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Next Generation Biometrics Matching Engine using FPGA (Field Programmable Gate Array)

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Identity & Biometric Solutions

In recent years, biometrics technology has gained increased public acceptance. Biometric applications have been extended from the traditional field of law enforcement to the fields of public security, border control, military, healthcare, civil identity, population registration, voter registration, physical and logical access control as well as commercial applications. In these applications, the size of the biometric database has increased dramatically. Biometric solution providers are facing the challenges of providing real-time biometric identification and authentication solutions for these large scale database applications, yet with increasingly strict matching accuracy requirements.
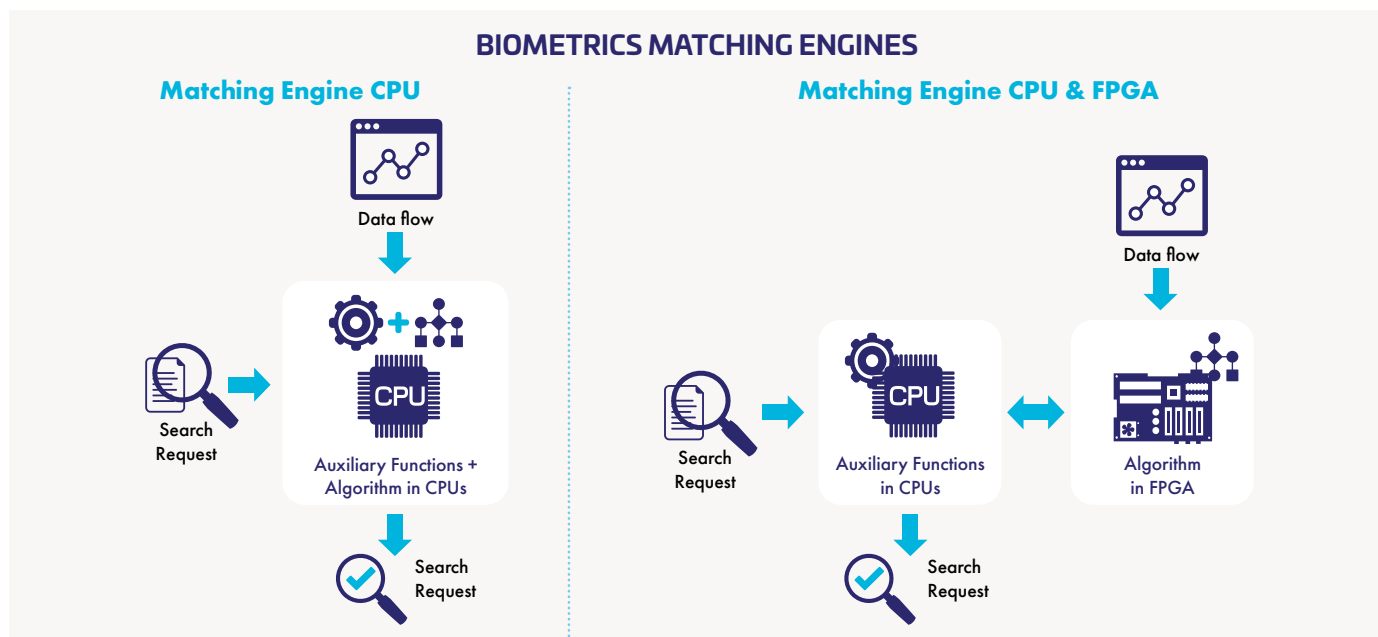
The biometric matching engine is the heart of the biometrics system. By executing the biometric matching algorithm, it processes the biometric matching request and provides the matching results. For example, it may receive a request to perform a fingerprint search against a fingerprint database with hundreds millions of database records and to provide a result of either a hit or a miss within 1 to 2 seconds. To accomplish the task, the matching engine needs to process a tremendous amount of computations within the specified time frame.

The biometric matching engines can be built with different architectures – the algorithm can:
- run on the server CPUs only,
- use the server CPUs and FPGA.

Thales' biometrics technology and matching engine have been leading the industry in terms of matching speed and accuracy for more than 20 years. Our FGPA based matching engine offers unique advantages:

- **Fast matching speed:** FPGA offers low latency, massively parallel data processing with advanced hardware acceleration
- **System cost reduction:** Off-loading the heavy CPU calculations to FPGA acceleration cards results in fewer
- **Higher power efficiency:** FPGA data processing consumes much less power than CPUs alone to achieve the same matching throughput
- **Scalability:** Horizontal scaling advantage by duplicating the server entities; vertical scalability advantage by increasing the number of acceleration cards in the system
- **Flexibility:** Reconfigurable circuits, algorithms on FPGA can be improved by reprogramming without needing to buy new hardware
- **Commercial off-the-shelf (COTS):** The availability of FPGA cards from several vendors prevents vendor lock-in
- **Environmental sustainability:** FPGA option, depending on system specification, can lead up to 75% less servers, and around 50% less CO_2 emissions

BIOMETRICS MATCHING ENGINES

Matching Engine CPU

Data flow

Search Request

Auxiliary Functions + Algorithm in CPUs

Search Request

Matching Engine CPU & FPGA

Data flow

Search Request

Auxiliary Functions in CPUs

Algorithm in FPGA

Search Request

COMPARISON	MATCHING ENGINE - CPU	MATCHING ENGINE – CPU & FPGA
Latency/Matching Speed		✔
Total System Cost Saving		✔
Power Efficiency		✔
Footprint saving		✔
Horizontal Scalability	✔	✔
Vertical Scalability		✔
Adaptability		✔
Environmental Sustainability		✔

What is FPGA?

FPGA, or Field Programmable Gate Array, is an integrated circuit that can be customized for a specific application. FPGAs are "field-programmable", meaning they can be configured by the user after manufacturing. FPGAs contain programmable logic blocks that can be wired in different configurations.

What are the benefits of the FPGA COTS cards?

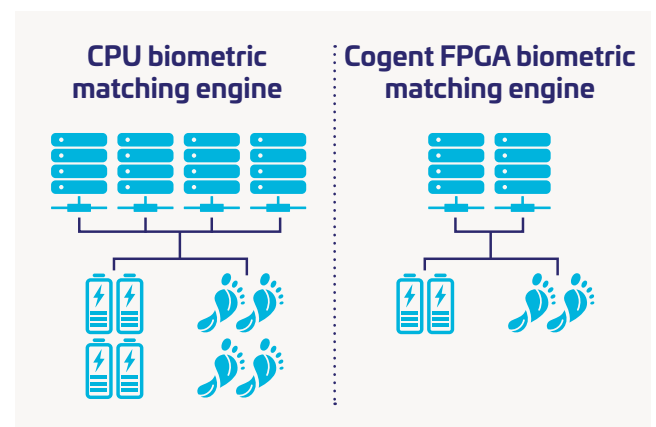Several manufacturers offer a range of commercial off-the-shelf (COTS) FPGA cards.

These Accelerator Cards are designed for general purpose use, to accelerate workloads including high performance computing, computational storage, data analytics and video processing. Like the various CPU chips, these Accelerator Cards are standard, non proprietary, general purpose and commercially available.

In addition, COTS Accelerator Cards and related software packages are certified by the mainstream server companies and OS vendors, including HPE and Dell and are certified for RedHat Linux Enterprise operating system.

Commercial off-the-shelf products have "no vendor lock-in". They became mainstream in the past few years due to demand in financial and scientific computing markets, linked to their ability to provide predictable low-latency response. At the same time, programming tools have evolved to improve adoption. FPGAs do not require special drivers, thus limiting potential incompatibility issues. They are available from vendors, including Xilinx, Intel and their partners.

Thales has combined its 20+ years experience with biometric hardware matching engine with the latest FPGA COTS technology, to continue to lead the industry by providing the fastest, most accurate, Cloud and on-premises accessible, hardware matching engine. Our biometrics system solution is best suitable for very large scale biometrics systems in the following aspects:

- Highest speed and accurate performance

- System deployment cost saving

- System maintenance cost saving from power consumption and smaller footprint,

- Cloud and on-premises deployment option benefit from the standard, non-proprietary, general purpose COTS hardware selection

- Adaptable biometrics system which can benefit from future progress of biometrics algorithm and architecture improvement.

- Most robust and reliable large scale biometrics system.

CPU biometric matching engine   **Cogent FPGA biometric matching engine**

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