

Title

Biometric Technologies and Security - International Biometric Standards Development Activities

Name and Affiliation

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Related Concepts

Security standards, token standards, smart card standards, authentication standards, ID management standards, cyber-security standards

Definition

For any given technology, industry standards assure the availability in the marketplace of multiple sources for compatible products. In addition to benefiting end-users, system developers and private industry, standards also benefit other customers such as the standards bodies that are developing related standards.

Background

Biometric technologies establish or verify the personal identity of previously enrolled individuals based on biological or behavioural characteristics (i.e., ascertaining what you are). Examples of biological characteristics are hand, finger, facial, and iris. Behavioural characteristics are traits that are learned or acquired, such as dynamic signature verification and keystroke dynamics. Using biometric technologies for identifying human beings offers some unique advantages, as they are the only technologies that can really identify an individual or verify an individual's identity. Other technologies such as tokens (e.g., what you have) can be lost or stolen. Passwords (e.g., what you know) can be forgotten, shared, or observed by another individual. Used alone, or together with other authentication technologies such as tokens, biometric technologies can provide higher degrees of security than other technologies employed alone and can also be used to overcome their weaknesses. For decades, biometric technologies were used primarily in law enforcement applications, and they are still a key component of these important applications. Over the past several years the marketplace for biometric-based applications has widened significantly; they are now increasingly being used in multiple public and private sector applications worldwide [1]. Currently, biometric technologies are found in a number of global government projects for diverse applications such as border, aviation, maritime, transportation security and physical / logical access control. Market opportunities for biometrics also include financial institutions (e.g., employee-based / customer-based applications), the healthcare industry (e.g., service provider security to protect patient privacy, patient delivery verification protecting patient and provider) and educational applications (e.g., school lunch programs / online identity verification, parent / guardian verification for child release). Consumer uses are also expected to significantly increase for personal security and for convenience in diverse applications such home automation and security (e.g., home alarm systems & environmental controls, door locks & access control systems), retail (e.g., point of purchase authentication at retail locations) and applications in the gaming and hospitality industries. Biometric technologies are also found in cell phones, mobile computing devices (e.g., laptops, PDS) and portable memory storage [2] [3].

The deployment of standards-based biometric technologies is expected to significantly raise levels of security for critical infrastructures, which has not been possible to date with other technologies. Deploying these systems requires a comprehensive set of international, technically sound standards that meet the customer's needs. Biometric

standards promote the availability of multiple sources of compatible products in the marketplace. In addition to benefiting end-users, system developers and the IT industry, biometric standards benefit other customers such as the standards committees that are developing related standards in support of personal authentication and security as well as the end-users of these standards. The status of international, voluntary biometric standards and ongoing standard development efforts are discussed below. The need for these open, international, voluntary consensus biometric standards will continue to grow.

International Biometric Standards

Major efforts associated with the development of international biometric standards are underway under the umbrella of the Joint Technical Committee 1 of ISO and IEC on "Information Technology". JTC 1's scope is "International standardization in the field of Information Technology". Information Technology includes the specification, design and development of systems and tools dealing with the capture, representation, processing, security, transfer, interchange, presentation, management, organization, storage and retrieval of information. According to the JTC 1 Long-term Business Plan [4], "ISO/IEC JTC 1 is the standards development environment where experts come together to develop worldwide Information and Communication Technology (ICT) standards for business and consumer applications. Additionally, JTC 1 provides the standards approval environment for integrating diverse and complex ICT technologies. These standards rely upon the core infrastructure technologies developed by JTC 1 centers of expertise complemented by specifications developed in other organizations".

ISO/IEC JTC 1 Subcommittee 37 – "Biometrics" (JTC 1/SC 37) was established by JTC 1 in June 2002. JTC 1 /SC 37 is responsible for the development of a large portfolio of International biometric standards. Since its inception, JTC 1/SC 37 has addressed the standardization of generic biometric technologies pertaining to human beings to support interoperability and data interchange among applications and systems. From the Subcommittee's perspective, generic biometric standards include: common file structures; biometric application programming interfaces; biometric data interchange formats; related biometric application profiles; application of evaluation criteria to biometric technologies; methodologies for performance testing and reporting, and cross jurisdictional and societal aspects. The main JTC 1/SC 37 goal is the development of international standards that support the mass market adoption of biometric technologies. Additional goals are that other JTC 1 Subcommittees and ISO/IEC Technical Committees use these standards by reference within their own standards projects and that organizations external to ISO and IEC (consortia, government institutions and the private sector) use them as well to specify the use of standards-based solutions for their requirements. Since June 2002, thirty-seven standards (including amendments, corrigenda, and technical reports) developed by JTC 1/SC 37 have been published. ISO maintains a list of these published standards and provides a description of the content of each standard at its web site [5].

JTC 1/SC 37 has completed first editions of many biometric standards. They include biometric Application Programming Interfaces, biometric data structures to store or transmit any type of biometric data independently of the biometric modality, biometric data interchange formats for a number of biometric modalities, biometric performance testing and reporting methodologies, biometric application profiles and technical reports addressing jurisdictional and societal considerations for commercial applications. Other publications include a biometric tutorial and a technical report on multimodal and other multi-biometric fusion.

Currently the Subcommittee is developing additional biometric standards to address technology innovations and new customers' needs. Also, second editions of several biometric standards are being developed, which add clarifications to the contents of previously published first editions. In addition to revision projects for the biometric data interchange formats standards, other biometric testing methodology standards and new biometric technical

interfaces, the Subcommittee is addressing the standardization of conformance testing methodology standards for the biometric data interchange formats and biometric technical interfaces. Biometric sample quality standards are being developed and jurisdictional and societal issues on the use of biometric technology are being addressed, including the development of pictograms, icons and symbols for use within biometric systems, the use of biometric technology in commercial identity management applications and processes and guidance on the inclusive design and operation of biometric systems.

The JTC 1/SC 37 membership currently consists of twenty-five countries that participate in the work as voting members. In addition, the Subcommittee has seven observer countries. A number of liaison organizations participate as well. The current list of countries participating and other important public information can be obtained through the JTC 1/SC 37 web site [6].

JTC 1/SC 37's work is performed by six Working Groups (WGs) that address different aspects of biometric standardization:

- *WG 1 – Harmonized biometric vocabulary*
- *WG 2 – Biometric technical interfaces*
- *WG-3 – Biometric data interchange formats*
- *WG-4 - Biometric functional architecture and related profiles*
- *WG 5 - Biometric testing and reporting*
- *WG 6 - Cross-jurisdictional and societal aspects of biometrics*

WG1 has already specified over one hundred harmonized terms and definitions. This work is expected to lead to the development of an international standard for a comprehensive harmonized biometric vocabulary.

WG 2 is addressing the standardization of all necessary interfaces and interactions between biometric components and sub-systems, including the possible use of security mechanisms to protect stored data and data transferred between systems. Representative projects include a biometric Application Programming Interface (BioAPI) multi-part standard (ISO/IEC 19784) and the development of a Biometric Exchange Formats Framework (CBEFF) multi-part standard (ISO/IEC 19785). Several parts of these multi-part standards have been published. WG 2 has also developed a BioAPI Interworking Protocol (BIP) (ISO/IEC 24708), which was a joint development project with ITU-T SG 17 (International Telecommunication Union – Study Group 17 – Security) [7]. WG 2 is also developing a conformance testing methodology multi-part standard for BioAPI and is considering the development of advanced biometric interfaces that may be needed, for example, for enrolment by a remote station to a central database; authentication exchanges between a point of sale terminal and its related database; interfaces for building access; interfaces from border control stations to their underlying database, and interfaces needed to support other applications.

WG 3 is dealing with the standardization of the content, meaning, and representation of biometric data formats which are specific to a particular biometric technology or technologies. The ISO/IEC 19794 multi-part standard (eleven parts already published) specifies biometric data interchange formats for a number of biometric modalities including finger, face, iris, signature/sign and vascular data. WG 3 has begun development of the second edition of these standards to address technology innovations, the inclusion of richer metadata and new customers' needs. Development of revised data interchange formats specified in the published standards as well as data formats for two other modalities

(voice and DNA data) are underway. WG 3 is also developing a biometric sample quality multi-part standard (ISO/IEC 29794) One part has been published (Part 1: Framework) and two additional parts (Part 4: Finger Image Data and Part 5: Face Image Data) have been completed. Development of conformance testing methodology standards for the biometric data interchange formats is also underway. Future activities under consideration in WG 3 include transition of the data formats to XML encoding (or development of a complementary format); conformance level 3 (semantic) testing for the data formats; development of technical reports supporting the normative requirements in the standards, and development of a new part for the biometric sample quality standard (iris image).

WG 4 is addressing the standardization of biometric functional architecture and related profiles that bind together the various biometric-related base standards in a manner consistent with functional blocks of operation of biometric systems. These profiles identify the pertinent biometric-related base standards. They also define which optional fields of the base standards shall be used, as well as how to set the configurable parameters, in order to achieve interoperability within a set of pre-defined constraints. Three parts of a multi-part standard (ISO/IEC 24713) are now published: Part 1: Overview of biometric systems and biometric profiles; Part 2: Physical access control for employees at airports, and Part 3: Biometric Based Verification and Identification of Seafarers. The latter was developed in liaison with the ILO (the International Labour Organization of the United Nations). WG 4 has initiated the development of two Technical Reports: Guidance for Biometric Enrolment and Passenger Processes for Biometric Recognition in Automated Border Crossing Systems. WG 4's program of work includes the development of international consensus biometric profiles that can support a single end user (e.g., ILO) or many end users (e.g., airport authorities) who have collective requirements for biometric interoperability on a local to worldwide basis. Potential areas of additional biometric profile development by WG 4 include: physical access control for travelers; verification of customers at points-of-sale, and physical/logical access control for employees in manufacturing and service sectors such as healthcare, education, transportation, finance, government, etc.

WG 5 is handling the standardization of testing and reporting methodologies and metrics that cover biometric technologies, systems and components. Three parts of a biometric performance testing and reporting multi-part standard (ISO/IEC 19795) have been published: Part 1: Principles and framework; Part 2: Testing methodologies for technology and scenario evaluation, and Part 4: Interoperability performance testing. Part 3, Modality-specific testing, has been published as a Technical Report. Additional parts of this multi-part standard are under development. WG 5 is also progressing: a multi-part standard to specify machine readable test data for biometric testing and reporting; a Technical Report that will provide guidance for specifying performance requirements to meet security and usability needs in applications using biometric, and a Technical Report addressing the characterization and measurement of difficulty for fingerprint databases for technology evaluation. WG 5 recognizes the need to identify developments, new requirements and technologies that may not be amenable to testing using the current test processes. Such areas may include testing of behavioural aspects of biometric technologies relating to so called behavioural biometrics and behavioural elements of biological biometrics. There is also a perceived requirement for a standard, or minimally, a Technical Report specific to identification system testing. The current versions of the ISO/IEC 19795 multipart standard treat identification metrics and methodologies, but the full range of considerations specific to identification systems (e.g., ingestion, queuing, and hardware optimization) is not addressed.

WG 6 is addressing the field of cross-jurisdictional and societal aspects in the application of international biometrics standards. Within this context, the scope of work includes the support of design and implementation of biometric technologies with respect to accessibility, health and safety, support of legal requirements and acknowledgement of cross jurisdictional and societal considerations pertaining to personal information. A multi-part Technical Report (TR 24714) covers jurisdictional and societal considerations for commercial applications. Part 1 (General guidance) is

published. WG 6 is also developing another multi-part Technical Report (24779) on pictograms, icons and symbols for use with biometric systems. Recently two new projects were initiated: a Technical Report on the use of biometric technology in commercial Identity Management applications and processes and a Technical Report that is aimed at providing guidance on the inclusive design and operation of biometric systems. Needs for additional projects in the WG 6 area of work are being considered.

Overall, JTC 1/SC 37 is currently responsible for the development and maintenance of ninety-five projects. The published international standards can be obtained (for a fee) through the International Standards Organization web site [8] and individual National Body (country) web sites. As discussed below, other JTC1 Subcommittees are involved in the development of biometric standards for certain aspects of standardization within their scope of work. JTC1 Subcommittee 17 - *Cards and personal identification*, specifies the application of biometric technologies to cards and personal identification and JTC 1 Subcommittee 27 - *IT Security techniques* is currently documenting the use of biometrics in some security standards. Other international organizations currently involved in some aspects of biometric standardization or the use of biometric standards for their own standards, specifications or requirements include ITU-T and ILO mentioned above, ICAO (the International Civil Aviation Organization), ISO Technical Committee 68 (Financial Services), the VoiceXML Forum, and the BioAPI Consortium (who developed the initial version of the BioAPI specification). Figure 1 provides an overall scenario of the international organizations involved in different aspects of biometric standardization or requirements for the use of biometrics in applications. JTC 1/SC 37 collaborates with a number of these organizations through technical development teams established by the Subcommittees and through liaison relationships with the goal of supporting the harmonization of biometric, token, security and telecommunication standards.

The technologies addressed by JTC 1/SC 17 and JTC 1/SC 37 are, for some applications, complementary in nature. JTC 1/SC 17 is addressing the development of a standard specifying on-card biometric comparison (ISO/IEC 24787). The standard is developed on the basis of ISO/IEC 7816-11 (Identification cards -- Integrated circuit cards -- Part 11: Personal verification through biometric methods). JTC 1/SC 37 has also contributed to JTC 1/SC 17's work that uses the compact data interchange formats specified in some of the JTC 1/SC 37 standards, such as the ccompact formats in the finger-minutia and finger patterns data format standards.

JTC 1/ SC 27 addresses a number of projects related to biometrics or the use of biometric standards. JTC 1/ SC 27 developed ISO/IEC 19792: *Security evaluation of biometrics*, which was published in 2009. This standard specifies the biometric-specific aspects and principles to be considered during the security evaluation of a biometric system. It does not address the non-biometric aspects which might form part of the overall security evaluation of a system using biometric technology (e.g. requirements on databases or communication channels). ISO/IEC 24761: *Authentication context for biometrics* was also published in 2009. This standard defines the structure and the data elements of Authentication Context for Biometrics (ACBio), which is used for checking the validity of the result of a biometric verification process executed at a remote site. This allows any ACBio instance to accompany any data item that is involved in any biometric process related to verification and enrolment. Ongoing projects in JTC 1/SC 27 where JTC 1/SC 37 is also contributing include: *Security techniques - Biometric Template Protection* (draft standard ISO/IEC 24745); *A framework for access management* (draft standard ISO/IEC 24745); *A framework for identity management* (ISO/IEC 24760); *Requirements on relative anonymity with identity escrow* (ISO/IEC 29191); *Privacy framework* (ISO/IEC 29100); *Privacy Reference Architecture* (ISO/IEC 29101); and *Entity authentication assurance* (ISO/IEC 29115). Figure 2 depicts the international biometric standards activities within JTC 1 Subcommittees.

JTC 1/SC 37 has contributed to other biometric-related standards including ISO 19092, *Biometrics - Security Framework*, that was published in 2008. This standard was developed by Subcommittee 2 of ISO Technical

Committee 68. Using established collaborative procedures between ITU-T and JTC 1, coordination of work between JTC1/SC 37 and ITU-T SG17 is ongoing in areas such as security requirements and specifications and authentication. JTC 1/SC 37 has contributed to a number of projects developed by ITU-T related to Telebiometrics such as the BIP (Biometric Interworking Protocol) project. JTC 1/SC 37 also maintains close liaison relationships with other organizations such as the BioAPI Consortium, the International Biometric Industry Association (IBIA) and the International Labour Office of the UN. The BioAPI Consortium developed the initial specification of the BioAPI standard and is actively participating in the JTC 1/SC 37 standards activities that are related to the continued development of this standard. IBIA serves as the Common Biometric Exchange Formats Framework (CBEFF) Registration Authority for the JTC 1/SC 37 standard ISO/IEC 19785. JTC 1/SC 37 maintains an active liaison with this organization and assists them in fulfilling this important role. As stated above, the ILO and JTC 1/SC 37 collaborated in the development of a biometric profile (Biometric Based Verification and Identification of Seafarers). This work takes into account ILO's requirements for a detailed biometric profile for verification and identification of seafarers.

Biometric Standards Adoption

A number of the biometric standards developed by JTC 1/SC 37 are already required by international and national organizations. ICAO, for example, selected facial recognition as the globally interoperable biometric for machine-assisted identity confirmation for Machine Readable Travel Documents (MRTD). ICAO requires conformance to the face recognition standard developed by JTC 1/SC 37. Other ICAO requirements for JTC 1/SC37 standards are the fingerprint data interchange formats, the iris recognition interchange format, and an instantiation of the Common Biometric Exchange Formats Framework. ILO's requirements for the Seafarers' ID Card include the use of two fingerprint templates to be stored in a barcode placed in the area indicated by the ICAO's 9303 standard. ILO's requirements specify the use of some of the standards approved by JTC 1/SC 37; specifically finger minutiae and finger image data interchange formats and an instantiation of a CBEFF data structure. The European Union (EU) password specification working document [9] describes solutions for chip enabled EU passports, based on EU's Council Regulation on standards for security features and biometrics in passports and travel documents issued by Member States [10]. The specification relies on international standards, especially ISO/IEC standards and ICAO recommendations on MRTDs, and includes specifications for biometric face and fingerprint identifiers; thus, the specifications are underpinned by ISO/IEC standards resulting from the work of JTC 1/SC 37. A number of standards are referred to in this EU document including an ICAO New Technology Working Group's Technical Report [11] as well as the ISO/IEC 19794-4:2005 and ISO/IEC 19794-5:2005 standards developed by JTC 1/SC 37.

Countries participating in JTC 1/SC 37 are also adopting standards developed by this Subcommittee. In Spain, the electronic national identity card (DNle) includes personal information of the citizen, details of electronic certificates and the biometric information. The image of the face is stored following ISO/IEC 19794-5 and ICAO standards. Finger minutiae are stored using the ISO/IEC 19794-2 standard. In addition, the biometric data included in Spanish e-Passports is the image of the face based on ISO/IEC 19794-5 and ICAO standard compliant stored in JPEG2000 format (ISO 15444) [12]. In the United States of America, several organizations require selected biometric data interchange standards developed by JTC1/SC 37 and some of the ongoing biometric testing programs use some of the performance testing methodology standards developed by the Subcommittee. The Registry of U.S. Government Recommended Biometric Standards developed by the National Science and Technology Council Subcommittee on Biometrics and Identity Management [13] recommends some of the data formats specified in JTC 1/SC 37 standards: the finger minutiae, face image and iris image data interchange formats as well as the BioAPI specification and its

companion conformance testing methodology standard. Two parts of the multi-part performance testing methodology standard are also included in the Registry.

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