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R e s e a r c h C o n s u l t i n g I n t e g r a t i o n

Multimodal Biometric Systems: Applications and Usage Scenarios

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International Biometric Group
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Agenda

- About International Biometric Group
- Multimodal Biometrics: Overview and Developments
- Target Applications
- AMOLD Framework
- Multimodal Verification and Identification Models
- Issues and Challenges

International Biometric Group

- Independent biometric technology solutions, consulting, and research & testing firm, founded in 1996
- Offices in New York, Washington, D.C., London
 - Including BiometricStore, a hands-on showroom and test facility with over 75 hardware and software solutions
- Technology-neutral and vendor-independent
 - Extensive experience across all biometric technologies
 - IBG does not resell or distribute biometric hardware
- Key services
 - Evaluate large-scale biometric projects for government agencies, recommending technologies, process design, system design
 - Build product and services development strategies for systems integration, high-tech, and industrial firms
 - Conduct scenario-based biometric accuracy testing
 - Design and deploy custom solutions for IT security, e-commerce, access control, public sector ID systems

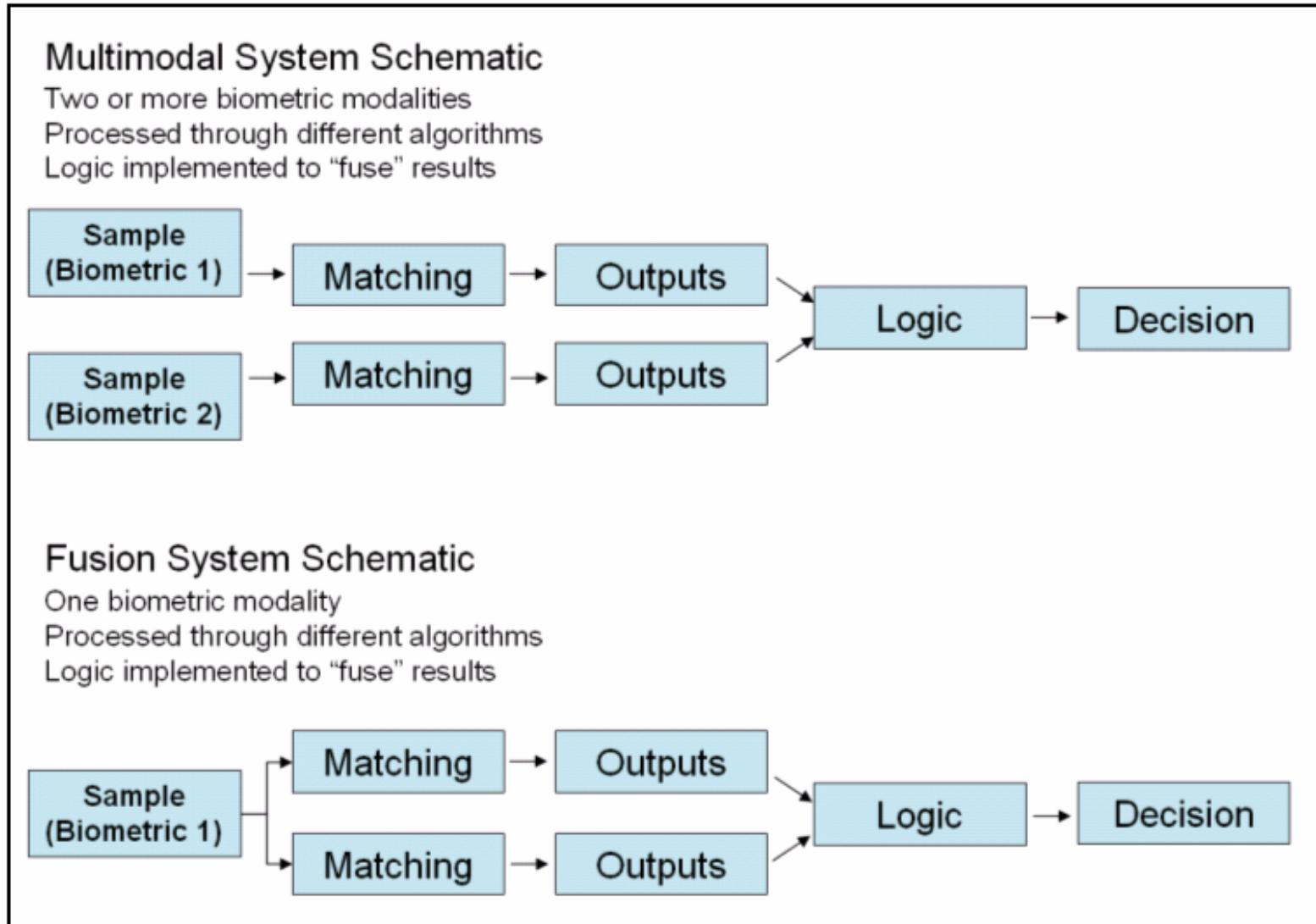
Representative IBG Clients

Technology & Transportation	Federal - State - Local Government Agencies	Financial Services
American Airlines	AAMVA	AIG
Diebold	California DMV	Charles Schwab
EDS	White House OSTP	Chase Manhattan Bank
Ingersoll-Rand	Federal Aviation Administration	Citibank
Intel	Ontario, Canada MBS	Dresdner Bank
Kensington	National Institute of Justice	Fidelity Investments
Lockheed Martin	NYPD	FSTC
Microsoft	Transport Canada	Visa
Raytheon	U.S. Navy/SPAWAR	World Bank

Multimodal Biometrics: Definition

- Multimodal biometric systems are those which utilize, or are capability of utilizing, more than one physiological or behavioral characteristic for enrollment, verification, or identification
- Open issues
 - Terminology used in reference to multimodal biometric systems
 - Concepts of operation of multimodal biometric systems
 - Evaluating performance of multimodal biometric systems

Multimodal and Fusion



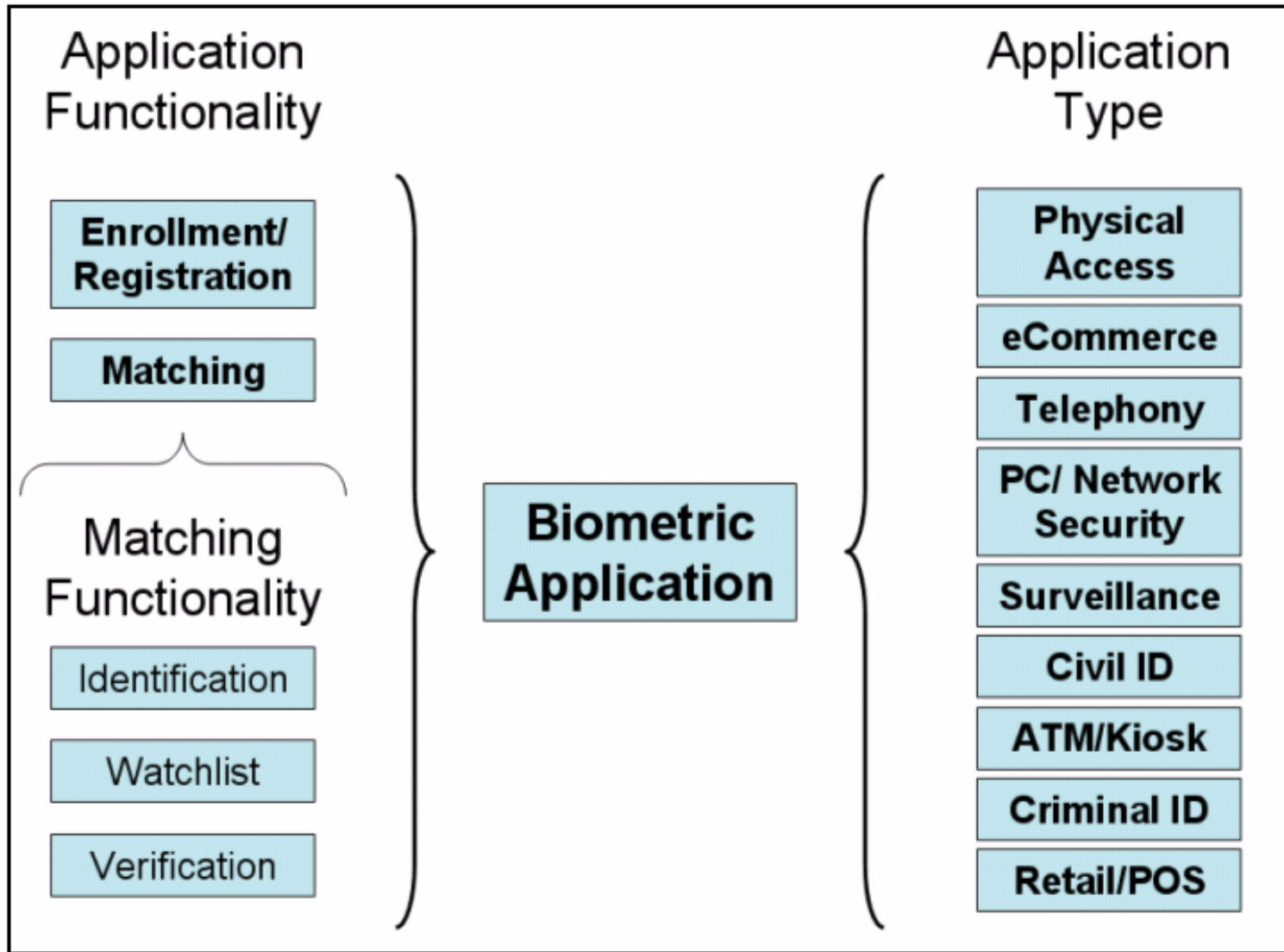
Benefits and Advantages of Multimodality

- Accuracy
 - FNMR, FMR
- Enrollment
 - FTE
 - Universal registration requirements
- Anti-Spoofing

Typical Multimodal Implementations

- Biometric Automated Toolset
 - Face, finger, iris, voice
 - Afghani detainees
- Narita Airport
 - Iris, face
 - Airport
- GA DL/ID
 - Finger, face
 - Through Viisage-SMI
- Other developments
 - SAGEM (France) teams with Iridian, Identix (face), Cognitec

Evaluating Applications



Application Characteristics

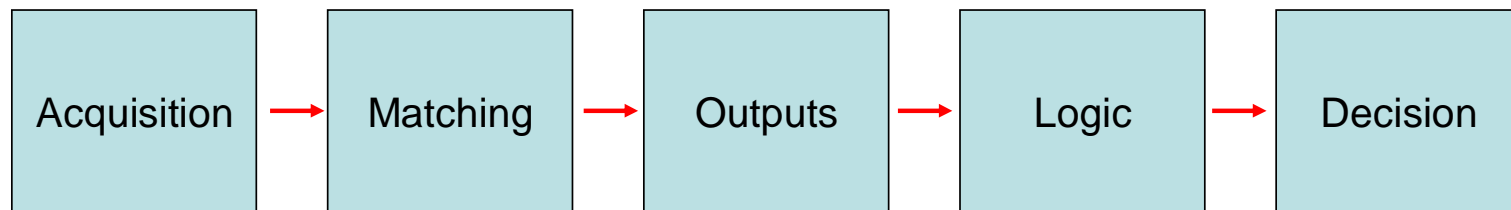
- Application characteristics drive the need for multimodal biometrics
 - Risk and Viability of Spoofing
 - Universal Enrollment Requirements
 - Accuracy/Integrity Requirements
 - Suitability in Usage Environment
 - Transaction Time Flexibility

Target Applications

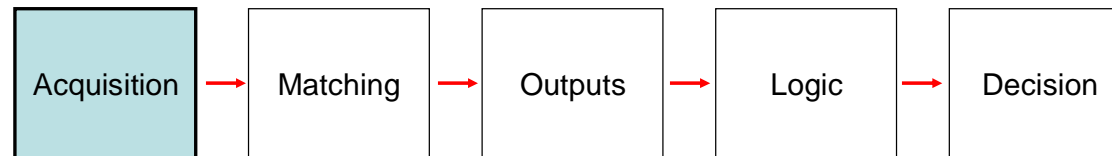
- Strong Potential for Multimodal Solutions
 - Physical Access
 - Civil ID
 - Criminal ID
- Moderate Potential for Multimodal Solutions
 - Network/PC Access
 - Kiosk/ATM
- Modest Potential for Multimodal Solutions
 - Retail/POS
 - Surveillance
 - eCommerce
 - Telephony

AMOLD Framework

- How do we categorize and discuss variables in multimodal applications?
 - Use what we know: the biometric processing cycle
 - **A**cquisition
 - **M**atching
 - **O**utput
 - **L**ogic
 - **D**ecision

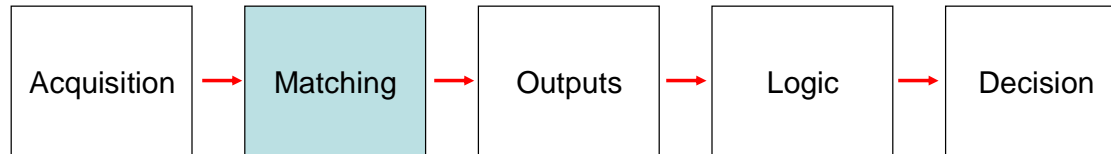


Multimodal Acquisition



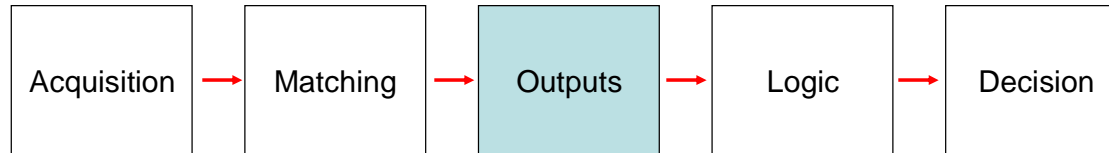
Number of Acquisition Devices
Number of Core Technologies
Acquisition Contingency
Enrollment Quality Contingency
Authentication Sample Quality Contingency
Simultaneous Acquisition
Synchronous Acquisition
Asynchronous Acquisition
Result Contingency

Multimodal Matching



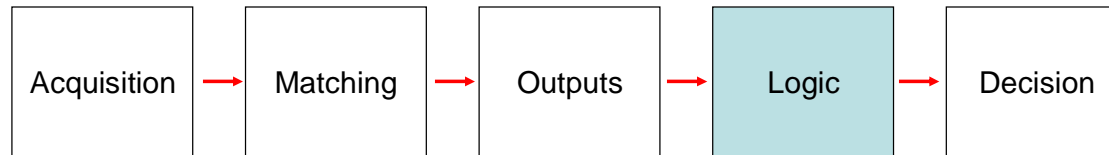
Number Of Core Technologies
Number Of Algorithms
Situational Matching
Match Contingency
Source Fusion

Multimodal Outputs



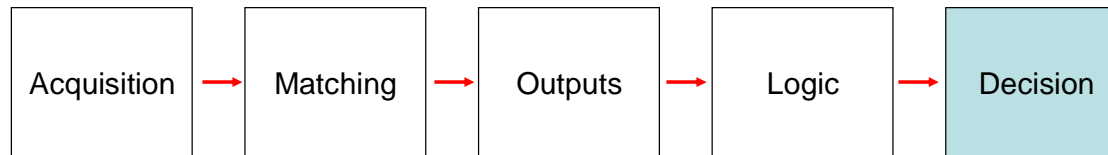
Rank 1
Rank X
Binary Output
Native Score Outputs
BioAPI Score Output
Probability Output

Multimodal Logic



System Weight
Score Weight
Binary Match 'And'
Binary Match 'Or'
Match Score 'And'
Match Score 'Or'
Combined Score 'And'
Rank N Match 'Or'
Rank N Match 'And'
Rank 1 Match 'Or'
Rank 1 Match 'And'

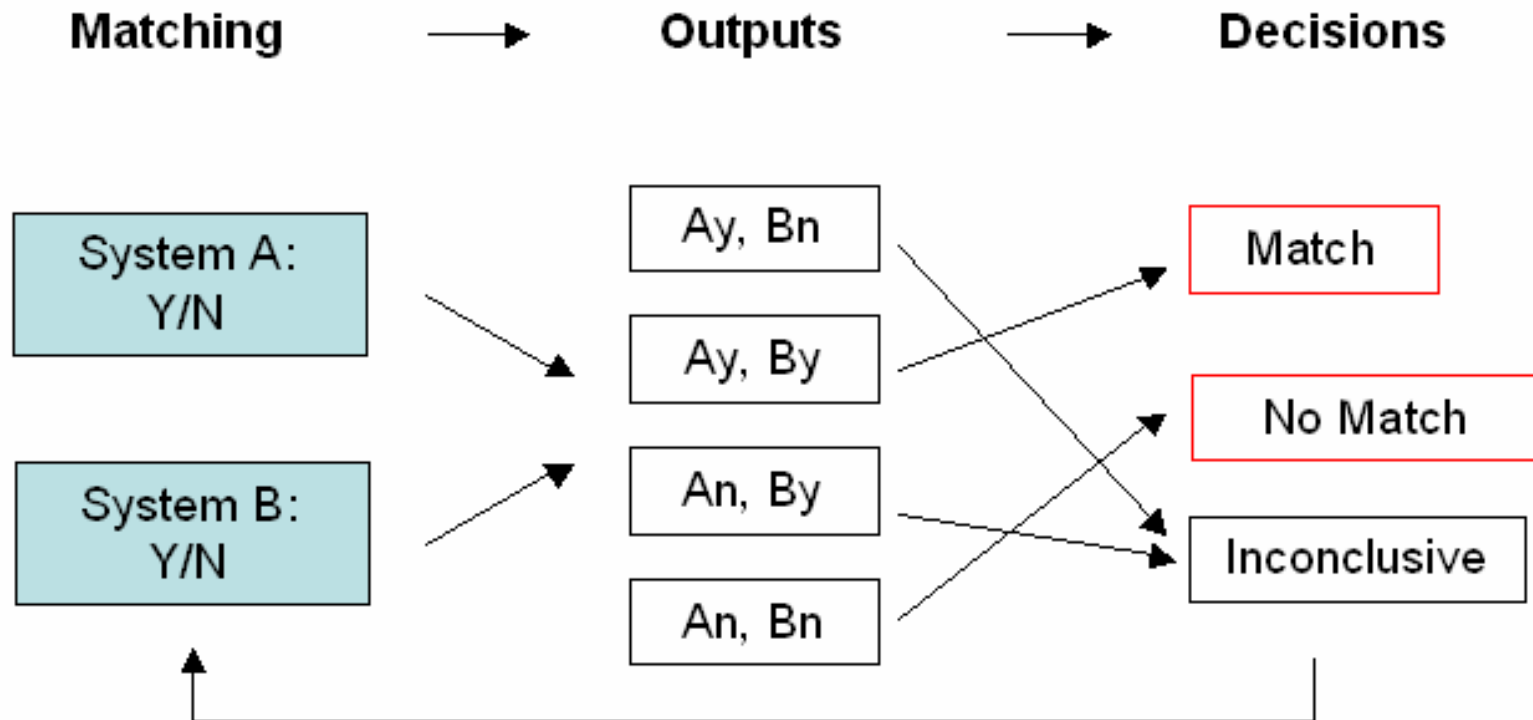
Multimodal Decisions



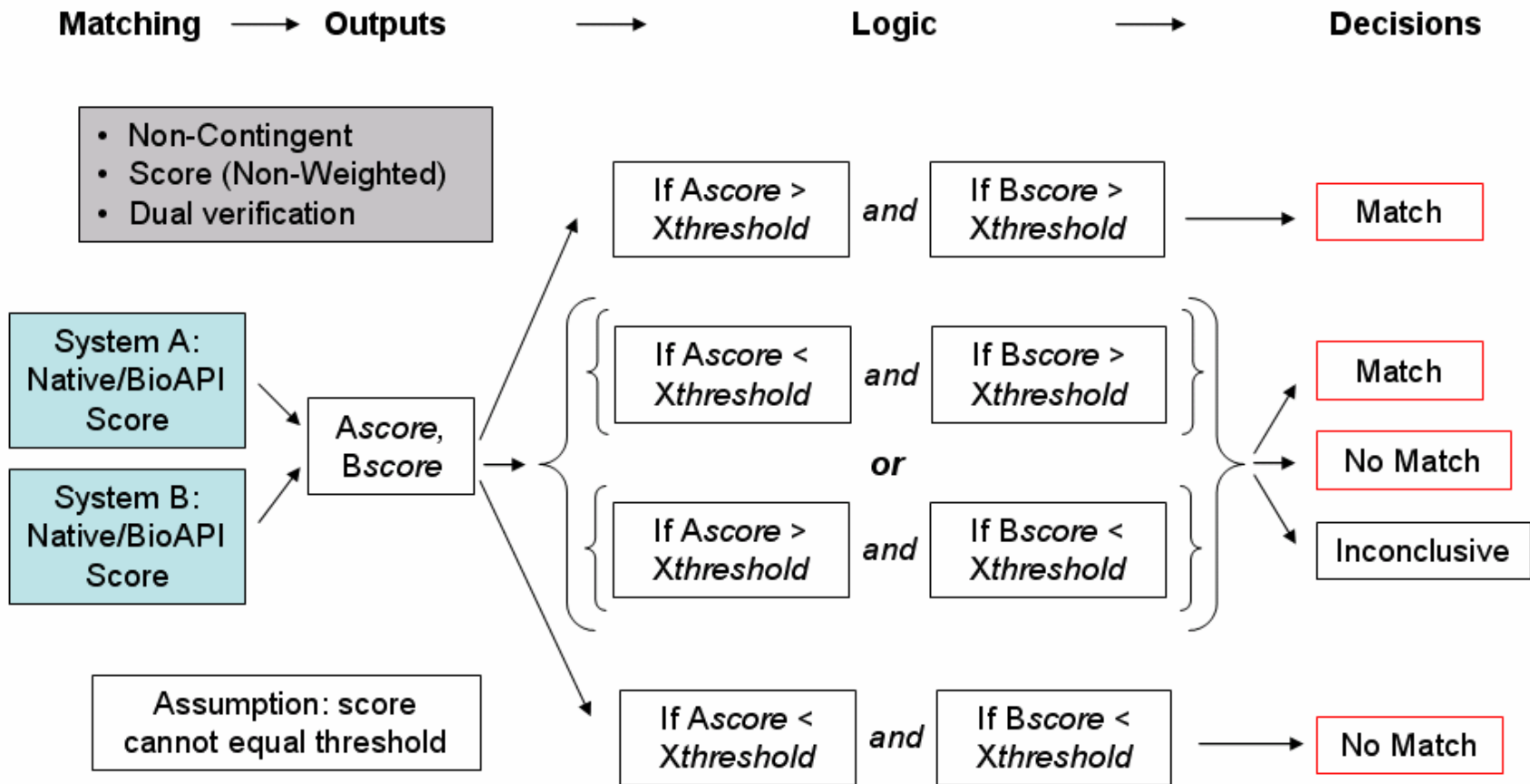
No Match, Terminate Sequence
No Match, Retry
Match, Grant Access
Rank 1 Match Found
Rank 1 Match Not Found
Candidate Found Within Ranks 1-N
Candidate Not Found Within Ranks 1-N
Candidates Found Within Ranks 1-N
Inconclusive

Multimodal Verification Models

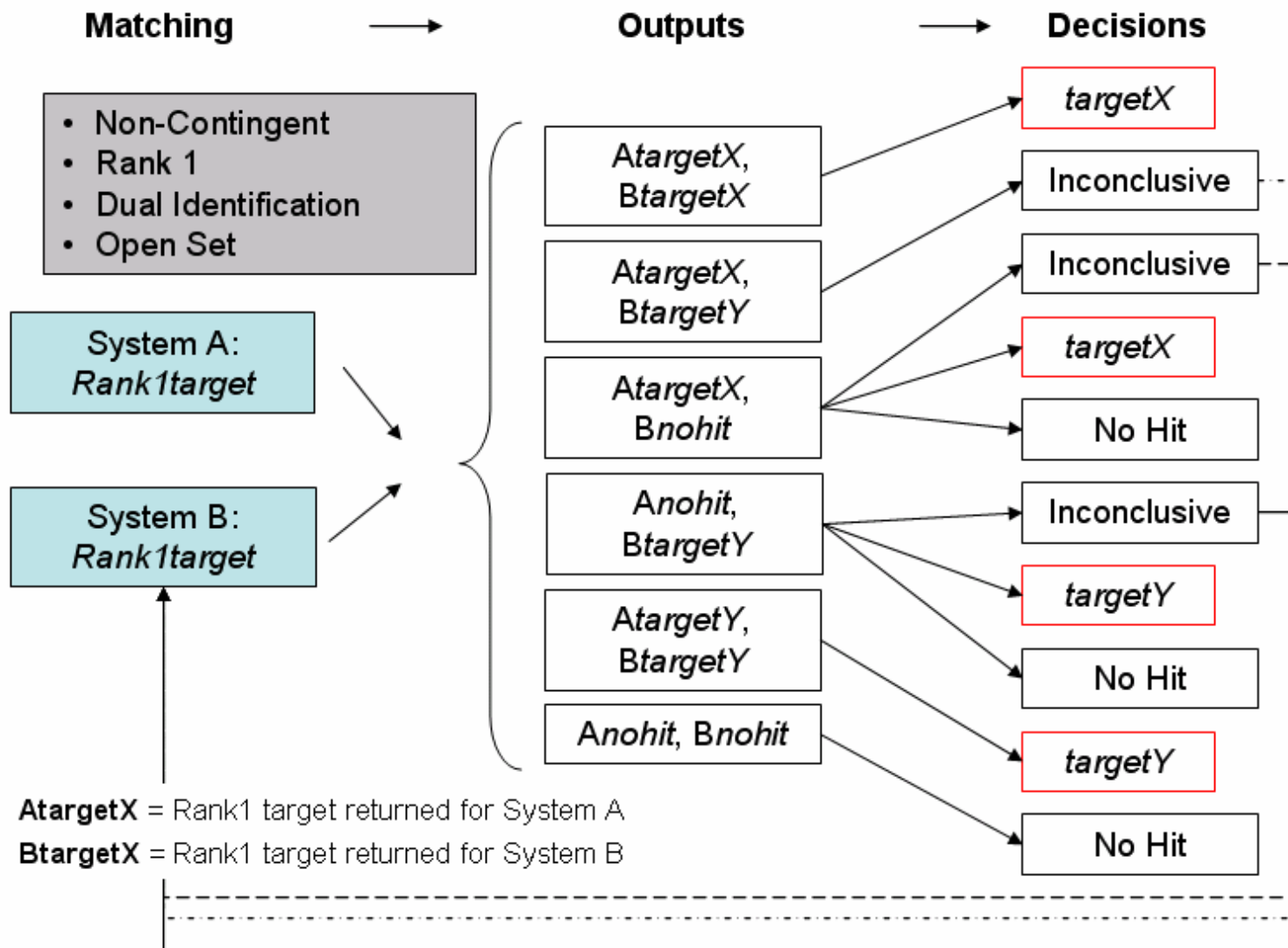
- Non-Contingent
- Binary
- Dual verification



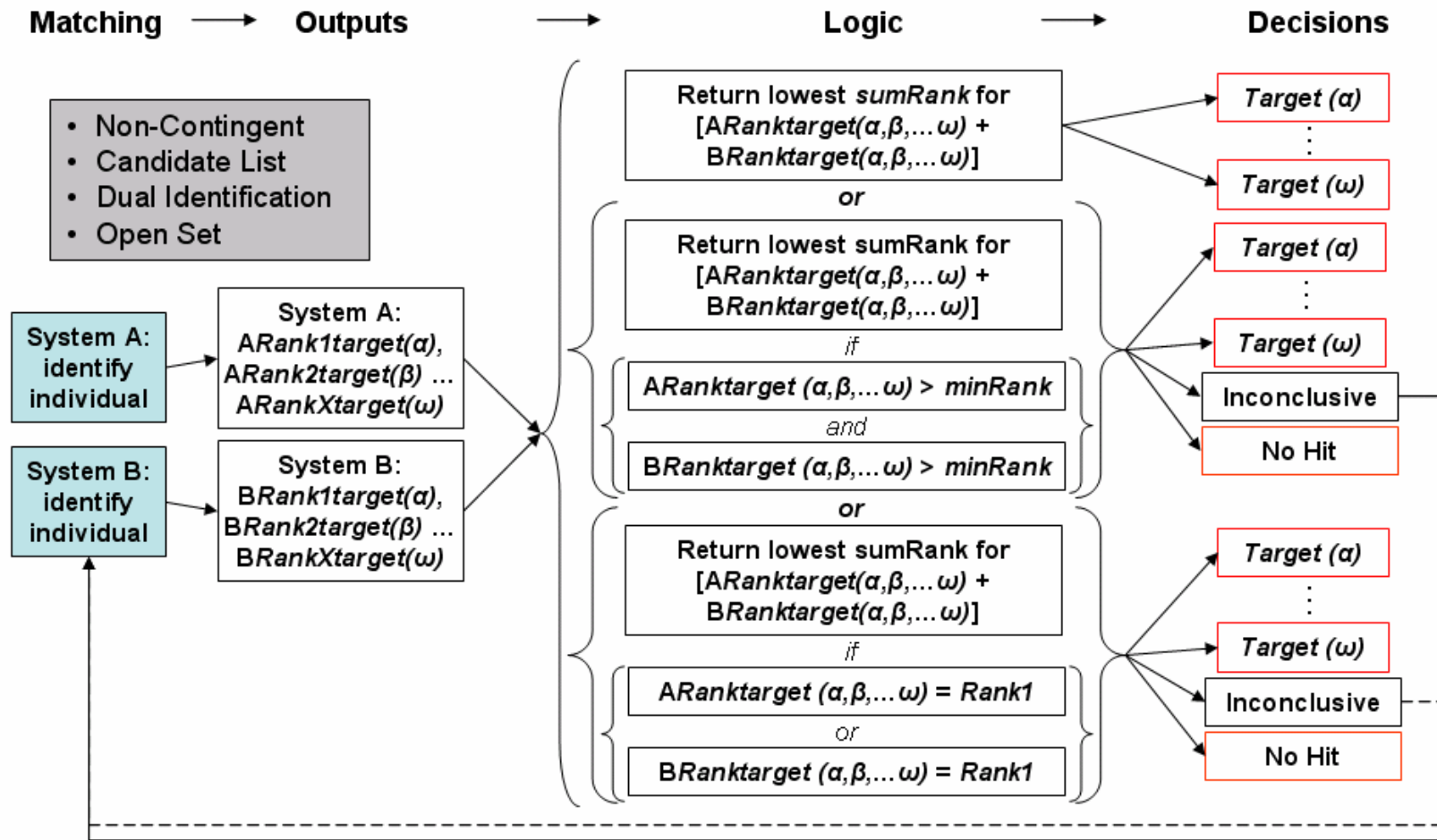
Multimodal Verification Models



Multimodal Identification Models



Multimodal Identification Models



Target = individual enrolled in database

$XRankYtarget(\alpha)$ = rank (Y) on candidate list for target ($\alpha, \beta, \dots \omega$) in System X

$minRank$ = lowest (worst) rank accepted for identification by deployer (e.g. $minRank10$ means that no rank above 11 accepted)

$sumRank$ = sum of $Ranktarget(\alpha, \beta, \dots \omega)$ in each system, e.g. $ARank2target(\beta) + BRank4target(\beta) = sumRank6target(\beta)$

Multimodality and Passports

- ICAO standards define compliance for biometric usage in passports
- Technology for interoperability: facial recognition
 - Unknowns: accuracy level, data storage, processing
 - Recommendations emphasize convenience over security
 - Developed pre-9/11
 - How will compliance be evaluated?
- Fingerprint and iris recognition can also be used in conjunction with facial recognition
- Biometric authentication of passport-bearing entrants at the border – particularly land borders – may face considerable technical challenges

US VISIT – Multimodal Application

- National Institute of Standards and Technology (NIST) testing
 - Recommended that two fingerprints and one face image – stored in image form, most likely on a contact card – would provide sufficient 1:1 capabilities for U.S. visa issuance applications.
- Questions
 - How will these technologies be implemented in a multimodal fashion
 - Are two fingerprints adequate to perform either internal 1:N searches or 1:N background check searches against the U.S. IAFIS database (which contains 40m ten-print records)
 - Alignment with ICAO standards

Multimodal Standards & Interoperability

- State of the industry
 - Little no interoperability intra- or inter-biometric systems
 - Few mature standards
 - Little means of ensuring compliance
- Why does it matter?
 - Device/algorithm obsolescence
 - Deployers can get locked into a technology not easily replaced
 - Enrollment in one system may not work in another system
 - Poses challenges to large-scale deployments

Relevant Standards Activities

- INCITS M1, Biometrics
 - Primary U.S. standards body
 - Addresses technical interfaces, application profiles, testing, and data interchange
 - Provides U.S. experts to international body (ISO/IET JTC1 SC 37)
 - Studying multimodal biometrics
- BioAPI Consortium
 - Developed open platform standard to enable device-application interfaces
 - Widely adopted in government applications
 - Korean proposal for multimodal API
- X9F Data & Information Security
 - Defines methods of securing biometric transactions
- Areas not fully addressed by standards: accuracy, interoperability

Challenges

- Impact on current processes
- Standards and interoperability
- Costs
- Training and acclimation
- Security

Thank You

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