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Solution for
large-scale AFIS or
multi-biometric systems

MegaMatcher Accelerator

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Contents

MegaMatcher Accelerator is a hardware/software solution that provides high speed, high volume biometric identification for national-scale projects.

The **Extreme** and **Extended** versions are designed to run on **server hardware** and perform fast biometric template matching on the server-side of a large-scale AFIS or multi-modal system. The **Standard** version and **Development Edition** are designed to be run on a **common PC**. MegaMatcher Accelerator software licenses are available for new and existing MegaMatcher Extended SDK customers.

- Proven in national-scale projects, including voter registration and national ID.
- NIST MINEX-compliant fingerprint engine, NIST IREX proven iris engine.
- Available as a ready-to-use biometric solution with server hardware or as biometric software that will run on server hardware or a common PC.
- Up to 1,200,000,000 fingerprints, faces or irises per second matching speed on a single unit.
- Fingerprint, iris, face and palmprint modalities supported.
- Scalable cluster architecture.
- ISO & ANSI fingerprint template standards support.
- Suitable for duplicates search.

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References

- **DR Congo Voter Registration Project** uses MegaMatcher Accelerator as part of the MegaMatcher ABIS solution. 11 MegaMatcher Accelerator Extreme units have been deployed to provide enough performance for all-with-all comparison to perform massive voter registration in order to prepare for DRC 2018 elections. The solution **deduplicated 46.5 million voter records** in **less than 2 months**. 5.3 million duplicate records and 900 thousand underage records were found. RYou can download the **case study**: *https://download.neurotechnology.com/CaseStudy_DRC_Voter_Registration_Project.pdf*
- **Venezuela Voter Registration System** is based on MegaMatcher Accelerator solution and proved its speed and accuracy with biometric data from nearly **18 million** registered people during the 2012 Venezuelan presidential election. You can download the **case study**: *https://neurotechnology.com/download/CaseStudy_Venezuela_Voter_Registration_System.pdf*
- **Ukraine's National Biometric Verification and Identification System** is based on MegaMatcher Accelerator solution and MegaMatcher technology with **12 million** people already enrolled into the system, which is designed to enroll up to 30,000 people per day and serve identification requests in under 4 seconds. For more information see: *https://neurotechnology.com/cgi-bin/customers.cgi?ref=sp&oid=1&aid=150*
- **Mexico Multi-Biometric Enrollment System** is using MegaMatcher Accelerator solution and MegaMatcher technology to enroll 5 million taxpayers by 2014. You can download the **case study**: *https://neurotechnology.com/download/CaseStudy_Mexico_Tax_Agency_Multibiometric_Enrollment_System.pdf*
- **Sierra Leone Biometric Voter Registration System** is based on MegaMatcher Accelerator solution. You can download the **case study**: *https://download.neurotechnology.com/CaseStudy_Sierra_Leone_Biometric_Voter_Registration_System.pdf*
- **Somaliland National ID Project** uses three biometric modalities and is based on MegaMatcher Accelerator solution and MegaMatcher technology. You can download the **case study**: *https://download.neurotechnology.com/CaseStudy_Somaliland_National_ID_Project.pdf*

MegaMatcher Accelerator is a part of MegaMatcher SDK, which has been also used in multiple large-scale projects like voter registration, border control, passport issuance, national ID, civil and forensic AFIS projects. These references are available online at *https://www.neurotechnology.com/cgi-bin/customers.cgi*

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Features and Capabilities

MegaMatcher Accelerator software is available in these editions:

- **MegaMatcher Accelerator Extreme** is designed to run on **server hardware** with dual Xeon processors and 512 GB of RAM. Optionally, a **ready-to-use solution** with server hardware and pre-installed MegaMatcher Accelerator software can be provided.
- **MegaMatcher Accelerator Extended** is designed to run on **server hardware** with dual Xeon processors and 128 GB of RAM. Optionally, a **ready-to-use solution** with server hardware and pre-installed MegaMatcher Accelerator software can be provided.
- **MegaMatcher Accelerator Standard** is designed to be run on a **PC** with Core i7 processor and 16 GB of RAM.
- **MegaMatcher Accelerator Development Edition** software is designed for developers who need to run MegaMatcher Accelerator software in-house for software development and support purposes. This version is available with the *MegaMatcher Extended SDK*.

MegaMatcher Accelerator software provides these capabilities for biometric identification:

- **Fast matching.** A single MegaMatcher Accelerator 12.1 Extreme unit can match up to **1.2 billion fingerprints** per second or up to **1.2 billion irises** per second or up to **1.2 billion faces** per second in 1-to-many mode using the Neurotechnology proprietary biometric template format. A single MegaMatcher Accelerator 12.1 Extended unit can match up to **100 million fingerprints** per second or up to **200 million irises** per second or up to **100 million faces** per second or up to **2 million palmprints** per second in 1-to-many mode using the Neurotechnology proprietary biometric template format. A PC with MegaMatcher Accelerator 12.1 Standard software can match up to **35 million fingerprints** per second or up to **70 million irises** per second or up to **35 million faces** per second in 1-to-many mode.
- **Matching accuracy.** MegaMatcher Accelerator matching engines are based on biometric identfication algorithms which had been recognized by NIST and other authoritative institutions as the **most reliably accurate** even at the **highest matching speeds**.
- **Multiple modalities support.** MegaMatcher Accelerator 12.1 can be used within a biometric system that contains templates with any number of fingerprint, iris, face and/or palmprint records.
- **Full database search.** The biometric engines included in MegaMatcher Accelerator do not perform internal database indexing or pre-classification (by fingerprint type, eye color etc) thus avoiding false rejections when incorrect classifiers appear. This way the whole database is scanned comprehensively during every matching request and very low false rejection ensured. On the other hand, integrators may use non-biometric classifiers like gender or a country's region to optimize system size.
- **Scalable architecture.** Multiple MegaMatcher Accelerator units can be combined together in a cluster for higher matching speed. For example, a cluster of 4 MegaMatcher Accelerator 12.1 Extended units would enable matching at a rate of about 108 million templates per second (when a template contains 4 fingerprint records), a cluster of 10 units – about 270 million templates per second, and so on. No additional cluster software is required, as MegaMatcher Accelerator includes all the necessary software which is easily managed through a web interface.
- **Suitable for duplicates search.** Searching for duplicates in a biometric templates database is a task that requires many computations, as each biometric template needs to be verified with each other template in the database. MegaMatcher Accelerator provides enough productivity to complete duplicate searching in a reasonable time. Scalable architecture allows the combination of several MegaMatcher Accelerator units for tasks involving bigger databases.

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Technology Awards

MegaMatcher Accelerator technology is based on awards-winning fingerprint and iris recognition algorithms.

MINEX evaluations by NIST

- **MINEX III** evaluation was successfully passed in 2015. In **2019** Neurotechnology's fingerprint template generator algorithm has been ranked the **first in the NIST MINEX interoperability category**; the fingerprint matching algorithm has also been ranked as the **front-runner in terms of interoperability** and, when combined, the two have become the **supreme accuracy, high speed fingerprint recognition system**.
- **MINEX Ongoing** evaluation was successfully passed in 2014. The **second place in the Ongoing MINEX ranking** for fingerprint matching algorithms was achieved. MegaMatcher technology was recognized by the NIST as fully MINEX compliant.

FVC-onGoing results

- In 2020 MegaMatcher **fingerprint** recognition algorithm has shown the **top result** at the FVC-onGoing evaluation. The fingerprint extractor and matcher were ranked as the **most accurate** for both FV-STD-1.0 and FV-HARD-1.0 benchmarks
- In 2019 MegaMatcher **palm print** matching algorithm has shown the **top result** at the FVC-onGoing evaluation. The algorithm was the **most accurate** overall and **fastest** among the five most accurate matchers.

PFT II and PFT III (Proprietary Fingerprint Template) Evaluation

- Different versions of Neurotechnology's fingerprint recognition algorithm were submitted to the NIST Proprietary Fingerprint Template Evaluation. The algorithm's template matching accuracy was among the best participants at the previous PFT II evaluation. Our latest submissions to the PFT II and the ongoing **PFT III** are in average the **most accurate** algorithms in all the experiments

FpVTE (Fingerprint Vendor Technology Evaluations) by NIST

- **FpVTE 2012** – in 2015 NIST recognized Neurotechnology's fingerprint identification algorithm as **one of the fastest and most accurate** among the evaluation's participants.
- **FpVTE 2003** – one of the best reliability results in the Middle Scale Test were shown. Neurotechnology participated in FpVTE 2003 under the name *Neurotechnologija*.

IREX evaluations by NIST

- **IREX 10** – in 2020 Neurotechnology's iris recognition algorithm has been judged by NIST as the **second most accurate** among the IREX 10 participants. The submitted algorithm featured **much faster template creation** and **search time**, and **much smaller template** size than the only more accurate contender.
- **IREX III, IREX IV and IREX IX** - in 2012, 2013, and 2018 correspondingly Neurotechnology's iris recognition algorithm has earned top positions in these evaluations.

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Scalable High Productivity Systems

Large-scale biometric projects may have specific system performance requirements. The MegaMatcher Accelerator family of products is intended for large-scale AFIS / ABIS projects and offers different matching engines and editions for high performance during large number of requests.

MegaMatcher Accelerator provides easy system **scalability** and allows to start a biometric system from a **single unit** at the beginning, with further scaling up together with project capacity and speed requirements by expanding the system into **cluster** and/or **upgrading** the units using using engines with higher capabilities.

MegaMatcher Accelerator is designed for using together with other components of *MegaMatcher SDK*, which provide biometric data capture and template extraction. These system architectures and components are usually used for specific projects:

- **Template creation on client-side and matching on server-side** – recommended for AFIS, border control, various ID issuing systems, such as passports, ID cards, voter registration.
- **Template creation and matching on server side** – recommended for online banking, government e-services and other mass scale systems, in which requests can be submitted by any device or computer.
- **Deduplication after all users data collected** – recommended for ID issuing systems, which have previously collected biometric data, such as voter or population registry cleaning.

See the next pages for detailed descriptions of these architectures.

A combination of the mentioned architectures and components can be also used within a large-scale biometric system to reach optimal performance and/or availability.

MegaMatcher Accelerator software licenses are available for new and existing MegaMatcher Extended SDK customers.

MegaMatcher Automated Biometric Identification System, an integrated multi-biometric **solution** for national-scale identification projects, can be also considered. The solution can be **customized** by Neurotechnology for specific project needs. See *www.neurotechnology.com/megamatcher-abis.html* for more information.

See Product Advisor at ***www.neurotechnology.com/product-advisor.html*** to find out what Neurotechnology products and components will best suit your project requirements.

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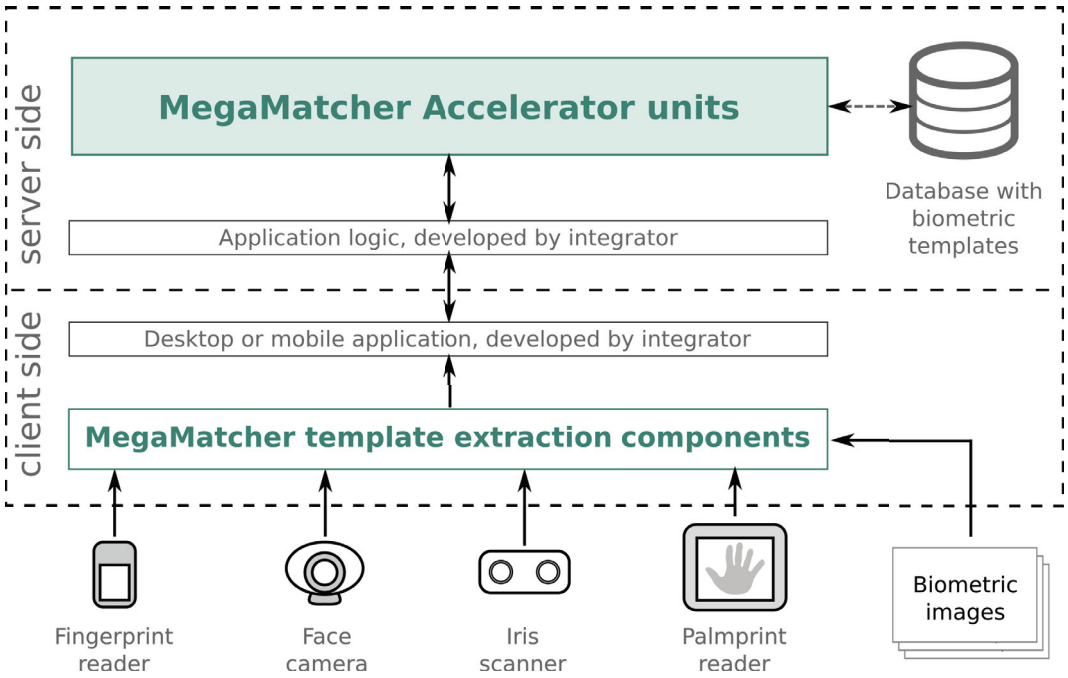
Template creation on client-side and matching on server-side

This is the most often used architecture for AFIS / ABIS, border control, various ID issuing systems, such as passports, ID cards or voter registration. It is suitable for various systems, ranging from small LAN-based systems to national-scale projects. The chart below shows the key components need for this architecture.



The **ready-to-use** MegaMatcher Accelerator 12.1 units are deployed on the server-side and include **biometric engines** for matching fingerprint, palmprint, face and iris templates, which can be easily **scaled up** at any time for higher performance based on the project requirements.

MegaMatcher template extraction components are used by integrators to **develop** client-side desktop or mobile applications. The components include all necessary functionality and performance for biometric data **capture** and template **extraction** for sending them to the server-side. The applications **deployment** needs only additional licenses for the corresponding components for each computer or device running the application.

See page 10 for more information about scalable server-side components.

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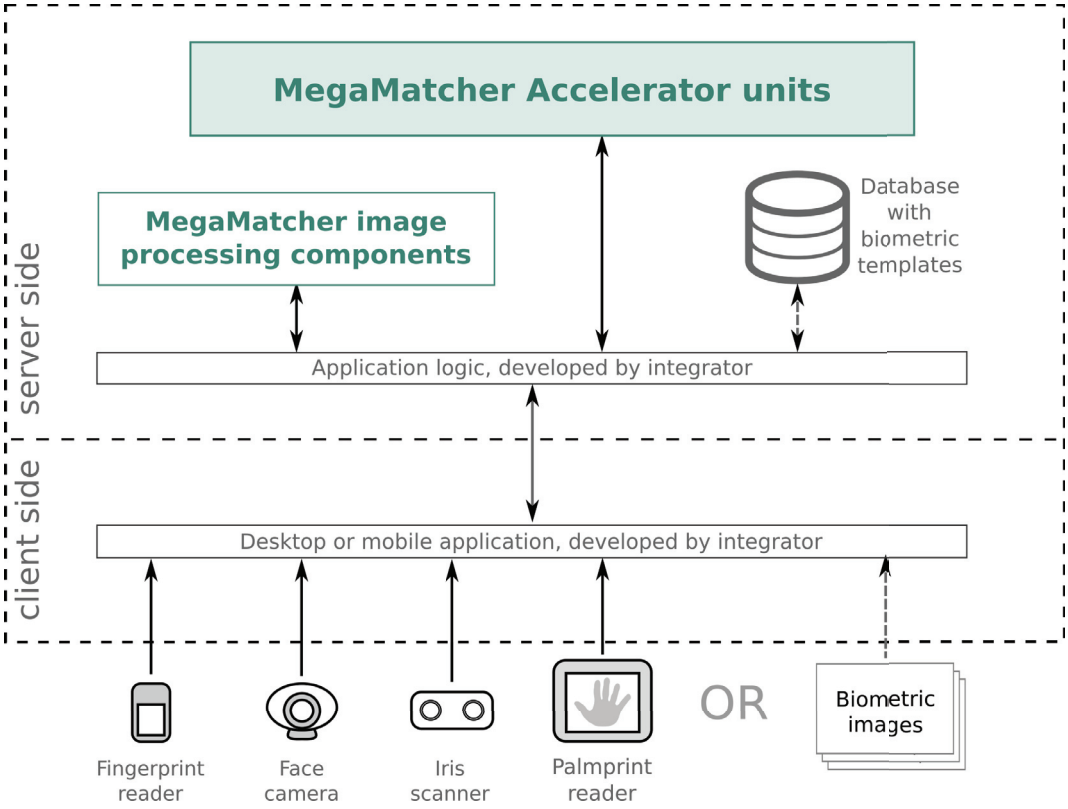
Template creation and matching on server side

This architecture is designed to be used for biometric systems, which need to process requests from a very large number of clients in scenarios like **online banking** or **government e-services**, as well as other mass scale systems with very large number of users. The chart below shows the key components needed for this architecture.



The **ready-to-use** MegaMatcher Accelerator 12.1 units are deployed on the server-side and include **biometric engines** for matching fingerprint, palmprint, face and iris templates, which can be easily **scaled up** at any time for higher performance based on the project requirements.

MegaMatcher template extraction components are deployed on the server-side of the biometric system. The integrators need to **develop** application logic, which will operate with the template extraction components.

MegaMatcher biometric data capture components provide necessary functionality for **client-side** applications, which **acquire** biometric images from scanners or cameras and send them to the server-side for further template extraction. Applications deployment needs only additional licenses for the corresponding components for each computer or device running the application. Integrators can also implement image capture by themselves and send images to the server-side part of the system. In this case client-side applications deployment does not need any licenses for Neurotechnology components.

See page 10 for more information about scalable server-side components.

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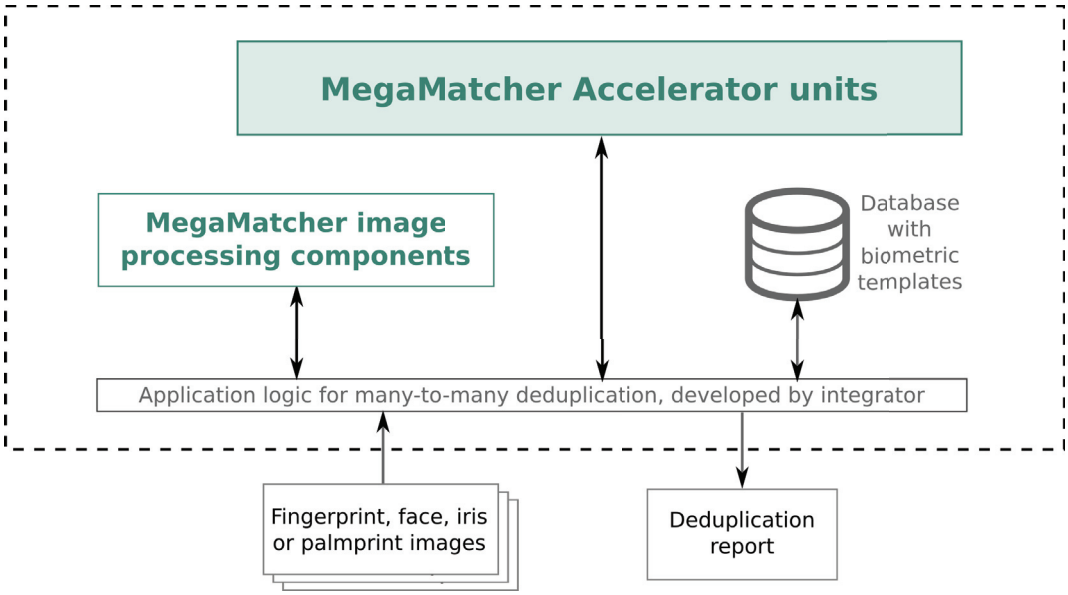
Deduplication after all users data collected

This architecture is intended for large-scale projects, like **voter registration** or **population registry cleaning**, when users' biometric data collection is done in two steps. First, the biometric data is captured on multiple sites, which are not connected to the central database. Later, the biometric data from all sites is submitted to the central database and checked for duplicates. The chart below shows the key components need for this architecture.



The **ready-to-use** MegaMatcher Accelerator 12.1 units are deployed on the server-side and include **biometric engines** for matching fingerprint, face and iris templates, which can be easily **scaled up** at any time for higher performance based on the project requirements. Integrators will need to develop **simple application logic** for sending the biometric templates for for many-to-many deduplication and generating the duplicates search report. Note, that database deduplication task requires a lot of computational resources, as it needs to compare every biometric template with every other biometric template in a database.

MegaMatcher template extraction components may need to be deployed on the server-side, as usually the biometric data is captured as fingerprint, palmprint, face or iris images, which need to be processed into biometric templates. The integrators need to **develop** application logic, which will operate with the template extraction components.

Product Advisor at ***www.neurotechnology.com/product-advisor.html*** can provide an estimation of possible components and their quantities based on the actual duplicates search project requirements.

You may also consider the **MegaMatcher ABIS Cloud Service**, which provides results for a reasonable price without the need to develop a solution. See ***www.megamatcher.online*** for more information.

See page 10 for more information about scalable server-side components.

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Scalable server-side matching with MegaMatcher Accelerator

MegaMatcher Accelerator 12.1 is a solution for **large-scale** AFIS and multi-biometric projects, which is available as Development Edition, Standard, Extended and Extreme versions. A system based on MegaMatcher Accelerator with a **single unit** can be **scaled up** by adding more units to create a **cluster** and/or **upgrading** to a more powerful version of MegaMatcher Accelerator. The MegaMatcher Accelerator includes necessary software to enable system **scalability**, high **availability** and **fault tolerance**.

MegaMatcher Accelerator 12.1 software is provided with MegaMatcher 12.1 Extended SDK.

The table below compares different versions of MegaMatcher Accelerator 12.1 solution.

MegaMatcher Accelerator 12.1 performance and scalabilty					
		Fingerprints	Faces	Irises	Palmprints
Cluster of MegaMatcher Accelerator 12.1 Dev. Edition with *N* units	Database capacity	*N* × 4,000,000 fingerprints	*N* × 1,000,000 faces	*N* × 5,000,000 irises	*N* × 400,000 palmprints
	Matching speed	*N* × 1,000,000 fingerprints per second	*N* × 1,000,000 faces per second	*N* × 1,000,000 irises per second	*N* × 20,000 palmprints per second
Cluster of MegaMatcher Accelerator 12.1 Standard with *N* units	Database capacity	*N* × 4,000,000 fingerprints	*N* × 1,000,000 faces	*N* × 5,000,000 irises	*N* × 400,000 palmprints
	Matching speed	*N* × 35,000,000 fingerprints per second	*N* × 35,000,000 faces per second	*N* × 70,000,000 irises per second	*N* × 600,000 palmprints per second
Cluster of MegaMatcher Accelerator 12.1 Extended with *N* units	Database capacity	*N* × 40,000,000 fingerprints	*N* × 10,000,000 faces	*N* × 50,000,000 irises	*N* × 4,000,000 palmprints
	Matching speed	*N* × 100,000,000 fingerprints per second	*N* × 100,000,000 faces per second	*N* × 200,000,000 irises per second	*N* × 2,000,000 palmprints per second
Cluster of MegaMatcher Accelerator 12.1 Extreme with *N* units	Database capacity	*N* × 160,000,000 fingerprints	*N* × 40,000,000 faces	*N* × 200,000,000 irises	*Palmprint engine is not available in MegaMatcher Accelerator Extreme Edition*
	Matching speed	*N* × 1,200,000,000 fingerprints per second	*N* × 1,200,000,000 faces per second	*N* × 1,200,000,000 irises per second	

Recommendations:

- **MegaMatcher Accelerator Development Edition** has no limitations on cluster size, but in general it makes no sense to run more than **3 nodes** in the cluster, as the whole system will cost like one MegaMatcher Accelerator Standard unit while providing lower performance.
- **MegaMatcher Accelerator Standard** has no limitations on cluster size, but in general it makes no sense to run more than **2 nodes** in the cluster, as the whole system will cost like one MegaMatcher Accelerator Extended unit while providing lower performance and capacity.
- **MegaMatcher Accelerator Extended** has no limitations on cluster size, but in general it makes no sense to run more than **4 nodes** in the cluster, as the whole system will cost like one MegaMatcher Accelerator Extreme unit while providing lower performance and capacity.
- The matching speeds are provided for single-biometrics engines. If a template in a database contains multi-biometric entries, like fingerprint and face records belonging to the same person, the matching components will match proportionally lower number of persons' biometric database entries per second.
- MegaMatcher Accelerator unit(s) can be used for fast candidate selection using irises, faces or several fingerprints with further results validation using slower fingerprint, face, iris and voiceprint matching engines which are also included with MegaMatcher Accelerator.
- Smaller systems, which need to match up to 200,000 fingerprints, faces or irises per second, can be based on the Matching Server which is available in the *MegaMatcher SDK*.

Also, two or more MegaMatcher Accelerator based clusters can be connected together for a high availability system.

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MegaMatcher Accelerator cluster software

MegaMatcher Accelerator includes cluster software, thus multiple MegaMatcher Accelerator 12.1 units (cluster nodes) can be connected via network to a cluster. A cluster of MegaMatcher Accelerators may be **scaled up at anytime**, meeting changing project requirements such as an increase in number of users or request environment. The cluster software provides these advanced capabilities:

- **Horizontal scalability** – achieved by adding new MegaMatcher Accelerator nodes to a cluster. Because each unit operates on a portion of the database, an increase in the number of MegaMatcher Accelerator units results in faster matching and a higher number of processed requests.
  For example, there is a database with the biometric data for 15 million people (4 fingerprints for each user, 60 million fingerprints in total). The number of required MegaMatcher Accelerator units would be calculated in this way:
  - The whole database **should fit into the memory** of the MegaMatcher Accelerator units. A single MegaMatcher Accelerator 12.1 Extended unit stores 40 million fingerprints, therefore, 2 units would be required to store the sample 60 million fingerprints database.
  - The **response time** for an identification request should satisfy project requirements. A single MegaMatcher Accelerator 12.1 Extended unit matches 27 million fingerprint templates per second in 4-to-many mode If the project requires receiving an an answer to an identification request in 1 second, therefore, two units will satisfy the project requirements for response time.
  - The **peak hour request quantity** should satisfy project requirements. For example, the project expects that there may be up to 15,000 identification requests per hour. A single MegaMatcher Accelerator 12.1 Extended unit matches 27 million fingerprint templates per second in 4-to-many mode, it will therefore be able to process 6,480 requests per hour with the sample 15 million template database. A cluster of 3 MegaMatcher Accelerator 12.1 Extended units will be required to process the expected number of identification requests in this case.
- **Vertical scalability** – usually achieved by upgrading to a more powerful edition of MegaMatcher Accelerator. For example, a single MegaMatcher Accelerator Extended unit provides almost three times faster biometric matching and can store ten times more biometric templates compared to a single MegaMatcher Accelerator Standard unit.
- **Fault tolerance** – a cluster of MegaMatcher Accelerators can restore its operation after one or more of the nodes abnormally leaves the cluster for any reason, like hardware or network failure, software issue etc. The cluster software automatically detects the failure events and redistributes the data from the failed nodes between the active nodes to keep the whole database available for identification requests. Naturally, this functionality requires to have **larger number of nodes** than the minimum needed for the specified performance and/or capacity, so there are some reserve for replacing the failed nodes.
- **High availability** – two clusters of MegaMatcher Accelerators may be run in **parallel**, keeping the **data synchronized** between the clusters. This configuration provides twice the performance while both clusters operate normally. If one cluster becomes unavailable, the other will continue operation and provide the standard level of performance
- **Peer-to-peer architecture** – the cluster nodes automatically distribute biometric database and requests from clients between themselves. This architecture means that there are no master node in the cluster, therefore there are no issues with single point of failure or bottleneck.
- **Nonstop operation** – there are no downtime while new nodes are being added to the cluster or one of the nodes disappears. The normal system operation is not interrupted.

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MegaMatcher Accelerator Extreme

MegaMatcher Accelerator 12.1 Extreme is a family of **biometric solutions** for fast fingerprint, iris and face matching on the server-side of an AFIS or multi-biometric system. The solutions are intended for national-scale biometric identification projects with hundreds of millions of people enrolled in the database.

- These biometric matching engines can be used with MegaMatcher Accelerator 12.1 Extreme:
  - Fast **fingerprint, iris** and **face** matching engines that can be used **separately** or **together**. See technical specifications for engine comparison and licensing model for engine availability.
  - Fingerprint, face, iris and voiceprint matching engines that can be used separately or together to validate matching results produced by the fast fingerprint and/or iris engines. See *MegaMatcher SDK* brochure for more information.
- MegaMatcher Accelerator software is distributed as **Docker containers** for using on **Linux** OS.
- **Server hardware** is optionally available. In this case the MegaMatcher Accelerator 12.1 Extreme software will be **pre-installed** by Neurotechnology on each unit, and the customers will receive ready-to use **hardware/software solution**.
  HPE ProLiant DL360 Gen10 server units are offered with these specifications:
  - 2 x Intel Xeon Gold 6126 processor (12 cores, 19.25M cache, 2.6 GHz) or better;
  - RAM, depending on the number of biometric engines:
    - 512 GB RAM – for single biometric engine or two biometric engines;
    - 1024 GB RAM – for three biometric engines;
  - Persistent storage:
    - 2x HPE 400GB SATA 6G Write Intensive (2.5”) SC SSD or HDD with similar capacity
  - HPE Tower to Rack Conversion Kit with Sliding Rail Rack Shelf and Cable Management Arm;
  - HPE iLO Advanced lic.
- Multiple MegaMatcher Accelerator 12.1 Extreme units can be combined using the included cluster software to reach a higher level of performance.

A **client communication module** is included with MegaMatcher 12.1 Extended SDK. The module allows the sending of a task to MegaMatcher Accelerator, querying the status of the task, retrieving the results and then removing the task. A high-level API is provided for the developer, all low-level communications are hidden.

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MegaMatcher Accelerator Extended

MegaMatcher Accelerator 12.1 Extended is a family of **biometric solutions** for fast fingerprint, palmprint, iris and face matching on the server-side of an AFIS or multi-biometric system. The solutions are intended for national-scale biometric identification projects with millions of people enrolled in the database.

- These biometric matching engines can be used with MegaMatcher Accelerator 12.1 Extended:
  - Fast **fingerprint, palmprint, iris** and **face** matching engines that can be used **separately** or **together**. See technical specifications for engine comparison and licensing model for engine availability.
  - Fingerprint, palmprint, face, iris and voiceprint matching engines that can be used separately or together to validate matching results produced by the fast fingerprint, face and/or iris engines. See *MegaMatcher SDK* brochure for more information.
- MegaMatcher Accelerator software is distributed as **Docker containers** for using on **Linux** OS.
- **Server hardware** is optionally available. In this case the MegaMatcher Accelerator 12.1 Extended software will be **pre-installed** by Neurotechnology on each unit, and the customers will receive ready-to use **hardware/ software solution**. HPE ProLiant DL360 Gen10 server units are offered with these specifications::
  - 2 x Intel Xeon Gold 6126 processor (12 cores, 19.25M cache, 2.6 GHz);
  - RAM, depending on the number of biometric engines:
    - 128 GB RAM (8 x 16 GB Dual Rank x8 DDR4-2666) – for single biometric engine;
    - 256 GB RAM (16 x 16 GB Dual Rank x8 DDR4-2666) – for two biometric engines;
    - 384 GB RAM (24 x 16 GB Dual Rank x8 DDR4-2666) – for three biometric engines;
    - 512 GB RAM (16 x 32 GB Dual Rank x8 DDR4-2666) – for four biometric engines;
  - Persistent storage:
    - 6 x 300 GB HDD (SAS, 12G Enterprise 10K SFF) is offered as a standard option;
    - SSD is recommended for increasing overall system performance.
  - HPE iLO Advanced;
  - HPE Smart Array P408i-a SR Gen10 (8 Internal Lanes 2GB Cache) 12G.
- Multiple MegaMatcher Accelerator 12.1 Extended units can be combined using the included cluster software to reach a higher level of performance.

A **client communication module** is included with MegaMatcher 12.1 Extended SDK. The module allows the sending of a task to MegaMatcher Accelerator, querying the status of the task, retrieving the results and then removing the task. A high-level API is provided for the developer, all low-level communications are hidden.

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MegaMatcher Accelerator Standard

MegaMatcher Accelerator 12.1 Standard is a family of ready-to-use software products for fast fingerprint, palmprint, iris and face matching on the server-side of an AFIS or multi-biometric system. These products are intended for large-scale biometric projects with up to several million people enrolled in the database.

- These biometric matching engines can be used with MegaMatcher Accelerator 12.1 Standard:
  - Fast **fingerprint, palmprint, iris** and **face** matching engines that can be used **separately** or **together**. See technical specifications for engine comparison and licensing model for engine availability.
  - Fingerprint, palmprint, face, iris and voiceprint matching engines that can be used separately or together to validate matching results produced by the fast fingerprint, face and/or iris engines. See *MegaMatcher SDK* brochure for more information.
- MegaMatcher Accelerator software is distributed as **Docker containers** for using on **Linux** OS.
- Hardware is not included.
- Several PCs with the Standard Accelerator software can be combined using the included cluster software to reach a higher level of performance.

A **client communication module** is included with MegaMatcher 12.1 Extended SDK. The module allows the sending of a task to MegaMatcher Accelerator, querying the status of the task, retrieving the results and then removing the task. A high-level API is provided for the developer, all low-level communications are hidden.

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MegaMatcher Accelerator Development Edition

MegaMatcher Accelerator 12.1 Development Edition software is intended for developers who need to run MegaMatcher Accelerator software in-house for **software development** and **support** without the need to purchase a dedicated Standard or Extended unit. It is also suitable for for deploying **pilot projects**, as well as biometric projects with up to several million people enrolled in the database.

- Provides the same API for the developers as the Standard, Extended and Extreme versions of MegaMatcher Accelerator, thus the system deployment only requires to replace it with MegaMatcher Accelerator 12.1 Standard, Extended or Extreme.
- Has the same database capacity as the MegaMatcher Accelerator 12.1 Standard, but lower matching speed.
- Fast fingerprint, iris and face matching engines that can be used separately or together.
- One **free license** is available with the MegaMatcher 12.1 Extended SDK,
- MegaMatcher Accelerator software is distributed as **Docker containers** for using on **Linux** OS.
- Hardware is not included.

A **client communication module** is included with MegaMatcher 12.1 Extended SDK. The module allows the sending of a task to MegaMatcher Accelerator, querying the status of the task, retrieving the results and then removing the task. A high-level API is provided for the developer, all low-level communications are hidden.

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Technical Specifications

Database **storage capacities** for a single MegaMatcher Accelerator 12.1 unit are:

- **160,000,000 fingerprint records** or **200,000,000 iris records** or **40,000,000 face records** for each MegaMatcher Accelerator 12.1 **Extreme** unit.
- **40,000,000 fingerprint records** or **50,000,000 iris records** or **10,000,000 face records** or **4,000,000 palmprint records** for each MegaMatcher Accelerator 12.1 **Extended** unit.
- **4,000,000 fingerprint records** or **5,000,000 iris records** or **1,000,000 face records** or **400,000 palmprint records** for each PC that runs MegaMatcher Accelerator 12.1 **Standard** or **Development Edition** software.

Note, that the palmprint engine is not available with MegaMatcher Accelerator 12.1 Extreme.

If a biometric template contains several fingerprint, palmprint, face and/or iris records, the database storage capacity changes proportionally. The table below shows storage capacities for example combinations of fingerprints and/or irises records. There are no limitations on the quantity of fingerprint, palmprint, face or iris records in a template.

Product Advisor will help to determine how many MegaMatcher Accelerators would be required for a specific project (***www.neurotechnology.com/product-advisor.html***).

The actual database storage capacities for various combinations of biometric records are on the next page.

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Database storage capacities for single MegaMatcher Accelerator unit (templates)				
One template contains:	MegaMatcher Accelerator 12.1 Extreme	MegaMatcher Accelerator 12.1 Extended	MegaMatcher Accelerator 12.1 Standard	MegaMatcher Accelerator 12.1 Development Edition
1 fingerprint record	160,000,000	40,000,000	4,000,000	4,000,000
2 fingerprint records	80,000,000	20,000,000	2,000,000	2,000,000
1 face record	40,000,000	10,000,000	1,000,000	1,000,000
1 iris record	200,000,000	50,000,000	5,000,000	5,000,000
2 iris records	100,000,000	25,000,000	2,500,000	2,500,000
1 palmprint record	*Not supported*	4,000,000	400,000	400,000
2 palmprint records	*Not supported*	2,000,000	200,000	200,000
1 fingerprint + 1 face records	40,000,000	10,000,000	1,000,000	1,000,000
2 fingerprint + 1 face records	40,000,000	10,000,000	1,000,000	1,000,000
4 fingerprint + 1 face records	40,000,000	10,000,000	1,000,000	1,000,000
10 fingerprint + 1 face records	16,000,000	4,000,000	400,000	400,000
1 fingerprint + 1 iris records	160,000,000	40,000,000	4,000,000	4,000,000
1 fingerprint + 2 iris records	100,000,000	25,000,000	2,500,000	2,500,000
2 fingerprint + 1 iris records	80,000,000	20,000,000	2,000,000	2,000,000
2 fingerprint + 2 iris records	80,000,000	20,000,000	2,000,000	2,000,000
4 fingerprint + 2 iris records	40,000,000	10,000,000	1,000,000	1,000,000
10 fingerprint + 2 iris records	16,000,000	4,000,000	400,000	400,000
4 fingers + 1 palm record	*Not supported*	4,000,000	400,000	400,000
10 fingers + 2 palms records	*Not supported*	2,000,000	200,000	200,000
1 face + 1 iris records	40,000,000	10,000,000	1,000,000	1,000,000
1 face + 2 iris records	40,000,000	10,000,000	1,000,000	1,000,000
1 face + 1 palm record	*Not supported*	4,000,000	400,000	400,000
1 face + 2 palms records	*Not supported*	2,000,000	200,000	200,000
4 fingers + 1 face + 2 iris records	40,000,000	10,000,000	1,000,000	1,000,000
10 fingers + 1 face + 2 iris records	16,000,000	4,000,000	400,000	400,000

The tables on the next page show the performance of MegaMatcher Accelerator fast fingerprint, face, iris and palmprint matching engines on the specified hardware. The fingerprint engine specifications are valid for databases that contain flat fingerprint templates with 48 minutiae in average.

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MegaMatcher Accelerator 12.1 Extreme biometric engines matching speed	
One template contains:	Speed (templates per second)
1 fingerprint record	1,200,000,000
2 fingerprint records	600,000,000
4 fingerprint records	300,000,000
10 fingerprint records	120,000,000
1 face record	1,200,000,000
1 iris record	1,200,000,000
2 iris records	600,000,000

MegaMatcher Accelerator 12.1 Extended biometric engines matching speed (templates per second)			
One template contains:	Maximized matching speed configuration	Default settings configuration	Maximized matching accuracy configuration
1 fingerprint record	100,000,000	84,000,000	15,000,000
2 fingerprint records	55,000,000	42,000,000	6,000,000
4 fingerprint records	27,000,000	21,000,000	2,600,000
10 fingerprint records	10,500,000	9,000,000	1,500,000
1 face record	100,000,000		
1 iris record	200,000,000		
2 iris records	100,000,000		
1 palmprint record	2,000,000		
2 palmprint records	1,000,000		

MegaMatcher Accelerator 12.1 Standard biometric engines matching speed (templates per second)			
One template contains:	Maximized matching speed configuration	Default settings configuration	Maximized matching accuracy configuration
1 fingerprint record	35,000,000	27,000,000	3,500,000
2 fingerprint records	18,000,000	13,000,000	1,600,000
4 fingerprint records	8,000,000	6,000,000	700,000
10 fingerprint records	3,500,000	2,500,000	350,000
1 face record	35,000,000		
1 iris record	70,000,000		
2 iris records	35,000,000		
1 palmprint record	600,000		
2 palmprint records	300,000		

MegaMatcher Accelerator 12.1 Development Edition biometric engines matching speed (templates per second)			
One template contains:	Maximized matching speed configuration	Default settings configuration	Maximized matching accuracy configuration
1 fingerprint record	1,000,000	1,000,000	1,000,000
2 fingerprint records	500,000	500,000	500,000
4 fingerprint records	250,000	250,000	250,000
10 fingerprint records	100,000	100,000	100,000
1 face record	1,000,000		
1 iris record	1,000,000		
2 iris records	500,000		
1 palmprint record	20,000		
2 palmprint records	10,000		

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System Requirements

- MegaMatcher Accelerator software is distributed as **Docker containers**.
  - Any modern Linux distribution can be used as a base operating system, including Debian, Ubuntu or CentOS.
  - The distribution package includes **scripts for automatic installation** of all necessary components.

- MegaMatcher Accelerator 12.1 **Extreme** software should be run on server hardware or virtual machine with these specifications:
  - **24 processor cores**, running at **2.6 GHz** or higher frequency.
    - Two Intel Xeon Gold 6126 processors can be used as an example.
  - RAM, depending on the number of the biometric engines:
    - **512 GB RAM** – for single biometric engine or two biometric engines;
    - **1024 GB RAM** – for three biometric engines;
  - Persistent storage:
    - **SSD** is recommended for increasing overall system performance.
  - High-speed network connection

- MegaMatcher Accelerator 12.1 **Extended** software should be run on server hardware or virtual machine with these specifications:
  - **24 processor cores**, running at **2.6 GHz** or higher frequency.
    - Two Intel Xeon Gold 6126 processors can be used as an example.
  - RAM, depending on the number of the biometric engines:
    - **128 GB RAM** – for single biometric engine;
    - **256 GB RAM** – for two biometric engines;
    - **384 GB RAM** – for three biometric engines;
    - **512 GB RAM** – for four biometric engines;
  - Persistent storage:
    - **SSD** is recommended for increasing overall system performance.
  - High-speed network connection

- MegaMatcher Accelerator 12.1 **Standard** or **Development Edition** software should be run on PC, server hardware or virtual machine with these specifications:
  - **4 processor cores**, running at **3.5 GHz** or higher frequency.
  - **16 GB RAM.**
  - Persistent storage:
    - **SSD** is recommended for increasing overall system performance.
  - High-speed network connection

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Technical Support

The Hewlett Packard Company provides a 3 year worldwide warranty, with part replacement in 5 business days, for the server hardware. It is possible to receive part replacement in as little as 4 hours.

Neurotechnology provides free and unlimited technical support for MegaMatcher Accelerator over phone or email. Technical support covers issue resolution, bug fixing and providing the required technical information.

Related Products

- MegaMatcher Automated Biometric Identification System (ABIS) – a turnkey multi-biometric solution for national-scale identification projects. Available as **on-premise solution** and as **cloud service**. See *"MegaMatcher ABIS"* brochure for more information.
- MegaMatcher SDK – for development of AFIS or multi-biometric fingerprint, iris, face, voice and palm print identification products. Can be used to develop **multi-biometric client** applications for PCs, smartphones or tablets that will communicate with MegaMatcher Accelerator. The MegaMatcher Extended SDK includes MegaMatcher Accelerator 12.1 Development Edition software license. See *"MegaMatcher SDK"* brochure for more information.

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Licensing MegaMatcher Accelerator

MegaMatcher Accelerator is a **ready-to-use server-side solution** that accepts tasks from client-side software. Integrators **develop client-side software** according to their needs and then **deploy** the system as a whole.

MegaMatcher Accelerator software licenses are **available for new and existing customers of MegaMatcher Extended SDK.**

MegaMatcher 12.1 Extended SDK includes components and samples for developing the client-side software to use with MegaMatcher Accelerator.

MegaMatcher Accelerator 12.1 is available in these versions:

- MegaMatcher Accelerator 12.1 Extreme licenses; each license allows the use of the included engines on a single server unit:
  - MegaMatcher Accelerator 12.1 **fingerprint engine** license.
  - MegaMatcher Accelerator 12.1 **iris engine** license.
  - MegaMatcher Accelerator 12.1 **face engine** license.
- MegaMatcher Accelerator 12.1 Extreme units with server hardware and pre-installed biometric engines. The available engines are the same, as mentioned above.
- MegaMatcher Accelerator 12.1 Extended licenses; each license allows the use of the included engines on a single server unit:
  - MegaMatcher Accelerator 12.1 **fingerprint engine** license.
  - MegaMatcher Accelerator 12.1 **iris engine** license.
  - MegaMatcher Accelerator 12.1 **face engine** license.
  - MegaMatcher Accelerator 12.1 **palmprint engine** license.
- MegaMatcher Accelerator 12.1 Extended units with server hardware and pre-installed biometric engines. The available engines are the same, as mentioned above.
- MegaMatcher Accelerator 12.1 Standard licenses; each license allows the use of the included engines on a single PC:
  - MegaMatcher Accelerator 12.1 **fingerprint engine** license.
  - MegaMatcher Accelerator 12.1 **iris engine** license.
  - MegaMatcher Accelerator 12.1 **face engine** license.
  - MegaMatcher Accelerator 12.1 **palmprint engine** license.
- MegaMatcher Accelerator 12.1 Development Edition licenses; each license allows the use of the included engines on a single PC:
  - MegaMatcher Accelerator 12.1 **fingerprint engine** license.
  - MegaMatcher Accelerator 12.1 **iris engine** license.
  - MegaMatcher Accelerator 12.1 **face engine** license.
  - MegaMatcher Accelerator 12.1 **palmprint engine** license.

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Free licenses for MegaMatcher Accelerator 12.1 Development Edition with fingerprint, palmprint, face and iris engines – one free license for each engine – are included with MegaMatcher 12.1 Extended SDK. The MegaMatcher Accelerator 12.1 Extreme, Extended and Standard licenses, as well as MegaMatcher Accelerator 12.1 Extended and MegaMatcher Accelerator 12.1 Extreme editions units may be purchased by the MegaMatcher 3.x / 4.x / 5.x / 6.0 / 9.0 / 10.0 / 11.x / 12.x Extended SDK customers.

Disaster recovery licenses for MegaMatcher Accelerator software are also available. The disaster recovery licenses are intended for using in disaster recovery centers (DRC). A DRC is a location which has the same equipment as the primary site, completely mirrors the data environment of the primary site and is **on standby** while the primary site is working. If the primary site fails, the DRC takes over operations.

Licenses for MegaMatcher Accelerator software are available for disaster recovery centers with **40 % discount**. The server hardware for MegaMatcher Accelerator Extended units is provided for disaster recovery centers without discount.

Please contact us for more information about the disaster recovery licenses.

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Prices for MegaMatcher Accelerator

- The prices are **effective September 29, 2020**. 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.
- MegaMatcher Accelerator units and licenses 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***

MegaMatcher Accelerator 12.1 Development Edition (prices per license)				
Quantity	Fingerprint engine license	Face engine license	Iris engine license	Palmprint engine license
1	€ 3,000.00	€ 3,000.00	€ 3,000.00	€ 4,500.00
2	€ 2,790.00	€ 2,790.00	€ 2,790.00	€ 4,200.00
3	€ 2,630.00	€ 2,630.00	€ 2,630.00	€ 3,950.00
4	€ 2,520.00	€ 2,520.00	€ 2,520.00	€ 3,780.00
5	€ 2,430.00	€ 2,430.00	€ 2,430.00	€ 3,650.00
6	€ 2,360.00	€ 2,360.00	€ 2,360.00	€ 3,540.00
7	€ 2,300.00	€ 2,300.00	€ 2,300.00	€ 3,450.00
8	€ 2,250.00	€ 2,250.00	€ 2,250.00	€ 3,380.00
9	€ 2,220.00	€ 2,220.00	€ 2,220.00	€ 3,330.00
10	€ 2,180.00	€ 2,180.00	€ 2,180.00	€ 3,270.00
11 and more	Please contact us for more information			

MegaMatcher Accelerator 12.1 Standard (prices per license)				
Quantity	Fingerprint engine license	Face engine license	Iris engine license	Palmprint engine license
1	€ 20,000.00	€ 10,000.00	€ 20,000.00	€ 30,000.00
2	€ 18,600.00	€ 9,300.00	€ 18,600.00	€ 27,900.00
3	€ 17,500.00	€ 8,800.00	€ 17,500.00	€ 26,300.00
4	€ 16,800.00	€ 8,400.00	€ 16,800.00	€ 25,200.00
5	€ 16,200.00	€ 8,100.00	€ 16,200.00	€ 24,300.00
6	€ 15,700.00	€ 7,900.00	€ 15,700.00	€ 23,600.00
7	€ 15,300.00	€ 7,700.00	€ 15,300.00	€ 23,000.00
8	€ 15,000.00	€ 7,500.00	€ 15,000.00	€ 22,500.00
9	€ 14,800.00	€ 7,400.00	€ 14,800.00	€ 22,200.00
10	€ 14,500.00	€ 7,300.00	€ 14,500.00	€ 21,800.00
11 and more	Please contact us for more information			

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MegaMatcher Accelerator 12.1 Extended (prices per license)				
Quantity	Fingerprint engine license	Face engine license	Iris engine license	Palmprint engine license
1	€ 51,000.00	€ 20,000.00	€ 51,000.00	€ 76,500.00
2	€ 47,600.00	€ 18,600.00	€ 47,600.00	€ 71,400.00
3	€ 44,700.00	€ 17,500.00	€ 44,700.00	€ 67,100.00
4	€ 42,700.00	€ 16,800.00	€ 42,700.00	€ 64,100.00
5	€ 41,300.00	€ 16,200.00	€ 41,300.00	€ 62,000.00
6	€ 40,100.00	€ 15,700.00	€ 40,100.00	€ 60,200.00
7	€ 39,100.00	€ 15,300.00	€ 39,100.00	€ 58,700.00
8	€ 38,400.00	€ 15,000.00	€ 38,400.00	€ 57,600.00
9	€ 37,700.00	€ 14,800.00	€ 37,700.00	€ 56,600.00
10	€ 37,000.00	€ 14,500.00	€ 37,000.00	€ 55,500.00
11 and more	Please contact us for more information			

Server hardware for MegaMatcher Accelerator 12.1 Extended (prices per unit)	
HPE ProLiant DL360 Gen10 (128 Gb RAM)	€ 8,500.00
HPE ProLiant DL360 Gen10 (256 Gb RAM)	€ 10,600.00
HPE ProLiant DL360 Gen10 (384 Gb RAM)	€ 12,650.00

MegaMatcher Accelerator 12.1 Extreme (Prices per license)			
Quantity	Fingerprint engine license	Iris engine license	Face engine license
1	€ 195,000.00	€ 195,000.00	€ 76,000.00
2	€ 182,000.00	€ 182,000.00	€ 70,900.00
3	€ 170,800.00	€ 170,800.00	€ 66,600.00
4	€ 163,300.00	€ 163,300.00	€ 63,700.00
5	€ 157,700.00	€ 157,700.00	€ 61,500.00
6	€ 153,300.00	€ 153,300.00	€ 59,700.00
7	€ 149,600.00	€ 149,600.00	€ 58,300.00
8	€ 146,600.00	€ 146,600.00	€ 57,100.00
9	€ 143,900.00	€ 143,900.00	€ 56,100.00
10	€ 141,500.00	€ 141,500.00	€ 55,200.00
11 and more	Please contact us for more information		

Server hardware for MegaMatcher Accelerator 12.1 Extreme (prices per unit)	
HPE ProLiant DL360 Gen10 (512 Gb RAM)	Please contact us for more information
HPE ProLiant DL360 Gen10 (1024 Gb RAM)	Please contact us for more information

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