

Standards in Support of Multi-Biometric Systems

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Evaluating Multibiometric Systems*

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Abstract

Multibiometrics have emerged within the national and international standards community as a topic of both technical interest and standardization activity. A comprehensive Technical Report is currently under development at the international (ISO/IEC) Standards Committee level, and significant aspects of that report shall be reviewed. Additionally, the US standards committee, M1, has authorized standards development specifically geared toward accommodating multibiometric systems. These standards activities will be summarized.

Scope of this presentation

International Technical Report (SC37)

New Domestic Standards Activities (M1)

The Multibiometric ROI Challenge

International Standards Activity

Draft Technical Report “Multi-modal and other Multi-biometric Fusion” developed by WG 2 of SC37

- Currently Working Draft 3 (WD3), 8/30/05

(ISO/IEC JTC 1/SC 37 N1271)

- Primary technical contributions from US M1 Ad Hoc Group on Evaluating Multi-biometric Systems (AHGEMS)

International Technical Report

Contents include:

- Terms and definitions
- Levels of combination
- Scope and options for standardization

Definition of Multibiometric

Multibiometrics

the automated recognition of individuals based on their biological or behavioral characteristics and involving the use of biometric fusion

Note: Multibiometric has four distinct sub-categories: Multimodal, multiinstance, multisensorial and multialgorithmic.

Definitions (cont.)

biometric fusion

the combination of information from multiple sources, originally obtained from an individual either by taking multiple samples of one biometric modality using multiple sensors, or by taking multiple samples of multiple biometric modalities, or by taking one sample and processing it with multiple algorithms.

multisensorial -using multiple sensors for measuring the same biometric instance.

Examples: for face: infrared spectrum, visible spectrum, 2-D image, and 3-D image; for fingerprint: optical, electrostatic and acoustic sensors.

Definitions (cont.)

multimodal- using multiple different biometric modalities.

Example: Fingerprint + Face

multialgorithmic - using multiple algorithms for processing the same biometric sample.

multiinstance -using multiple biometric instances within one biometric modality.

Examples: Iris (left) + Iris (right), Fingerprint (left index) + Fingerprint (right index).

Table 2 — Concept of multi-biometric categories

Category	Modality	Algorithm	Biometric Trait (e.g., body part)	Sensor
Multi-modal	2 (always)	2 (always)	2 (always)	2 (usually) ^c
Multi-algorithmic	1 (always)	2 (always)	1 (always)	1 (always)
Multi-instance	1 (always)	1 (always)	2 instances of 1 trait (always)	1 (usually) ^d
Multi-sensorial	1 (always)	1 (usually) ^b	1 (always, and same instance)	2 (always)
Repeated instance ^a	1	1	1	1

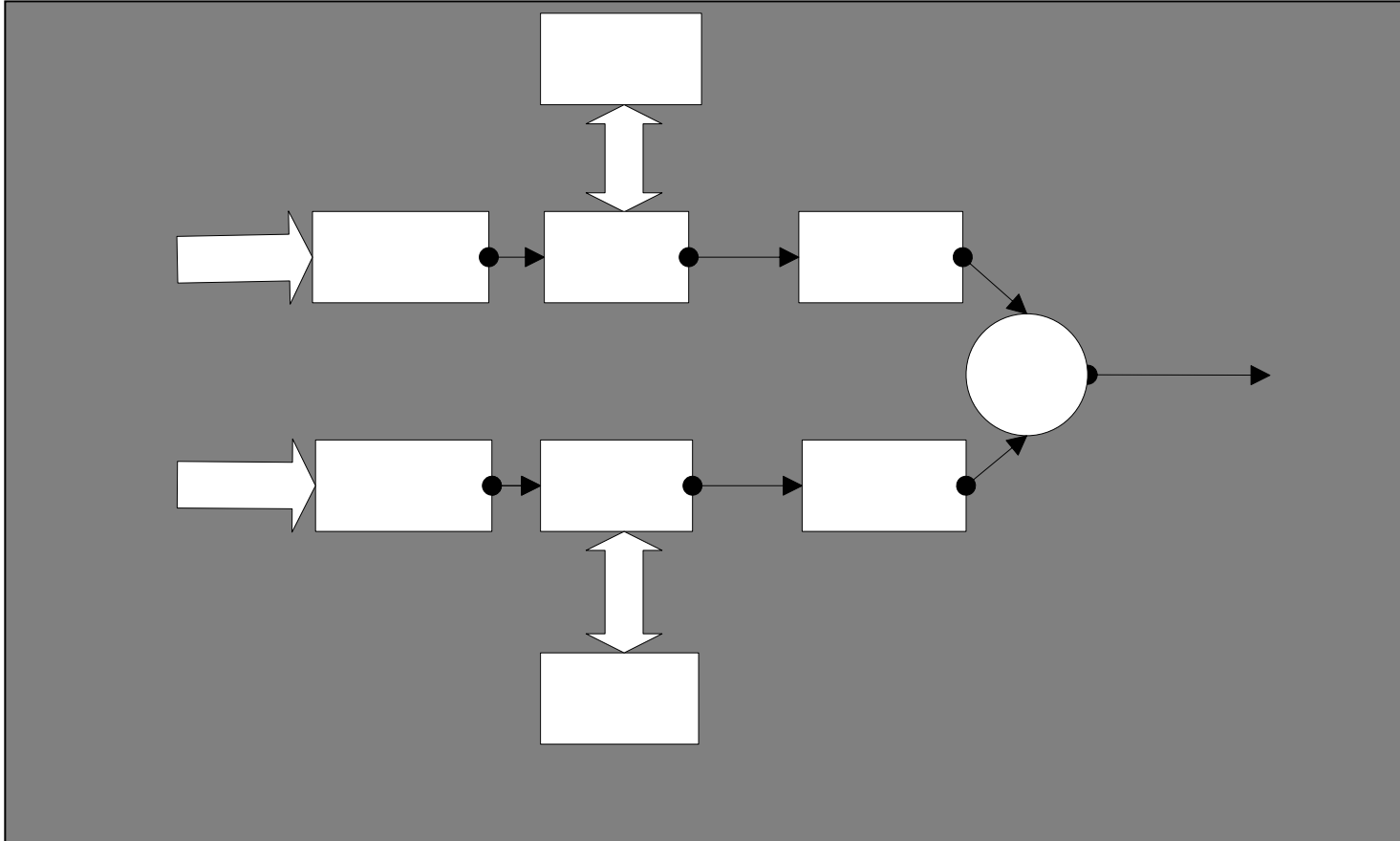
a “Repeated instance” by definition is not multi-biometric, but is listed just for comparison. The aspect that repeats is at the presentation or sample level. Some single-biometric system function on several samples as a matter of course, but do not involve fusion.

b It is possible that two samples from separate sensors could be processed by separate “feature extraction” portions of the algorithm, and then through a common “compare” process, making this “1.5 algorithms”, or two completely different algorithms.

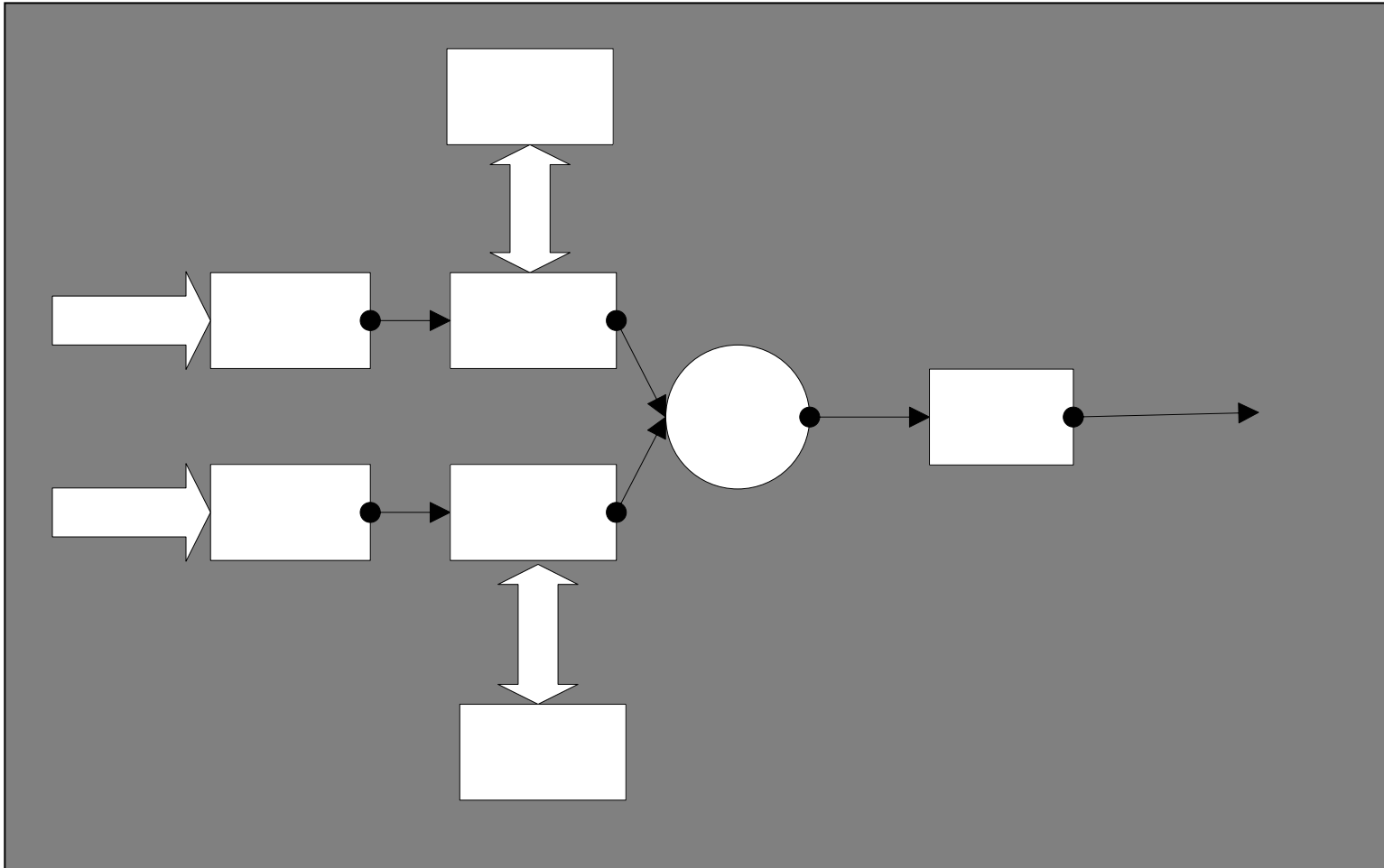
c Exceptions may be multi-modal system with a single sensor used to capture two different modalities, for example a high resolution image used to extract face and iris or face and skin texture.

d Exception may be the use of two individual sensors to each capture one instance, for example possibly a two-finger fingerprint sensor.

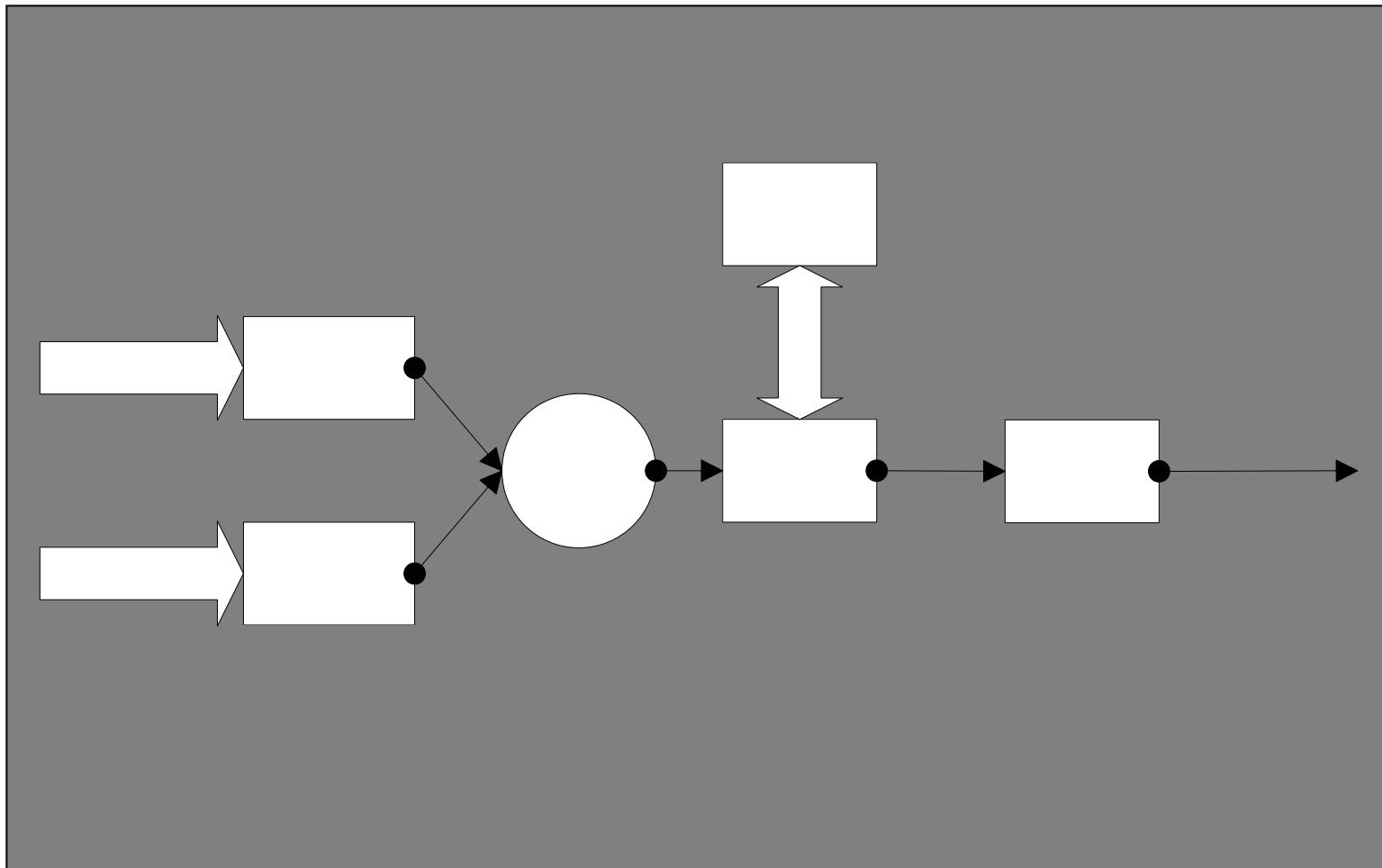
Decision Level Fusion



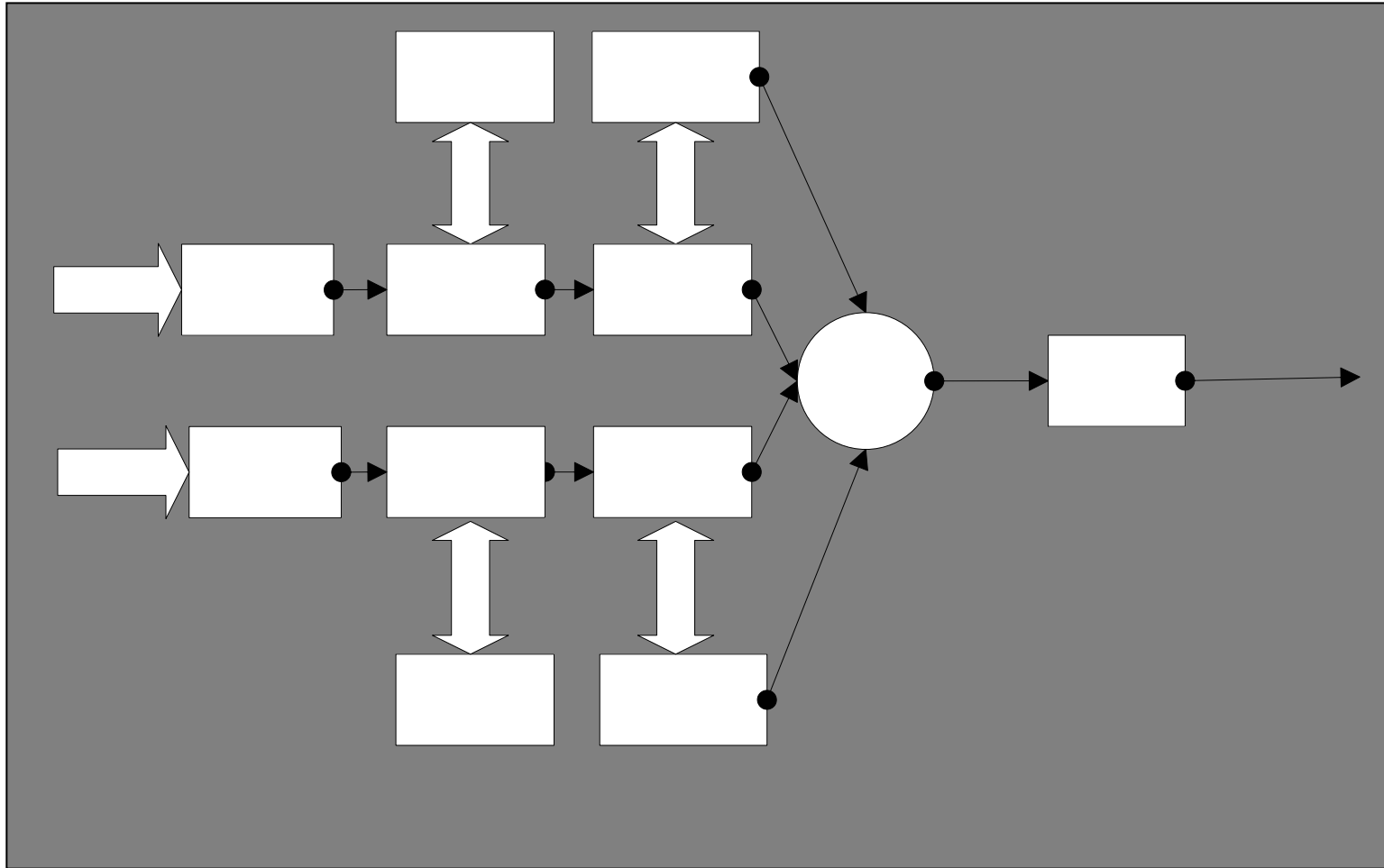
Score Level Fusion



Feature Level Fusion



Score Level Fusion with Normalization

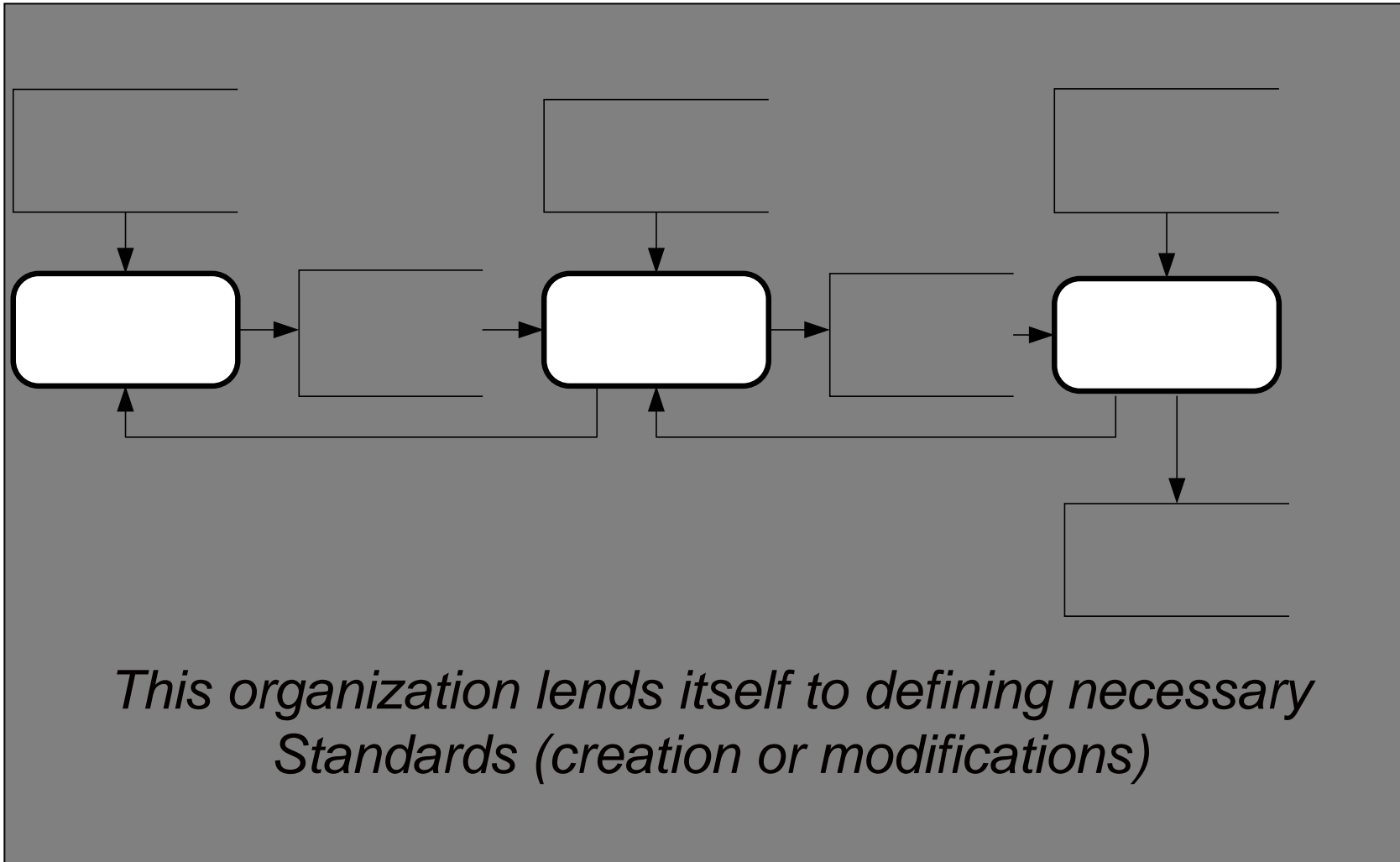


Additional Fusion Topics

- Combination vs. Classification approaches to score level fusion
- Layered vs. Cascaded logic
- Simultaneous vs. Sequential presentation

New Standards

Fusion Records/Process Structure



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Matching Input

New Standards

Two proposed domestic standards:

- *Fusion Information Format*
- *Amendment 1 of BioAPI–Support for Biometric Fusion.*

New Standards

Fusion Information Format (FIF)

- Defines a **new data interchange format** for biometric fusion
- Establishes a uniform markup of the similarity score distributional information
- Follows the overall format of the biometric sample formats already established by M1.3

New Standards

Fusion Support in BioAPI

- Adds direct support for biometric fusion
- Adds four **new functions**, three new BIR (Biometric Information Record) **data types** and one new **BIR purpose** to BioAPI

WHY Multibiometrics?

To Reduce (some or all of):

- False acceptance rate
- False rejection rate
- Failure to enroll rate
- Failure to acquire rate
- Susceptibility to artefacts or mimics

WHY NOT Multibiometrics?

To Reduce (some or all of):

- Sensor acquisition cost
- Enrollment time/cost
- Transit times
- Need for a priori data
- System development or complexity

Multibiometric Cost-Benefit Trade

Key decision considerations:

Is the benefit of implementing a multibiometric system proportional to the investment?

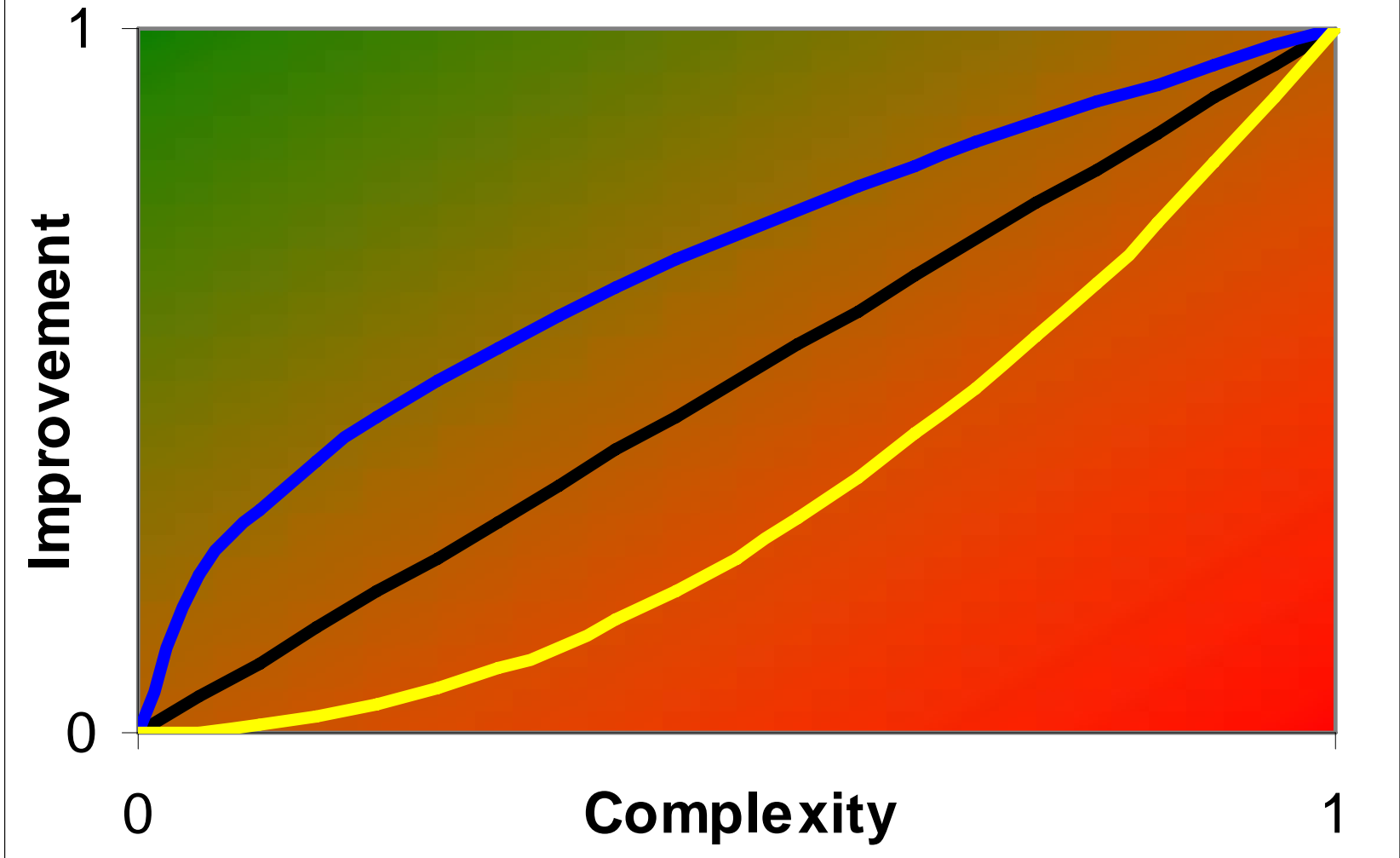
How much is enough?

Research consideration:

How to measure the Return on Investment (ROI)?

ROI for Multibiometric Complexity

What is the shape of the trade-off curve?



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