 6.3 Extended SDK customers.

Fingerprint WSQ

The Fingerprint WSQ component allows to integrate support for WSQ (Wavelet Scalar Quantization) image format. The WSQ format allows to compress a fingerprint image up to 10-15 times. WSQ compression process is "lossy", meaning that the reconstructed image is not equal to the original (some information is lost). However, the WSQ algorithm was specially designed to minimize the loss of fingerprint information therefore the reconstructed image is as close as possible to the original.

The component can be used from **C/C++** and **C#** applications on all supported platforms. **.NET** wrappers of Windows libraries are provided for .NET developers.

Licenses for the Fingerprint WSQ component can be purchased anytime by VeriFinger 6.3 Extended SDK and MegaMatcher 4.0 SDK customers.



Fingerprint BSS (Biometric Standards Support)

The Fingerprint BSS component allows to integrate support for fingerprint template and image format standards and additional image formats with new or existing biometric systems based on VeriFinger SDK.

These biometric standards are supported:

- **BioAPI 2.0 (ISO/IEC 19784-1:2006)** (Framework and Biometric Service Provider for fingerprint identification engine)
- **ISO/IEC 19794-2:2005** (Fingerprint Minutiae Data)
- **ISO/IEC 19794-4:2005** (Finger Image Data)
- **ANSI/INCITS 378-2004** (Finger Minutiae Format for Data Interchange)
- **ANSI/INCITS 381-2004** (Finger Image-Based Data Interchange Format)
- **ANSI/NIST-CSL 1-1993** (Data Format for the Interchange of Fingerprint, Facial, & SMT Information)
- **ANSI/NIST-ITL 1a-1997** (Data Format for the Interchange of Fingerprint, Facial, & SMT Information)
- **ANSI/NIST-ITL 1-2000** (Data Format for the Interchange of Fingerprint, Facial, & SMT Information)
- **ANSI/NIST-ITL 1-2007** (Data Format for the Interchange of Fingerprint, Facial, & Other Biometric Information)
- **ANSI/NIST-ITL 1a-2009** (Data Format for the Interchange of Fingerprint, Facial, & Other Biometric Information)

The Fingerprint BSS component allows conversion between Neurotechnology proprietary fingerprint templates, ISO/IEC 19794-2:2005, ANSI/INCITS 378-2004 and ANSI/NIST-ITL templates.

Fingerprint pattern classification module that allows to determine a fingerprint pattern class is included with Fingerprint BSS module. The classification is usually used in forensics, but also it can be used to increase fingerprint matching speed. The defined classes are:

- Left Slant Loop;
- Right Slant Loop;
- Tented Arch;
- Whorl;
- Scar;
- "Unknown" – for the nondetermined classes.

The Fingerprint BSS component also includes:

- JPEG 2000 image format support module with 1000 dpi Fingerprint Profile;
- NIST IHead image format support module;
- module with NIST Fingerprint Image Quality (NFIQ) algorithm, a standard method to determine fingerprint image quality.

Latent Fingerprint Editor is available with Fingerprint BSS component. In most cases automated image processing is unable to extract all minutiae or extracts a lot of false minutiae from latent fingerprint image (for example, taken from the crime scene). Therefore, an expert should manually edit a fingerprint template in order to submit it to an AFIS for the identification.

Sample latent fingerprint template editor (.NET) shows how to change minutia's coordinates, direction, type and other parameters.

The Fingerprint BSS component can be used from **C/C++** and **C#** applications on all supported platforms. **.NET** wrappers of Windows libraries are provided for .NET developers.

Licenses for the Fingerprint BSS component can be purchased anytime by VeriFinger 6.3 Extended SDK customers.



Fingerprint Client

The Fingerprint Client component is a combination of the **Fingerprint Extractor**, **Fingerprint BSS**, **Fingerprint Segmenter** and **Fingerprint WSQ** components. It is intended for the systems that need to support most or all functionality of the mentioned components on the same PC. Using these licenses allows to optimize component license costs as well as reduce license management.

Three non-concurrent licenses and one concurrent license for the Fingerprint Client component are included with VeriFinger 6.3 Extended SDK. More non-concurrent and concurrent licenses for this component can be purchased any time by VeriFinger 6.3 Extended SDK customers.

Fingerprint Matcher

The Fingerprint Matcher performs fingerprint template matching in 1-to-1 (verification) and 1-to-many (identification) modes. Also the Fingerprint Matcher component includes fused matching algorithm that allows to increase template matching reliability by:

- matching templates that contain 2 or more fingerprint records (note that Fingerprint Segmenter or Fingerprint Client components are required to perform template extraction from images that contain more than one fingerprint);
- matching templates that contain fingerprint, face and/or iris records (note that matching faces and irises requires to purchase Face Matcher and Iris Matcher components correspondingly - these components are available in *VeriLook 5.0 SDK* and *VeriEye 2.3 SDK* respectively; see these products brochures for more information);

“Technical specifications” and “reliability and performance tests” sections below contain information about the template matching speeds and recognition quality in different scenarios.

One Fingerprint Matcher license is included with VeriFinger 6.3 Standard SDK and VeriFinger 6.3 Extended SDK. More licenses for this component can be purchased any time by VeriFinger 6.3 SDK customers.



Matching Server

The Matching Server is ready-to-use software intended for building moderate size web-based and other network-based systems like local AFIS or multi-biometric identification system. The Server software runs on a server PC and allows to perform the biometric template matching on server side using Fingerprint Matcher component.

Fused multi-biometric matching can be enabled by running components for fingerprint, face and iris matching on the same machine.

Client communication module that allows sending a task to the Matching Server, querying status of the task, getting the results and removing the task from server, is included with MegaMatcher 4.0 SDK, VeriFinger 6.3 SDK, VeriLook 5.0 SDK and VeriEye 2.3 SDK. This module hides all low level communications and provides high-level API for the developer.

Source code of **sample web server software** is included with the Matching Server. The web server software accepts biometric templates from a web client application, sends them to Matching Server for matching and returns matching results to the client application. The web server is stand-alone and does not require any third-party web server software (like Apache or Microsoft IIS).

The components and database support modules with source codes included for Matching Server component are listed in the table below. Custom modules for working with other databases can also be developed by integrator and used with the Matching Server software.

The table below shows what components are available with Matching Server software.

Components	Microsoft Windows 32 & 64 bit	Linux 32 & 64 bit	Mac OS X
• Matching server software	+	+	+
• Server administration tool API	+	+	
• Source code of sample web server software	+		
Database support modules			
• Microsoft SQL Server	+		
• PostgreSQL	+	+	
• MySQL	+	+	
• Oracle	+	+	
• SQLite	+	+	+
Programming samples			
• C# client	+		
• Sun Java 2 web client	+		
Programming tutorials			
• C/C++	+	+	
• C#	+		

The Matching Server component requires a special one-time license that allows to run the component on all machines that run the fingerprint, face, iris or palm print matching components obtained by an integrator. The Matching Server software is included with VeriFinger 6.3 Extended SDK.

Also the Matching Server component is included with these Neurotechnology SDKs (see their brochures for more info):

- MegaMatcher 4.0 Standard or MegaMatcher 4.0 Extended SDK;
- VeriLook 5.0 Extended SDK;
- VeriEye 2.3 Extended SDK.



Supported fingerprint scanners under Microsoft Windows

List of scanners supported by VeriFinger SDK under Linux and Mac OS X is available on the next page.

	Windows XP		Windows Vista		Windows 7	
	32 bit	64 bit	32 bit	64 bit	32 bit	64 bit
• ARH AFS 510	+		+	+	+	+
• Atmel FingerChip	+					
• Athena ASEDive IIIe Combo Bio F2	+	+	+	+		
• AuthenTec AF-S2 / AES4000 / AES2501B	+					
• BioLink U-Match MatchBook v.3.5	+		+			
• Biometri-CS CS-Pass	+					
• Biometrika Fx2000 / Fx3000	+		+			
• Biometrika HiScan	+					
• Cross Match L SCAN Guardian / Verifier 300 / 310 / 320	+	+	+	+	+	+
• Dakty Naos-1	+					
• Dermalog ZF1	+					
• Digent FD1000	+					
• DigitalPersona U.are.U 2000	+		+			
• DigitalPersona U.are.U 4000 / 4500	+	+	+	+	+	+
• Fujitsu MBF200	+					
• Futronic FS50 / FS80 / FS82 / FS88 / FS90 / eFAM (FS84)	+	+	+	+	+	+
• Futronic FS60	+		+		+	
• Green Bit DactyScan 26	+		+			
• Hongda S500 / S680 / S700	+		+			
• id3 Certis Image	+					
• Identix DFR 2080 and DFR 2090	+					
• Identix DFR 2100	+		+			
• Intech SOP1	+					
• Integrated Biometrics LES650	+	+	+	+	+	+
• Jstac Athena 210	+					
• Lumidigm Mercury / Venus Series sensors	+	+	+	+	+	+
• NITGEN Fingkey Hamster / Fingkey Hamster II / Fingkey Mouse III / eNBioScan-F	+	+	+	+	+	+
• SecuGen Hamster III / Hamster Plus / Hamster IV / iD-USB SC / iD-USB SC/PIV	+	+	+	+	+	+
• Startek FM200	+		+			
• Suprema BioMini	+		+		+	
• Suprema RealScan-10 / RealScan-D / RealScan-S / SFR300-S / SFU300	+					
• Tacoma CMOS	+		+			
• Testech Bio-i	+		+			
• TST Biometrics BiRD 3	+		+			
• UPEK Eikon / Eikon To Go / EikonTouch 300 / 700 / TouchChip TCRU1C / TCRU2C	+		+		+	
• VistaMT Multimodal Biometric Device ⁽¹⁾	+	+	+	+	+	+
• ZKSoftware ZK6000	+		+			
• Zvetco Verifi P4000	+					
• Zvetco Verifi P5000	+				+	

(1) The list of supported OS is given only for fingerprint scanner part of the device; the device is also able to capture faces and irises.



Supported fingerprint scanners under Linux and Mac OS X

List of scanners supported by VeriFinger SDK under Microsoft Windows is available on the previous page.

	Linux		Mac OS X	
	32 bit	64 bit	x86	PowerPC
• AuthenTec AF-S2 / AES4000	+	+	+	+
• BioLink U-Match MatchBook v.3.5	+			
• Biometri-CS CS-Pass	+	+	+	+
• Biometrika Fx2000 / Fx3000 / HiScan	+			
• Fujitsu MBF200	+	+	+	+
• Futronic eFAM (FS84)	+	+	+	+
• Futronic FS50 / FS80 / FS82 / FS88 / FS90	+		+	
• Lumidigm Mercury / Venus series sensors	+			
• NITGEN eNBioScan-F	+			
• SecuGen Hamster III	+			
• Startek FM200	+	+	+	+
• Suprema BioMini	+			
• Tacoma CMOS	+	+	+	+
• Zvetco Verifi P4000	+	+	+	+



System requirements

- **PC with x86 (32bit) or x86-64 (64bit) compatible processors or Mac with x86 or PowerPC compatible processors.** 2GHz or better processor is recommended.
- **At least 128 MB of free RAM** should be available for the application. Additional RAM is required for applications that perform 1-to-many identification, as all biometric templates need to be stored in RAM for matching. For example, **25,000 templates** (each with 2 fingerprints inside) require about **50 MB of additional RAM**.
- **Free space on hard disk drive (HDD):**
 - at least 1 GB required for the development.
 - 100 MB required for VeriFinger components deployment.
 - Additional space would be required in these cases:
 - VeriFinger does not require the original fingerprint image to be stored for the matching; only the templates need to be stored. However, storing fingerprint images on hard drive for the potential future usage is recommended.
 - Usually a database engine runs on a separate computer (back-end server). However, DB engine can be installed on the same computer for standalone applications. In this case HDD space for templates storage must be available. For example, 25,000 templates (each with 2 fingerprints inside) stored using a relational database would require about 60 MB of free HDD space. Also, the database engine itself requires HDD space for running. Please refer to HDD space requirements from the database engine providers.
- **Fingerprint scanner.** VeriFinger SDK includes support modules for more than 70 fingerprint scanners under different platforms (see previous section for the list of supported scanners).
- **Database engine** or connection with it. VeriFinger templates can be saved into any DB (including files) supporting binary data saving. VeriFinger Extended SDK contains the following support modules for Matching Server:
 - Microsoft SQL Server (only for Microsoft Windows platform);
 - PostgreSQL (for Microsoft Windows and Linux platforms);
 - MySQL (for Microsoft Windows and Linux platforms);
 - Oracle (for Microsoft Windows and Linux platforms);
 - SQLite (for all platforms).
- **Network/LAN connection (TCP/IP)** for client/server applications. Also, network connection is required for using Matching Server component (included in VeriFinger Extended SDK). Communication with Matching Server is not encrypted therefore, if communication must be secured, a dedicated network (not accessible outside the system) or a secured network (such as VPN; VPN must be configured using operating system or third party tools) is recommended.



- **Microsoft Windows specific requirements:**

- Microsoft Windows 2000/XP/2003/2008/Vista/7, 32-bit or 64-bit. 32-bit platform is recommended for applications with fingerprint scanners, as most scanners have only 32-bit support modules.
- Microsoft .NET framework 2.0 or newer (for .NET components usage).
- One of following development environments for application development:
 - Microsoft Visual Studio 2005 SP1 or newer (for development under C/C++, C#, Visual Basic .Net);
 - Sun Java 1.5 SDK or later;
 - Microsoft Visual Basic 6;
 - Delphi 7.

- **Linux specific requirements:**

- Linux 2.6 or newer kernel, 32-bit or 64-bit. 32-bit platform are recommended for applications with fingerprint scanners, as most scanners have only 32-bit support modules.
- glibc 2.3.6 or newer.
- GTK+ 2.10.x or newer libs and dev packages (to run SDK samples and applications based on them).
- GCC-4.0.x or newer (for application development).
- GNU Make 3.81 or newer (for application development).
- Sun Java 1.5 SDK or later (for application development with Java).
- pkg-config-0.21 or newer (optional; only for Matching Server database support modules compilation).

- **Mac OS X specific requirements:**

- Mac OS X (version 10.4 or newer).
- XCode 2.4 or newer (for application development).



Technical Specifications

All specifications are given for Intel Core2 processor with 4 cores running at 2.66 GHz.

500 dpi is the recommended fingerprint image resolution for VeriFinger. The minimal fingerprint image resolution is 250 dpi.

All fingerprint templates should be loaded into RAM before identification, thus the maximum fingerprint templates database size is limited by the amount of available RAM.

The table below shows the technical specifications of VeriFinger 6.3 algorithm. The algorithm's performance depends on fingerprint scanner that was used for collecting fingerprint images, thus the specifications are given for two groups of flat fingerprint scanners:

- **Biometric scanners** in these specifications are scanners that produce fingerprint images of about **300 x 300 pixels**. These scanners are usually compact and inexpensive. An example of biometric scanner is DigitalPersona U.are.U 4000.
- **AFIS-class scanners** in these specifications are flat fingerprint scanners that have at least 1" x 1" fingerprint sensors and produce fingerprint images of at least **500 x 500 pixels** or even larger images. These scanners are mostly intended for use in large-scale AFIS projects that need to collect high quality fingerprint images. An example of AFIS-class scanner is Cross Match Verifier 300

VeriFinger fingerprint template matching algorithm can use more than one processor core on **multi-core processors**.

VeriFinger 6.3 algorithm technical specifications for biometric scanners

	Maximized matching accuracy	Maximized matching speed	Minimized template size
Template extraction time (seconds)	0.10 - 0.17		
Matching speed using 1 core (fingerprints per second)	5000 - 8000	9000 - 14000	7000 - 11000
Matching speed using 4 cores (fingerprints per second)	20000 - 32000	36000 - 56000	28000 - 44000
Matching speed with database pre-sorting ⁽¹⁾ using 1 core (fingerprints per second)	25000 - 40000	45000 - 70000	40000 - 60000
Template size (bytes)	3000 - 5000	500 - 800	200 - 300

VeriFinger 6.3 algorithm technical specifications for AFIS-class scanners

	Maximized matching accuracy	Maximized matching speed	Minimized template size
Template extraction time (seconds)	0.17 - 0.21		
Matching speed using 1 core (fingerprints per second)	3000 - 4000	5000 - 7000	4000 - 5500
Matching speed using 4 cores (fingerprints per second)	12000 - 16000	20000 - 28000	16000 - 22000
Matching speed with database pre-sorting ⁽¹⁾ using 1 core (fingerprints per second)	15000 - 20000	25000 - 35000	20000 - 28000
Template size (bytes)	4500 - 6000	700 - 1000	250 - 400

¹ For databases with 500 or more fingerprints. Use with smaller sample fingerprint databases typically yields lower speed.



Reliability and Performance Tests Results

All tests were performed on Intel Core2 processor with 4 cores running at 2.66 GHz.

We present the testing results to show how VeriFinger 6.3 technical specifications correspond the practical algorithm's performance and reliability evaluations.

Flat fingerprint databases were collected with two fingerprint scanners for algorithm testing:

- DigitalPersona U.are.U 4000. 1,400 fingerprint images were collected using this scanner, with image size 318 x 330 pixels.
- Cross Match Verifier 300 LC. 1,600 fingerprint images were collected using this scanner, with image size 504 x 480 pixels.

Three tests were performed with each database:

- **Test 1** maximized **matching accuracy**. VeriFinger 6.3 algorithm reliability in this test is shown as **red curves** on the ROC charts.
- **Test 2** maximized **matching speed**. VeriFinger 6.3 algorithm reliability in this test is shown as **green curves** on the ROC charts.
- **Test 3** minimized **template size**. VeriFinger 6.3 algorithm reliability in this test is shown as **blue curves** on the ROC charts.

Template matching was performed using **all 4 cores** of the processor.

Receiver operation characteristics (ROC) curves are usually used to demonstrate the recognition quality of an algorithm. ROC curves show the dependence of false rejection rate (FRR) on the false acceptance rate (FAR).

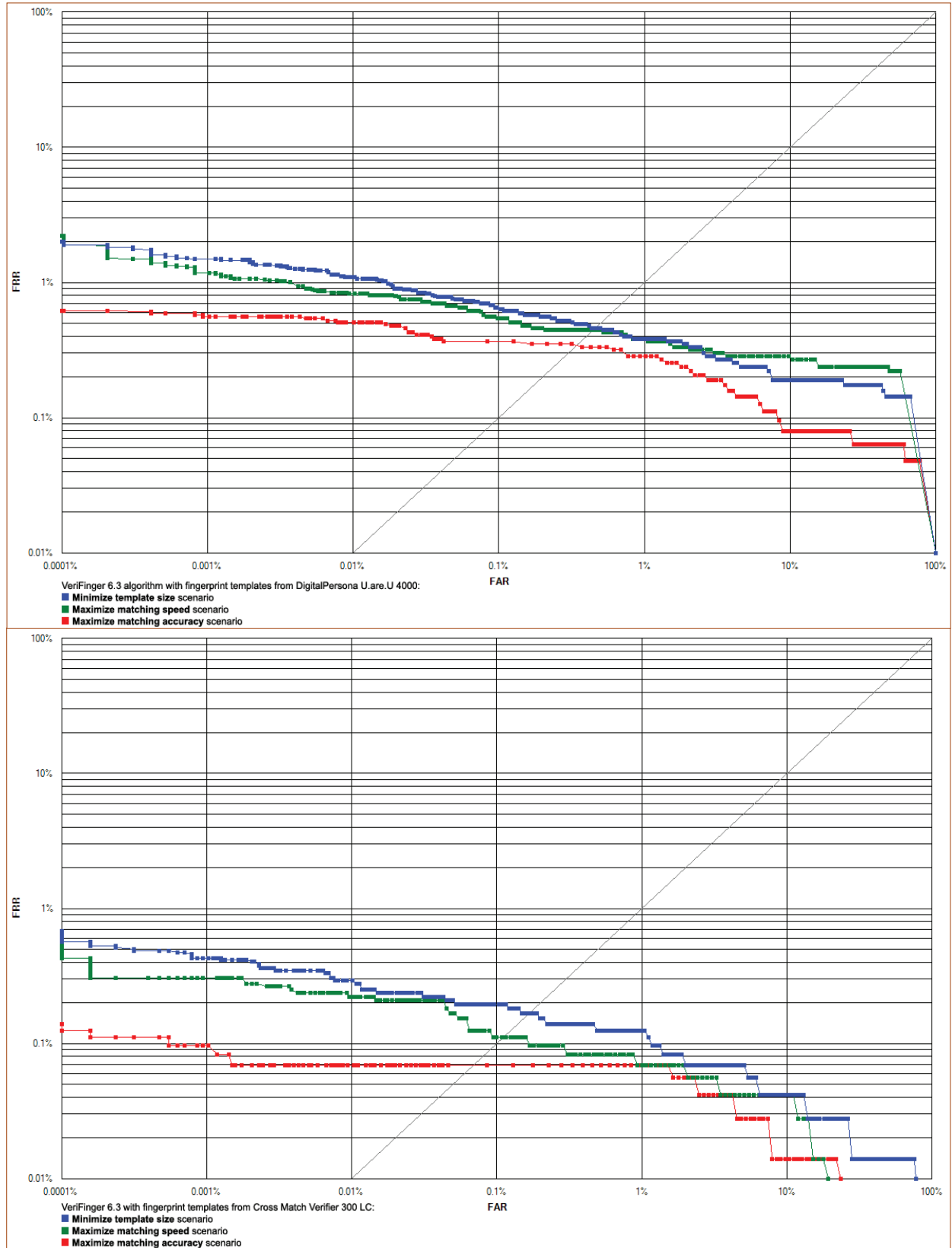
VeriFinger 6.3 algorithm tests with DigitalPersona U.are.U 4000

	Test 1	Test 2	Test 3
Average fingerprint template size (bytes)	3865	631	238
Average template extraction speed (milliseconds)	150		
Template matching speed (fingerprints per second)	32672	51884	44032
FRR at 0.001% FAR	0.56 %	1.18 %	1.49 %

VeriFinger 6.3 algorithm tests with Cross Match Verifier 300 LC

	Test 1	Test 2	Test 3
Average fingerprint template size (bytes)	5436	891	327
Average template extraction speed (milliseconds)	186		
Template matching speed (fingerprints per second)	15616	25604	22004
FRR at 0.001% FAR	0.10 %	0.31 %	0.43 %

VeriFinger fingerprint identification algorithm versions consistently have shown some of the best results for reliability in several biometric competitions, including the International Fingerprint Verification Competition (FVC2006, FVC2004, FVC2002 and FVC2000) and the National Institute of Standards & Technology (NIST) Fingerprint Vendor Technology Evaluation (FpVTE 2003), where Neurotechnology ranked among the top five companies for accuracy in single-finger tests.





VeriFinger Demo, Trial SDK and Related Products

VeriFinger **algorithm demo** application and VeriFinger **30-day SDK Trial** are available for downloading at www.neurotechnology.com/download.html.

These products are related to VeriFinger SDK:

- **MegaMatcher SDK** – intended for development of AFIS or multi-biometric fingerprint, face, iris and palm print identification products. See “MegaMatcher SDK” brochure for more information.
- **MegaMatcher Accelerator 3.0** – a solution for building the server-side part of a large-scale AFIS; available in Standard and Extended versions; a single MegaMatcher Accelerator Standard matches 30 million fingerprints per second and Extended matches 100 million fingerprints per second.
- **MegaMatcher On Card SDK** – a product for fingerprint and face matching on smart cards. See “MegaMatcher On Card SDK” brochure for more information.
- **Free Fingerprint Verification SDK** – a **freeware** SDK intended for adding fingerprint verification functionality into various applications. See our web site for more information.
- **FingerCell EDK** – intended for development of embedded and mobile fingerprint identification systems. See “FingerCell EDK” brochure for more information.



Licensing VeriFinger SDK

To **develop** a product based on VeriFinger 6.3 technology, an integrator should obtain VeriFinger 6.3 Standard SDK (EUR 339) or VeriFinger 6.3 Extended SDK (EUR 859).

Integrators can develop only an **end-user** product using VeriFinger SDK and sell/install the product to their own customers. If an integrator wants to develop and sell a VeriFinger based development tool (with custom API, programming possibilities, samples, etc.), he/she will need to become a value-added reseller (VAR).

To **deploy** the product that was developed with VeriFinger 6.3 SDK, the integrator should obtain only additional VeriFinger 6.3 component licenses for product installations. Also the additional VeriFinger 6.3 component licenses may be required during development of the product. The additional VeriFinger 6.3 component licenses can be obtained by VeriFinger 6.3 SDK customers at any time.

The table below lists the components of VeriFinger 6.3 SDK and shows the availability of the additional component licenses for the customers of VeriFinger 6.3 Standard SDK and VeriFinger 6.3 Extended SDK:

	VeriFinger 6.3 Standard SDK	VeriFinger 6.3 Extended SDK
• Fingerprint Extractor	+	+
• Fingerprint Segmenter		+
• Fingerprint BSS		+
• Fingerprint WSQ		+
• Fingerprint Client		+
• Fingerprint Matcher	+	+

A license for a VeriFinger component is required for **each PC** or **each server CPU** that runs this component. The following license types are available:

- Single computer license.
- Concurrent network license.
- Enterprise license.

VeriFinger 6.3 Standard SDK includes:

- 1 Fingerprint Extractor license.
- 1 Fingerprint Matcher license.

VeriFinger 6.3 Extended SDK includes:

- 1 Fingerprint Extractor license.
- 3 Fingerprint Client licenses.
- 1 Fingerprint Client concurrent license.
- 1 Fingerprint Matcher license.
- Matching Server license.

Please also refer to *MegaMacher 4.0*, *VeriFinger 6.3*, *VeriLook 5.0*, *VeriEye 2.3 SDK License Agreement* on Neurotechnology web site for all licensing terms and conditions.



Single computer license

A single computer license allows to install and run a VeriFinger 6.3 component installation on a single Personal Computer or on one Server CPU. The component license will not be lost if computer will be reinstalled.

The following license management options are available:

- license activation online by communicating with Neurotechnology's server;
- license activation by email;
- license activation using volume license manager;
- license management using volume license manager on LAN or Internet.

Single computer license activated over Internet or by email is not suitable for virtual environments. Volume license manager used as a dongle or license management over network would be required.

Concurrent network licenses

Fingerprint Client concurrent license allows to install Fingerprint Client component on an unlimited number of computers. An application should obtain Fingerprint Client license only to start capturing from scanner process and to perform template creation (extraction). The license is not required during capturing process and can be released just after the capturing was started; therefore license usage time does not depend on user actions. Template creation takes 0.1-0.2 seconds and after this time license can be released to be available for another user. Even one Fingerprint Client concurrent license can be shared among hundreds of users.

This type of licensing is especially **useful for web-based** software.

The allowed number of simultaneously running Fingerprint Client component instances is limited by the number of obtained concurrent licenses. Additional licenses can be obtained at any time.

The following license management options are available:

- License management by storing a file with a concurrent license on one PC connected to LAN or Internet. The file with the concurrent license is send by email after purchasing the license.
- License management using volume license manager on LAN or Internet.

VeriFinger 6.3 enterprise license

VeriFinger enterprise license allows an **unlimited use** of VeriFinger components in the end-user products in the certain territory, market segment or project. These limitations would be included in the licensing agreement.

The enterprise license price depends on the application size and the number of potential application's users within the designated territory, market segment or project. VeriFinger enterprise licenses are provided only for big projects, with price range starting at **EUR 20,000**.

VeriFinger algorithm **source code** may be included with a special source code licensing agreement for the selected customers, who are going to obtain VeriFinger enterprise license for at least EUR 100,000 or more.

For more information please contact us.



Volume license manager

Volume license manager is **used on site by integrators or end users** to manage obtained licenses for VeriFinger 6.3 components. It consists of license management software and a dongle, which are used to store the number of obtained licenses. An integrator or an end-user can use the volume license manager in the following ways:

- **Activating the single computer licenses.** An installation license for a VeriFinger 6.3 component will be activated for using on a particular computer. The license quantity for the VeriFinger component in the license manager will be decreased by the amount of activated licenses.
- **Managing the single computer or concurrent licenses on LAN or Internet.** The license manager allows to manage installation licenses for VeriFinger components across the computers on LAN or Internet. The number of managed licenses for a VeriFinger component is limited by the number of licenses in the license manager. No license activation is needed and the license quantity is not decreased. Once issued, the license is assigned to certain computer on the network.
- **Using a license manager as a dongle.** The volume license manager containing at least one license for a VeriFinger 6.3 component can be used as a dongle that allows to run VeriFinger 6.3 component installation on a particular computer.

Additional VeriFinger 6.3 component installation licenses for the license manager can be purchased anytime. Neurotechnology will generate a special update file and send it to you. Then you will just have to enter the file to the license manager to add these purchased licenses.



Prices for VeriFinger products

- These prices are **effective from January 10, 2011**. The prices may change in the future, so please **download and review the latest version** of the brochure before making an order.
- Quantity discounts do not accumulate over time.
- The prices do not include any local import duties or taxes.
- Product shipping cost depends on delivery country
- Our customers can gain a discount for our products by getting the Solution Partner status.

VeriFinger 6.3 SDK

VeriFinger 6.3 Standard SDK	€ 339.00
VeriFinger 6.3 Extended SDK	€ 859.00

Fingerprint Client concurrent licenses

Price per license	€ 590.00
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Fingerprint Components (prices per single computer license)

Quantity	Fingerprint Extractor	Fingerprint Client ⁽¹⁾	Fingerprint Matcher
1-9	€ 20.00	€ 35.00	€ 25.00
10-19	€ 15.00	€ 26.00	€ 18.00
20-49	€ 13.00	€ 23.00	€ 16.00
50-99	€ 11.00	€ 20.00	€ 14.00
100-199	€ 10.00	€ 18.00	€ 12.50
200-499	€ 9.00	€ 16.00	€ 11.00
500-999	€ 8.00	€ 14.00	€ 10.00
1000-1999	€ 7.00	€ 12.00	€ 9.00
2000-3999	€ 6.40	€ 11.00	€ 8.00
4000-7999	€ 5.80	€ 10.00	€ 7.00
8000 and more	Please contact us for more information		

⁽¹⁾ Fingerprint Client component is not available for VeriFinger Standard SDK customers.

License management

Volume license manager	€ 16.00
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VeriFinger 6.3 enterprise license

VeriFinger 6.3 enterprise license	Please contact us for more information
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VeriFinger products can be ordered:

- online, at www.neurotechnology.com/cgi-bin/order.cgi
- via a local Neurotechnology distributor; the list of distributors is available at www.neurotechnology.com/distributors.html