



NEUROtechnology



Speaker
recognition for
stand-alone or
client-server
applications

VeriSpeak SDK



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Speaker recognition for stand-alone or client-server applications

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VeriSpeak voice identification technology is designed for biometric system developers and integrators. The speaker recognition algorithm assures system security by checking both voice and phrase authenticity. Voiceprint templates can be matched in 1-to-1 (verification) and 1-to-many (identification) modes.

VeriSpeak is available as a software development kit that enables the development of stand-alone and network-based applications on Microsoft Windows, Linux, macOS, iOS and Android platforms.

- Text-dependent algorithm prevents unauthorized access with a covertly-recorded user voice.
- Two-factor authentication by checking voice biometrics and pass-phrase authenticity.
- Regular microphones and smartphones are suitable for recording user voices.
- Available as multiplatform SDK that supports multiple programming languages.
- Reasonable prices, flexible licensing and free customer support.



VeriSpeak Algorithm Features and Capabilities

Neurotechnology's VeriSpeak is a **speaker recognition algorithm** designed for biometric system integrators. The VeriSpeak algorithm implements voice enrollment and voiceprint matching using proprietary sound processing technologies:

- **Text-dependent algorithm.** The text-dependent speaker recognition is based on saying the **same phrase for enrollment and verification**. The VeriSpeak algorithm determines if a voice sample matches the template that was extracted from a specific phrase. During enrollment, one or more phrases are requested from the person being enrolled. Later that person may be asked to pronounce a specific phrase for verification. This method assures protection against the use of a covertly recorded random phrase from that person.
- **Two-factor authentication with a passphrase.** The VeriSpeak voiceprint matching algorithm can be configured to work in a scenario where each user records a **unique phrase** (such as passphrase or an answer to a "secret question" that is **known only by the person** being enrolled). Later a person is recognized by his or her own specific phrase with a high degree of accuracy. The overall system security increases as both voice authenticity and passphrase are checked.
- **Text-independent algorithm.** The phrase-independent speaker recognition uses different phrases for user enrollment and recognition. This method is more convenient, as it does not require each user to remember the passphrase. It may be combined with the text-dependent algorithm to perform faster text-independent search with further phrase verification using the more reliable text-dependent algorithm.
- **Automatic voice activity detection.** VeriSpeak is able to detect when users start and finish speaking.
- **Liveness detection.** A system may request each user to enroll a set of unique phrases. Later the user will be requested to say a specific phrase from the enrolled set. This way the system can ensure that a live person is being verified (as opposed to an impostor who uses a voice recording).
- **Identification capability.** VeriSpeak functions can be used in 1-to-1 matching (verification) and **1-to-many** (identification) modes.
- **Multiple samples of the same phrase.** A template may store several voice records with the same phrase to improve recognition reliability. Certain natural voice variations (i.e. hoarse voice) or environment changes (i.e. office and outdoors) can be stored in the same template.
- **Fused matching.** A system may ask users to pronounce several specific phrases during speaker verification or identification and match each audio sample against records in the database. The VeriSpeak algorithm can fuse the matching results for each phrase together to improve matching reliability.



Contents of VeriSpeak Standard SDK and Extended SDK

VeriSpeak SDK is based on VeriSpeak voice recognition technology and is designed for biometric systems developers and integrators. The SDK allows rapid development of biometric applications using functions from the VeriSpeak algorithm. VeriSpeak can be easily integrated into the customer’s security system. The integrator has complete control over SDK data input and output.

VeriSpeak is available as the following SDKs:

- **VeriSpeak Standard SDK** is designed for PC-based, embedded or mobile biometric application development. It includes Voice Matcher and Extractor component licenses, programming samples and tutorials and software documentation. The SDK enables the development of biometric applications for Microsoft Windows, Linux, macOS, Android and iOS operating systems.
- **VeriSpeak Extended SDK** is designed for biometric **client-server** application development. It includes all features and components of the Standard SDK with the addition of Voice Client component licenses for PCs and Android devices, sample client applications, tutorials and a **ready-to-use matching server** component.

The table below compares VeriSpeak 13.1 Standard SDK and VeriSpeak 13.1 Extended SDK. See the licensing model for more information on specific license types.

Component licenses that are included with a specific SDK		
	VeriSpeak 13.1 Standard SDK	VeriSpeak 13.1 Extended SDK
• Voice Matcher	1 single computer license	1 single computer license
• Mobile Voice Matcher	1 single computer license	1 single computer license
• Voice Client		3 single computer licenses
• Mobile Voice Client		3 single computer licenses
• Voice Extractor	1 single computer license	1 single computer license
• Mobile Voice Extractor	1 single computer license	1 single computer license
• Matching Server		+

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

	Windows	Linux	macOS	iOS	Android
Programming samples					
• C/C++	+	+	+		
• Objective-C				+	
• C#	+				
• Java	+	+	+		+
• Visual Basic .NET	+				
Programming tutorials					
• C	+	+	+		
• C#	+				
• Visual Basic .NET	+				
• Java	+	+	+		+





Biometric Components Description

Voice Matcher

The Voice Matcher performs voice template matching in 1-to-1 (verification) and 1-to-many (identification) modes. Also the Voice Matcher component includes fused matching algorithm that allows to increase template matching reliability by matching templates that contain fingerprint, face, voice and/or iris records (note that matching fingerprints, irises and faces requires to purchase Fingerprint Matcher, Iris Matcher and Face Matcher components correspondingly).

The Voice Matcher component matches **8,000 voiceprints per second** and is designed to be used in **desktop** or mobile biometric systems, which run on PCs or laptops with at least Intel **Core i7-8xxx** family processor.

One Voice Matcher license is included with VeriSpeak 13.1 Standard SDK and VeriSpeak 13.1 Extended SDK. The license can be used on Microsoft Windows, Linux x86-64 or macOS platform. More licenses for this component can be purchased any time by VeriSpeak 13.1 SDK customers.

Mobile Voice Matcher

The Mobile Voice Matcher has the same functionality, as the Voice Matcher. It matches **100 voiceprints per second** and is designed to be used in **embedded** or **mobile** biometric systems, which run on **Android** or **iOS** or ARM Linux devices. The Android devices should be based on at least **Snapdragon S4** system-on-chip (**Krait 300** processor with 4 cores running at 1.51 GHz).

One Mobile Voice Matcher license is included with VeriSpeak 13.1 Standard SDK and VeriSpeak 13.1 Extended SDK. The license can be used on Android, iOS or ARM Linux platform. More licenses for this component can be purchased any time by VeriSpeak 13.1 SDK customers.

Voice Client

The Voice Client component currently has the same functionality as Voice Extractor component. It is intended for using on PC- and Mac-based clients of network-based biometric systems.

The Voice Client extracts a single voiceprint template in **0.6 seconds**. The specified performance requires a **PC** or **laptop** with at least Intel **Core i7-8xxx** family processor.

Three licenses for the Voice Client component are included with VeriSpeak 13.1 Extended SDK. The licenses can be used on Microsoft Windows, Linux x86-64 or macOS platform. More licenses for this component can be purchased any time by VeriSpeak 13.1 Extended SDK customers.

Mobile Voice Client

The Mobile Voice Client component currently has the same functionality as Mobile Voice Extractor component. It is intended for using with Android or iOS or ARM Linux based devices on client-side of network-based biometric systems.

The component is designed to run on **Android** or **iOS** or ARM Linux devices. The Android devices should be based on at least **Snapdragon S4** system-on-chip (**Krait 300** processor with 4 cores running at 1.51 GHz).

Three licenses for the Mobile Voice Client component are included with VeriSpeak 13.1 Extended SDK. The licenses can be used on Android, iOS or ARM Linux platform. More licenses for this component can be purchased any time by VeriSpeak 13.1 Extended SDK customers.



Voice Extractor

Voice Extractor creates voice templates from audio samples on PC and Mac platform. The component can be configured to perform automatic voice activity detection, which allows to begin voice capture only when users start speaking, and finish capture when they stop speaking.

See technical specifications for the size of voice template and the requirements for voice record.

The component extracts a single voiceprint template in **1.34 seconds**. The specified performance requires a **PC** or **laptop** with at least Intel **Core i7-8xxx** family processor.

One Voice Extractor license is included with VeriSpeak 13.1 Standard SDK and VeriSpeak 13.1 Extended SDK. The license can be used on Microsoft Windows, Linux x86-64 or macOS platform. More licenses for this component can be purchased any time by VeriSpeak 13.1 SDK customers.

Mobile Voice Extractor

The Mobile Voice Extractor has the same functionality as the Voice Extractor and is designed to be run on **Android** or **iOS** or ARM Linux devices. The Android devices should be based on at least **Snapdragon S4** system-on-chip (**Krait 300** processor with 4 cores running at 1.51 GHz). The component extracts a single voiceprint template in **1.34 seconds**.

One Mobile Voice Extractor license is included with VeriSpeak 13.1 Standard SDK and VeriSpeak 13.1 Extended SDK. The license can be used on Android, iOS or ARM Linux platform. More licenses for this component can be purchased any time by VeriSpeak 13.1 SDK customers.



Matching Server

The Matching Server is ready-to-use software intended for building moderate size client-server and other network-based systems like local single- 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 Voice Matcher component.

Multi-biometric matching can be enabled by running components for fingerprint, face, voiceprint 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 13.1 SDK, VeriFinger 13.1 SDK, VeriLook 13.1 SDK, VeriSpeak 13.1 SDK and VeriEye 13.1 SDK. This module hides all low level communications and provides high-level API for the developer.

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	Linux	macOS
• Matching server software	+	+	+
• Server administration tool API	+	+	
Database support modules			
• Microsoft SQL Server	+		
• PostgreSQL	+	+	
• MySQL	+	+	
• Oracle	+	+	
• SQLite	+	+	+
Programming samples			
• C# client	+		
• Visual Basic .NET client	+		
• Java web client	+	+	+
Programming tutorials			
• C/C++	+	+	
• C#	+		
• Visual Basic .NET	+		
• Delphi	+		

The Matching Server component requires a **special 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 VeriSpeak Extended SDK.

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

- MegaMatcher 13.1 Standard or MegaMatcher 13.1 Extended SDK;
- VeriFinger 13.1 Extended SDK;
- VeriLook 13.1 Extended SDK;
- VeriEye 13.1 Extended SDK.



Basic Recommendations for Speaker Recognition

The speaker recognition accuracy of VeriSpeak depends on the audio quality during enrollment and identification. Certain constraints should be noted before or during algorithm integration into a speaker recognition system. Other variables may be overcome by enrollment with the same phrase in different environments.

Voice samples of at least 2 seconds in length are recommended to assure recognition quality.

General Security

A **passphrase should be kept in secret and not pronounced in an environment where other people may hear it** if the speaker recognition system is used in a scenario with unique phrases for each user.

The **text-independent** speaker recognition may be **vulnerable** to attack with a **covertly recorded phrase** from a person. **Passphrase verification** or **two-factor authentication** (i.e. requirement to type a password) will **increase** the overall system **security**.

Microphones

There are no particular constraints on models or manufacturers when using regular PC microphones, headsets or built-in laptop microphones. However these factors should be noted:

- The **same microphone model** is recommended (if possible) for use during both enrollment and recognition, as different models may produce different sound quality. Some models may also introduce specific noise or distortion into the audio, or may include certain hardware sound processing, which will not be present when using a different model. This is also the recommended procedure when using **smartphones** or **tablets**, as different device models may alter the recording of the voice in different ways.
- The same **microphone position** and distance is recommended during enrollment and recognition. **Headsets** provide optimal distance between user and microphone; this distance is recommended when non-headset microphones are used.
- **Web cam built-in** microphones should be **used with care**, as they are usually positioned at a rather long distance from the user and may provide lower sound quality. The sound quality may be affected if users change their position relative to the web cam.

Sound Settings

Settings for clear sound must be ensured; some audio software, hardware or drivers may have **sound modification** enabled by default. For example, the Microsoft Windows OS usually has, by default, sound boost enabled.

At least 8000 Hz sampling rate with at least **16-bit** depth should be set during voice recording.



Environment Constraints

The VeriSpeak speaker recognition algorithm is sensitive to **noise** or **loud voices** in the **background**; they may **interfere** with the user's voice and affect the recognition results. These solutions may be considered to reduce or eliminate these problems:

- A **quiet environment** for enrollment and recognition.
- **Several samples of the same phrase** recorded in different environments can be stored in a biometric template. Later the user will be matched against these samples with much higher recognition quality.
- **Close-range microphones** (like those in headsets) that are not affected by distant sources of sound.
- Third-party or custom solutions for background noise reduction, such as using two separate microphones for recording user voice and background sound, and later subtracting the background noise from the recording.

User Behavior and Voice Changes

Natural voice changes may affect speaker recognition accuracy:

- A temporarily **hoarse voice** caused by a cold or other sickness
- Different **emotional states** that affect voice (i.e. a cheerful voice versus a tired voice)
- Different **pronunciation speeds** during enrollment and identification

The aforementioned voice and user behavior changes can be managed in two ways:

- **Separate enrollments** for the altered voice, storing the records to the same person's template;
- A **controlled, neutral voice** during enrollment and identification.



System requirements

There are specific requirements for each platform which will run VeriSpeak-based applications.

Microsoft Windows platform requirements

- Microsoft Windows **7 / 8 / 10 / 11**.
- PC or laptop with **x86-64 (64-bit)** compatible processors.
 - 2 GHz or better processor is recommended.
 - **AVX2 support is highly recommended.** Processors that do not support AVX2 will still run the VeriSpeak algorithms, but in a mode, which will not provide the specified performance. Most modern processors support this instruction set, but please check if a particular processor model supports it.
 - The CPU plugin supports inference on Intel Xeon with Intel AVX2 and AVX-512, Intel Core processors with Intel AVX2, Intel Atom Processors with Intel SSE.
- At least **512 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.
- **Microphone.** Any microphone that is supported by the operating system can be used.
- **Database engine** or connection with it. VeriSpeak templates can be saved into any DB (including files) supporting binary data saving. VeriSpeak Extended SDK contains the following support modules for Matching Server on Microsoft Windows platform: **Microsoft SQL Server, MySQL, Oracle, PostgreSQL** and **SQLite**.
- **Network/LAN connection (TCP/IP)** for client/server applications. Also, network connection is required for using Matching server component (included in VeriSpeak Extended SDK). VeriSpeak SDK does not provide communication encryption with the Matching server, therefore, integrators should secure the communication by themselves.
- Microsoft **.NET framework 4.5** or newer (for .NET components usage).
- One of following **development environments** for application development:
 - Microsoft Visual Studio 2012 or newer (for application development under C/C++, C#, Visual Basic .Net)
 - Java SE JDK 8 or newer.



Android platform requirements

- A smartphone or tablet that is running **Android 5.0 (API level 21)** OS or newer.
 - If you have a custom Android-based device or development board, contact us to find out if it is supported.
- ARM-based **1.5 GHz processor recommended** for voiceprint processing in the specified time. Slower processors may be also used, but the voiceprint processing will take longer time.
- At least **1 GB 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.
- Any smartphone's or tablet's **built-in or headset microphone** which is supported by Android OS.
- **Network/LAN connection (TCP/IP)** for client/server applications. Also, network connection is required for using Matching server component (included in VeriSpeak Extended SDK). VeriSpeak SDK does not provide communication encryption with the Matching server, therefore, integrators should secure the communication by themselves.
- **PC-side development** environment requirements:
 - Java SE JDK 8 (or higher)
 - AndroidStudio 4.0 IDE
 - AndroidSDK 21+ API level
 - Gradle 6.1.1 build automation system or newer
 - Android Gradle Plugin 4.0.0
 - Internet connection for activating VeriSpeak component licenses

iOS platform requirements

- One of the following devices, running **iOS 11.0** or newer:
 - **iPhone 5S** or newer iPhone.
 - **iPad Air** or newer iPad models.
- At least **1 GB 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.
- Any smartphone's or tablet's **built-in or headset microphone** which is supported by iOS.
- **Network/LAN connection (TCP/IP)** for client/server applications. Also, network connection is required for using Matching server component (included in VeriSpeak Extended SDK). VeriSpeak SDK does not provide communication encryption with the Matching server, therefore, integrators should secure the communication by themselves.
- **Development environment** requirements:
 - a Mac running macOS 10.13 or newer.
 - Xcode 9.3 or newer.



macOS platform requirements

- A Mac running **macOS 10.13** or newer.
 - 2 GHz or better processor is recommended.
 - x86-64 (**Intel**) and ARM (**Apple M1** family) processor architectures supported.
- At least **512 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.
- **Microphone.** Any microphone that is supported by the operating system can be used.
- **Database engine** or connection with it. VeriSpeak templates can be saved into any DB (including files) supporting binary data saving. VeriSpeak Extended SDK contains **SQLite** support modules for Matching Server on macOS platform.
- **Network/LAN connection (TCP/IP)** for client/server applications. Also, network connection is required for using Matching server component (included in VeriSpeak Extended SDK). VeriSpeak SDK does not provide communication encryption with the Matching server, therefore, integrators should secure the communication by themselves.
- Specific requirements for **application development**:
 - XCode 9.3 or newer
 - GNU Make 3.81 or newer (to build samples and tutorials development)
 - Java SE JDK 8 or newer.



Linux x86-64 platform requirements

- **Linux 4.9 kernel** or newer is required.
- PC or laptop with **x86-64 (64-bit)** compatible processors.
 - 2 GHz or better processor is recommended.
 - **AVX2 support is highly recommended.** Processors that do not support AVX2 will still run the VeriSpeak algorithms, but in a mode, which will not provide the specified performance. Most modern processors support this instruction set, but please check if a particular processor model supports it.
 - The CPU plugin supports inference on Intel Xeon with Intel AVX2 and AVX-512, Intel Core processors with Intel AVX2, Intel Atom Processors with Intel SSE.
- At least **512 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.
- **Microphone.** Any microphone that is supported by the operating system can be used.
- glibc 2.24 library or newer
- alsa-lib 1.1.6 or newer (for voice capture)
- libgudev-1.0 230 or newer (for microphone usage)
- **Database engine** or connection with it. VeriSpeak templates can be saved into any DB (including files) supporting binary data saving. VeriSpeak Extended SDK contains **MySQL, Oracle, PostgreSQL** and **SQLite** support modules for Matching Server on Linux x86 / x86-64 platforms.
- **Network/LAN connection (TCP/IP)** for client/server applications. Also, network connection is required for using Matching server component (included in VeriSpeak Extended SDK). VeriSpeak SDK does not provide communication encryption with the Matching server, therefore, integrators should secure the communication by themselves.
- Specific requirements for **application development**:
 - gcc 6.3 or newer
 - GNU Make 3.81 or newer (to build samples and tutorials development)
 - Java SE JDK 8 or newer.



ARM Linux platform requirements

We recommend to contact us and report the specifications of a target device to find out if it will be suitable for running VeriSpeak-based applications.

There is a list of common requirements for ARM Linux platform:

- A device with ARM-based processor, running **Linux 3.2 kernel** or newer.
- ARM-based **1.5 GHz processor recommended** for voiceprint processing in the specified time. .
 - **ARMHF architecture (EABI 32-bit hard-float ARMv7)** is required.
 - Lower clock-rate processors may be also used, but the voiceprint processing will take longer time
- At least **1 GB 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.
- **Microphone.** Any microphone that is supported by the operating system can be used.
- glibc 2.24 library or newer
- alsa-lib 1.1.6 or newer (for voice capture)
- libgudev-1.0 230 or newer (for microphone usage)
- **Network/LAN connection (TCP/IP)** for client/server applications. Also, network connection is required for using Matching server component (included in VeriSpeak Extended SDK). VeriSpeak SDK does not provide communication encryption with the Matching server, therefore, integrators should secure the communication by themselves.
- **Development environment** requirements:
 - gcc 6.3 or newer
 - GNU Make 3.81 or newer (to build samples and tutorials development)
 - Java SE JDK 8 or newer.



Technical Specifications

A minimum 8000 Hz sampling rate, with at least **16-bit** depth, should be used during voice recording.

Voice samples of at least 2 seconds in length are recommended to assure recognition quality. Longer voice samples will further improve recognition.

See above the list of recommendations and constraints for speaker recognition.

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

The voiceprint template size has **linear dependence** on the voice sample length. For example, when using voice samples that are 2 times shorter, the template size values will be 2 times smaller.

VeriSpeak 13.1 text-dependent engine can perform template matching in two modes:

- **Fixed phrase** – each subject in the database has recorded the same phrase. This mode provides **faster matching**, but lower reliability.
- **Unique phrase** – each subject in the database has recorded a unique phrase. This mode provides **higher reliability**, but slower matching.

VeriSpeak biometric template extraction and matching algorithm is designed to run on **multi-core processors** allowing to reach maximum possible performance on the used hardware.

VeriSpeak 13.1 text-dependent algorithm specifications				
	Android-based platform		PC-based platform	
Template extraction components	Mobile Voice Extractor	Mobile Voice Client	Voice Extractor	Voice Client
Template extraction speed (voiceprints per minute)	45 ⁽¹⁾	50 ⁽¹⁾	45 ⁽²⁾	100 ⁽²⁾
Template matching components	Mobile Voice Matcher		Voice Matcher	
Template matching speed (voiceprints per second)	100 ⁽¹⁾		8,000 ⁽²⁾	
Single voiceprint record size in a template, when 5 second long voice samples used (bytes)	3,500 - 4,500			

Notes:

(1) Requires to be run on Android devices based on at least Snapdragon S4 system-on-chip with Krait 300 processor (4 cores, 1.51 GHz).

(2) Requires to be run on PC or laptop with at least Intel Core i7-8xxx family processor or newer to reach the specified performance.



Reliability Tests

The VeriSpeak 13.1 algorithm has been tested with voice samples taken from the XM2VTS Database, as well as with voice voice from Neurotechnology internal database.

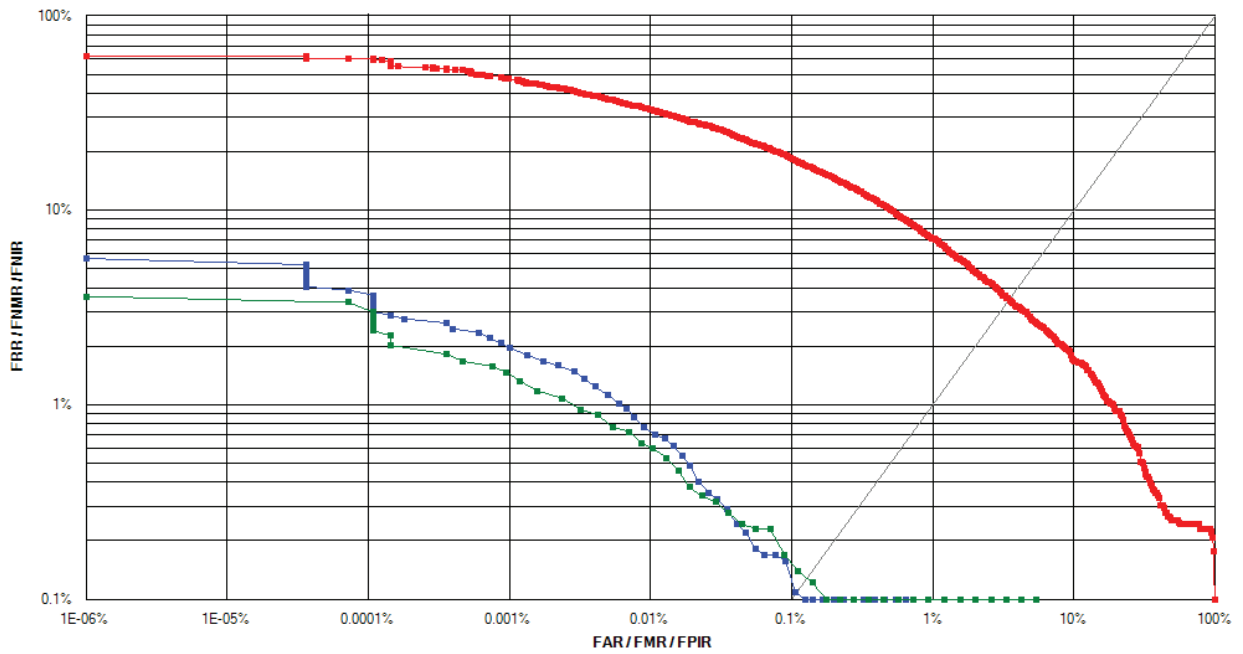
More information on XM2VTS database is available at <https://www.ee.surrey.ac.uk/CVSSP/xm2vtsdb/>

Voiceprint datasets used for VeriSpeak 13.1 matching engine testing			
	Experiment 1	Experiment 2	Experiment 3
Dataset used	XM2VTS (phrase 1)	Neurotechnology internal dataset 1	Neurotechnology internal dataset 2
Fixed/unique phrase	Fixed	Fixed	Unique
Total voice samples in the database	2360	309	305
Subjects in the database	295	42	42
Recording sessions per subject	8	1 - 10	1 - 10
Average voice sample length (seconds)	7.112	4.975	6.214

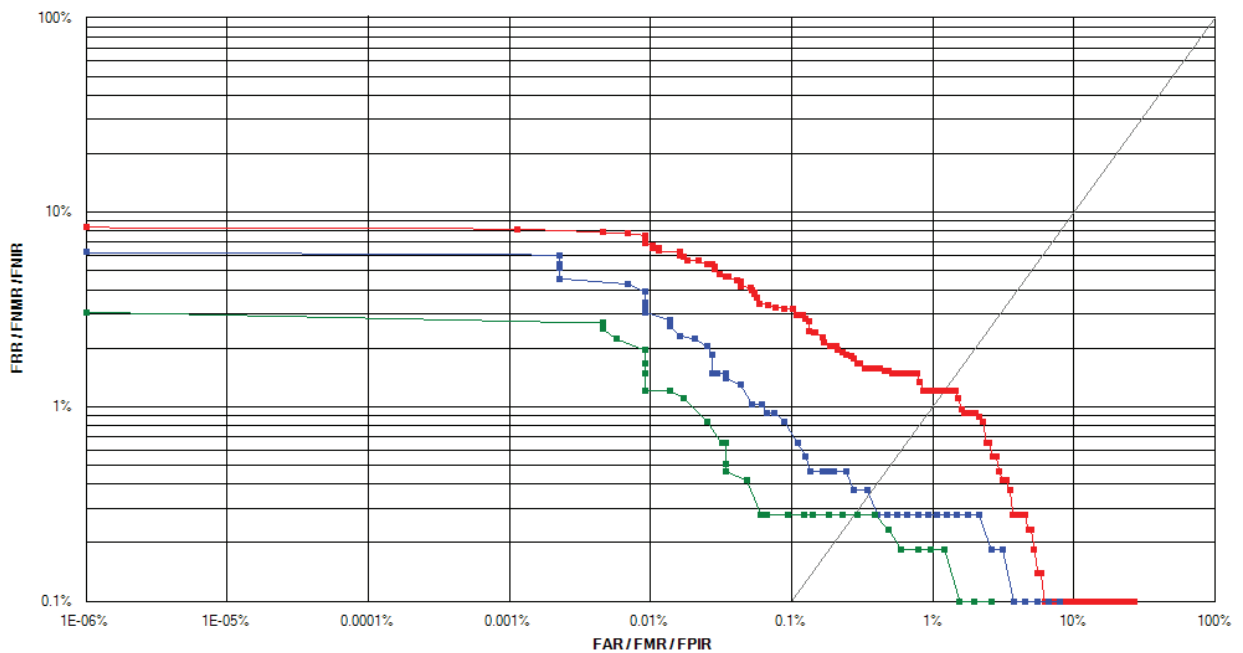
Three tests were performed during each experiment:

- **Test 1** used **text-dependent** voiceprint template matching algorithm. VeriSpeak 13.1 algorithm reliability in this test is shown as **red curves** on the ROC charts.
- **Test 2** used **text-independent** voiceprint template matching algorithm. VeriSpeak 13.1 algorithm reliability in this test is shown as **blue curves** on the ROC charts.
- **Test 3** used **fused** results from the text-dependent and text-independent voiceprint template matching algorithms. VeriSpeak 13.1 algorithm reliability in this test is shown as **green curves** on the ROC charts.

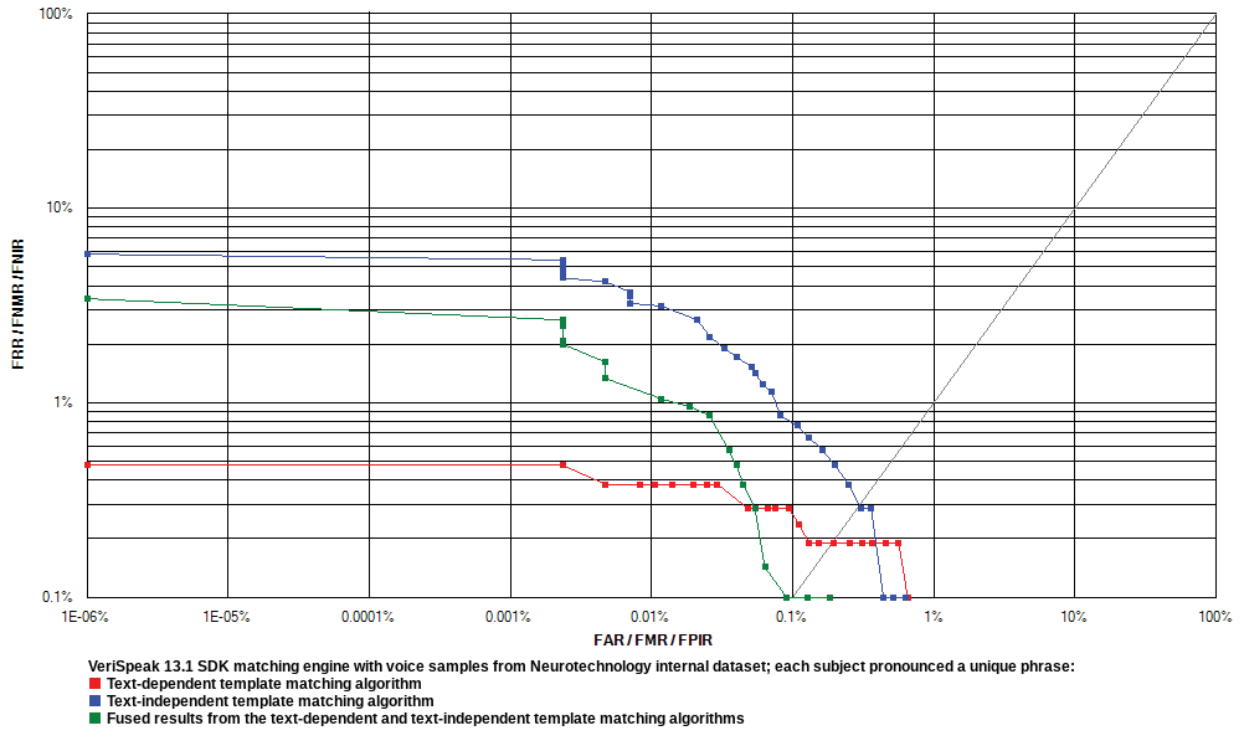
Receiver operation characteristics (**ROC**) curves are usually used to demonstrate the recognition quality of an algorithm. ROC curves show the dependence of false rejection rate (**FRR**) on the false acceptance rate (**FAR**). Charts with ROC curves and testing results for each of the experiments are available on the next pages.



VeriSpeak 13.1 SDK matching engine with voice samples from XM2VTS dataset; all subjects pronounced the same fixed phrase:
 ■ Text-dependent template matching algorithm
 ■ Text-independent template matching algorithm
 ■ Fused results from the text-dependent and text-independent template matching algorithms



VeriSpeak 13.1 SDK matching engine with voice samples from Neurotechnology internal dataset; all subjects pronounced the same fixed phrase:
 ■ Text-dependent template matching algorithm
 ■ Text-independent template matching algorithm
 ■ Fused results from the text-dependent and text-independent template matching algorithms



VeriSpeak 13.1 matching engine reliability tests									
	Experiment 1			Experiment 2			Experiment 3		
	Test 1	Test 2	Test 3	Test 1	Test 2	Test 3	Test 1	Test 2	Test 3
EER	3.4640 %	0.1074 %	0.1254 %	1.1750 %	0.3569 %	0.2528 %	0.1720 %	0.3147 %	0.0928 %
FRR at 0.1 % FAR	18.5500 %	0.1575 %	0.1696 %	3.2000 %	0.8349 %	0.2783 %	0.2854 %	0.8563 %	0.0952 %
FRR at 0.01 % FAR	32.9900 %	0.7634 %	0.6301 %	6.9110 %	3.0610 %	1.2060 %	0.3806 %	3.2350 %	1.3320 %
FRR at 0.001 % FAR	47.2000 %	2.0840 %	1.4660 %	8.3490 %	6.2150 %	3.0610 %	0.4757 %	5.8040 %	3.4250 %



VeriSpeak Trial SDK and Related Products

VeriSpeak 30-day SDK Trial is available for downloading at www.neurotechnology.com/download.html.

These products are related to VeriSpeak SDK:

- **MegaMatcher SDK** – for development of AFIS or multi-biometric face, fingerprint, voice, iris and palm print identification products. See “MegaMatcher SDK” brochure for more information.



Licensing VeriSpeak SDK

Product Development

An integrator should obtain either a VeriSpeak 13.1 Standard SDK (EUR 339) or VeriSpeak 13.1 Extended SDK (EUR 859) to develop a end-user product based on VeriSpeak technology. The SDK needs to be purchased just once and may be used for all projects and by all the developers within the integrator's company.

See the "Contents of VeriSpeak Standard SDK and Extended SDK" chapter (page 4) for the list of component licenses included with VeriSpeak 13.1 Standard and VeriSpeak 13.1 Extended SDK.

Integrators can obtain additional component licenses if more component licenses are required for the development process.

Product Deployment

To deploy their developed products, an integrator need obtain licenses of components for every **computer or device**, where component will be installed together with integrator's product. See Product Advisor to find out what specific components will be needed for the deployment of your system. Integrators can purchase additional VeriSpeak component licenses if required at anytime.

License activation options

The components are copy-protected. The following license activation options are available:

- **Serial numbers** are used to activate licenses for particular VeriSpeak components on particular computer or device. The activation is done via the Internet or by email. After activation the network connection is not required for single computer license usage.

Notes:

 1. Activation by serial number is **not suitable for ARM-Linux** platforms, except BeagleBone Black and Raspberry Pi 3 devices..
 2. Activation by serial number is **not suitable for virtual environments**.
- **Internet activation.** A special **license file** is stored on a computer or a mobile or embedded device; the license file allows to run particular VeriSpeak components on that computer or device after **checking** the license over the Internet. **Internet connection** should be available periodically for a short amount of time. A single computer license can be **transferred** to another computer or device by moving the license file there and waiting until the previous activation expires.
- **Volume License Manager.** Licenses may be stored in a volume license manager **dongle**. License activation using volume license manager may be performed without connection to the Internet and is suitable for virtual environments. Volume license manager is **used on site by integrators or end users** to manage licenses for VeriSpeak components in the following ways:
 1. **Activating single computer licenses** – An installation license for a VeriSpeak component will be activated for use on a particular computer. The number of available licenses in the license manager will be decreased by the number of activated licenses. .
 2. **Managing single computer licenses via a LAN or the Internet** – The license manager allows the management of installation licenses for VeriSpeak components across multiple computers or mobile/embedded devices in a LAN or over the Internet. The number of managed licenses is limited by the number of licenses in the license manager. No license activation is required and the license quantity is not decreased. Once issued, the license is assigned to a specific computer or device on the network.
 3. **Using license manager as a dongle** – A volume license manager containing at least one license for a VeriSpeak component may be used as a dongle, allowing the VeriSpeak component to run on the particular computer where the dongle is attached.



Licenses Validity

All SDK and component licenses are perpetual and do not have expiration. There are no annual fee or any other fees except license purchasing fee. It is possible to move licenses from one computer or device to another. Neurotechnology provides a way to renew the license if the computer undergoes changes due to technical maintenance.

Licensing Agreement

The Licensing Agreement (https://neurotechnology.com/mm_130_sla.html) contains all licensing terms and conditions.

Note that you unambiguously accept this agreement by placing an order using Neurotechnology online ordering service or by email or other means of communications. Please read the agreement before making an order.

Other licensing options

- **VAR License.** The above described licensing model is intended for **end-user** product developers. Integrators who want to develop and sell a VeriSpeak-based development tool (with API, programming possibilities, programming samples, etc.), must obtain permission from Neurotechnology and **sign** a special VAR agreement. For more information please contact us.
- **Enterprise License.** The VeriSpeak enterprise license allows an **unlimited use** of VeriSpeak components in end-user products for a specific territory, market segment or project. Specific restrictions would be included in the licensing agreement. The enterprise license price depends on the application size and the number of potential users of the application within the designated territory, market segment or project. For more information please contact us.



Prices for VeriSpeak products

- The prices are **effective February 13, 2024**. 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.
- Prices do not include local import duties or taxes.
- Product shipping costs depend on delivery country.
- Customers with Solution Partner status are eligible for product discounts.

VeriSpeak SDK			
VeriSpeak 13.1 Standard SDK			€ 339.00
VeriSpeak 13.1 Extended SDK			€ 859.00
Client-side voiceprint components for desktop (prices per single computer license)			
Quantity	Voice Extractor	Voice Client ⁽¹⁾	Voice Matcher
1-9	€ 20.00	€ 20.00	€ 25.00
10-19	€ 15.00	€ 15.00	€ 18.00
20-49	€ 13.00	€ 13.00	€ 16.00
50-99	€ 11.00	€ 11.00	€ 14.00
100-199	€ 11.20	€ 11.20	€ 12.50
200-499	€ 9.00	€ 9.00	€ 11.00
500-999	€ 8.00	€ 8.00	€ 11.20
1000-1999	€ 7.00	€ 7.00	€ 9.00
2000-3999	€ 6.40	€ 6.40	€ 8.00
4000-7999	€ 5.80	€ 5.80	€ 7.00
8000 and more	Please contact us for more information		
Client-side voiceprint components for Android, iOS and ARM Linux (prices per single computer license)			
Quantity	Mobile Voice Extractor	Mobile Voice Client ⁽¹⁾	Mobile Voice Matcher
1-9	€ 9.00	€ 9.00	€ 11.00
10-19	€ 6.50	€ 6.50	€ 8.00
20-49	€ 5.80	€ 5.80	€ 7.10
50-99	€ 5.10	€ 5.10	€ 6.20
100-199	€ 4.60	€ 4.60	€ 5.60
200-499	€ 4.10	€ 4.10	€ 5.00
500-999	€ 3.60	€ 3.60	€ 4.40
1000-1999	€ 3.20	€ 3.20	€ 3.90
2000-3999	€ 2.90	€ 2.90	€ 3.50
4000-7999	€ 2.60	€ 2.60	€ 3.10
8000 and more	Please contact us for more information		
License management			
Volume license manager			€ 16.00

(1) These components are not available for VeriEye Standard SDK customers.

VeriSpeak 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