U.S. Department of Homeland Security

SCIENCE AND TECHNOLOGY DIRECTORATE

Biometric and Identity Technology Testing and Standards Activities

November 15, 2022

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Biometric and Identity Technology Center

DHS Science and Technology Directorate

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We are the Department's Science Advisor and research and development arm.

Since 2003, the Department of Homeland Security (DHS) Science and Technology Directorate (S&T) has provided sound, evidence-based scientific and technical perspectives to address a broad spectrum of current and emerging threats.

Science and Technology

Biometric & Identity Technology Center

S&T conducts foundational research to ensure advancements in science and technology are harnessed for cutting-edge solutions to new and emerging operational challenges.

- Drive biometric and identity innovation at DHS through RDT&E capabilities
- Facilitate and accelerate understanding of biometrics and identity technologies for new DHS use cases
- Drive efficiencies by supporting cross cutting methods, best practices, and solutions across programs
- Deliver Subject Matter Expertise across the DHS enterprise
- Engage Industry and provide feedback
- Encourage Innovation with Industry and Academia

Biometric & Identity Technology Center

Research Activities

- Sponsor research (e.g. university and government applied research)
- Conduct technology evaluations and industry challenges
- Participate in industry voluntary consensus standards development
- Advise components in shaping acquisitions and regulations
- Assist stakeholders in evaluating and improving systems

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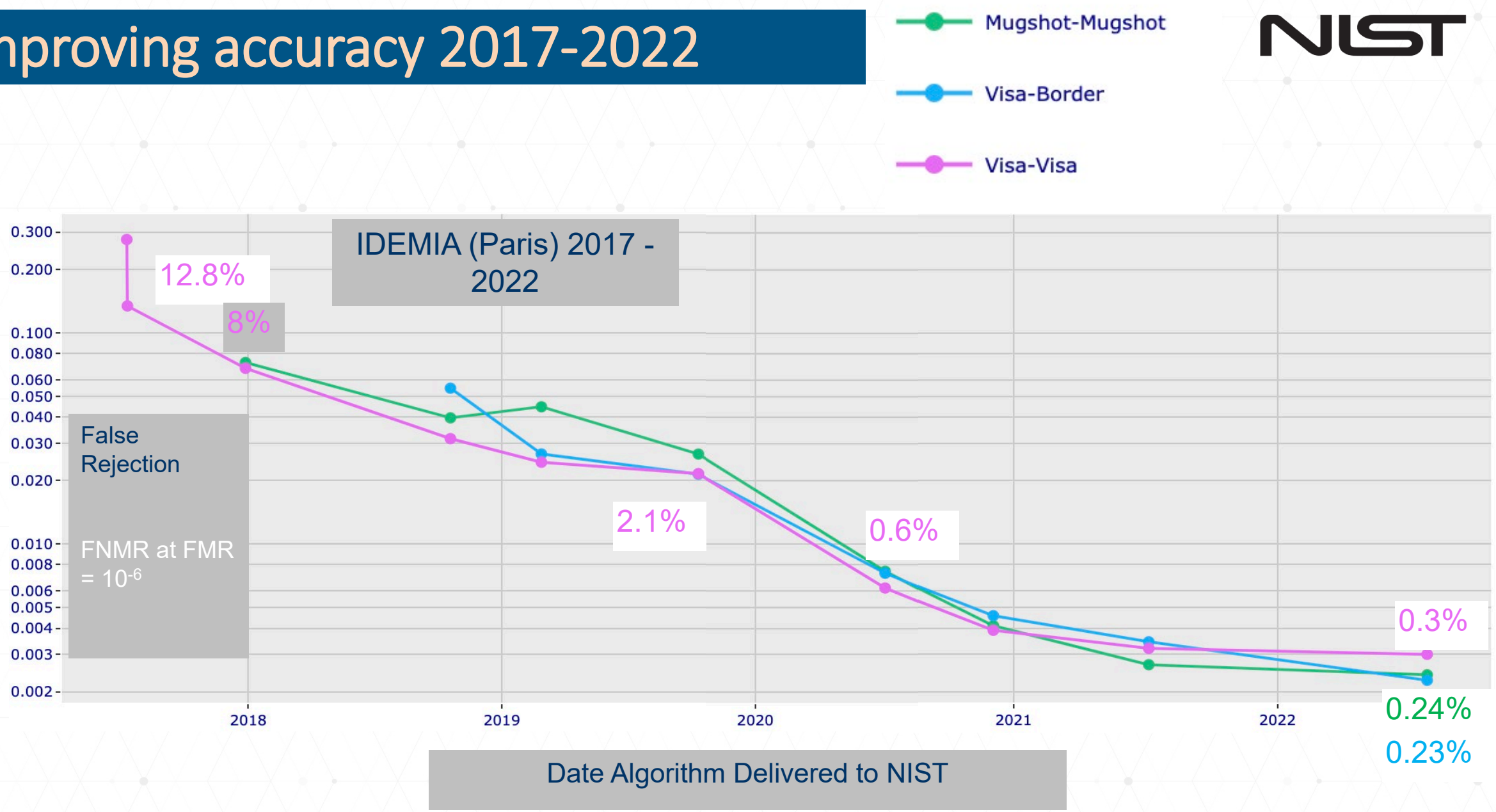
Improving accuracy 2017-2022



Slide Courtesy of NIST

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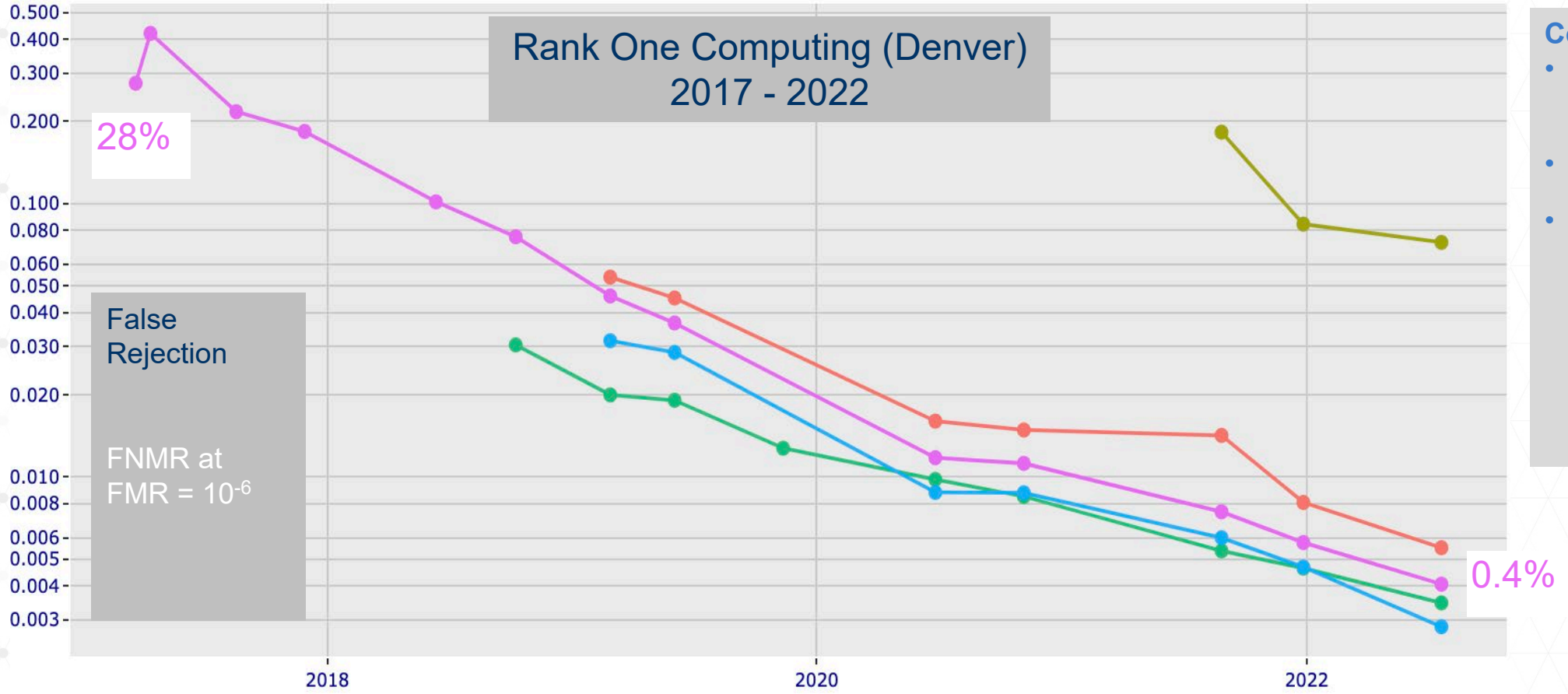
Gains are broad across the industry



Conclusions:

- Algorithms improve regularly
- Do tech refresh
- Contracts, agile procurement

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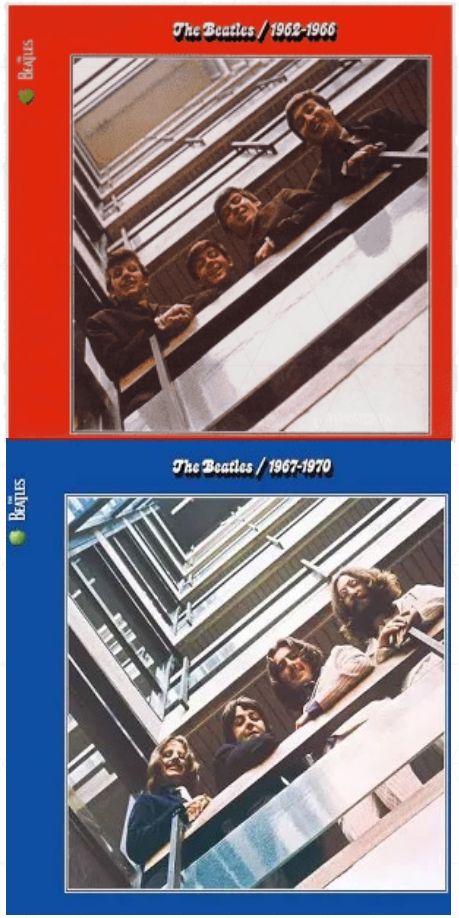
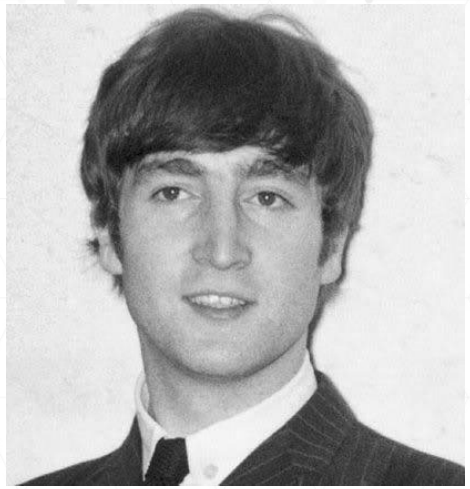
Gains from AI: Better Tolerance for Appearance Changes





Beatle John Lennon between the release of the Red Album and the Blue Album, ~5 years.

Year	Developer	Algorithm	Score	FMR	Outcome
2021	Idemia	008	7438.78	< 5e-07	Strong match
2022	Paravision	010	0.38308	< 5e-07	Strong match
2014	Cogent Thales	A20A	2521	0.48	Failed match
2014	NEC	E20A	0.562	0.002	Failed match

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Are we finished?

- Not so fast…
- Face Recognition Systems are complex and include many components
  - Many of these component sub systems may not be formally evaluated
- Face Images are not secret
  - AI/ML has enabled massive improvements in Face comparison algorithms, but it could also enable new types of attacks on face recognition systems
- Face Intraclass variation can be relatively large compared to interclass variation

Technology, Scenario, and Operational Testing

Technology Testing:

- Centered around a technology,
- Focused on a specific system component,
- Re-use of biometric datasets,
- Larger sample size.

- Answers questions about how technologies advance or perform relative to each other.
- Answers questions about the limits of a technology's performance.

- E.g. What is the minimum false match rate achievable by face recognition technology?

Scenario Testing:

- Centered around a use-case,
- Full multi-component biometric system,
- Gathering new biometric samples,
- Robust experimental control.

- Answers questions about how technology performs for an intended use.
- Answers questions about the suitability of a system for an intended use.
- Answers questions regarding demographic performance that cannot be answered through operational testing (E.g. performance across race categories or skin tones)

- E.g. How will face recognition perform in a high-throughput unattended scenario?

Operational Testing:

- Centered around a specific environment,
- Specific biometric system implementation,
- New data collected in the course of operational use,
- Little experimental control.

- Answers questions about how technology performs within the specific operational environment and with specific users.
- Answers questions regarding whether the technology meets specific operational performance benchmarks.

- E.g. Is the face recognition system meeting organizational performance objectives?

Face Recognition System

Examples of sub processes and system components

- Sensor or camera
  - Face detection/auto-capture
  - Liveness
  - Presentation attack detection
  - Face Image Quality
- Face or biometric comparison system
  - Face segmentation and templatization
  - Liveness
  - Presentation attack detection
- Decision logic
  - Face Image Quality
- Reference Image Gallery Composition
  - Face Image Quality
  - Face Morph and Presentation attack detection
- Human Adjudication
  - Face Image Quality

Issues and potential attacks on Face Recognition Systems

- Face images are not secrets
  - Is the photo of a real person?
  - Is the image modified?
  - Was the image submitted by the genuine user for the intended purpose?

- Potential Attacks
  - Face Swapping
  - Face Morphing
  - Generative Adversarial Networks
  - Digital Puppetry

Developing a Biometric Concept

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Identifying Promising Technologies

Well Respected Scientific Study

International Expert

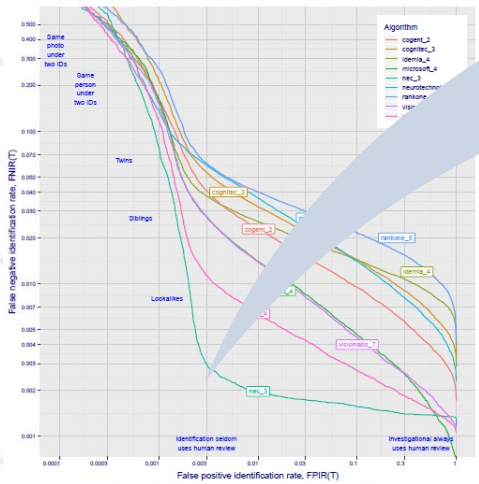

Figure 1: Miss rates across the false positive range

Promising Technology

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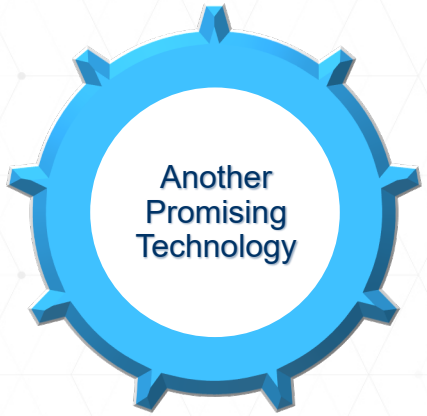
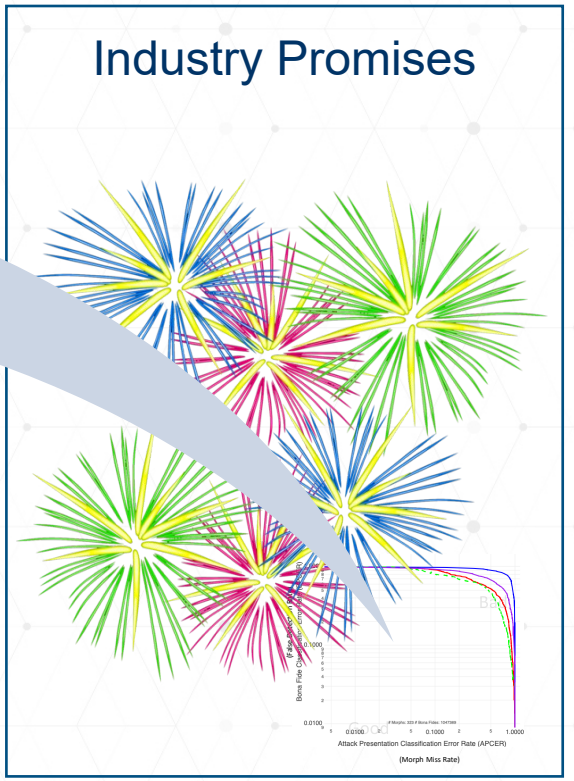
Identifying Promising Technologies





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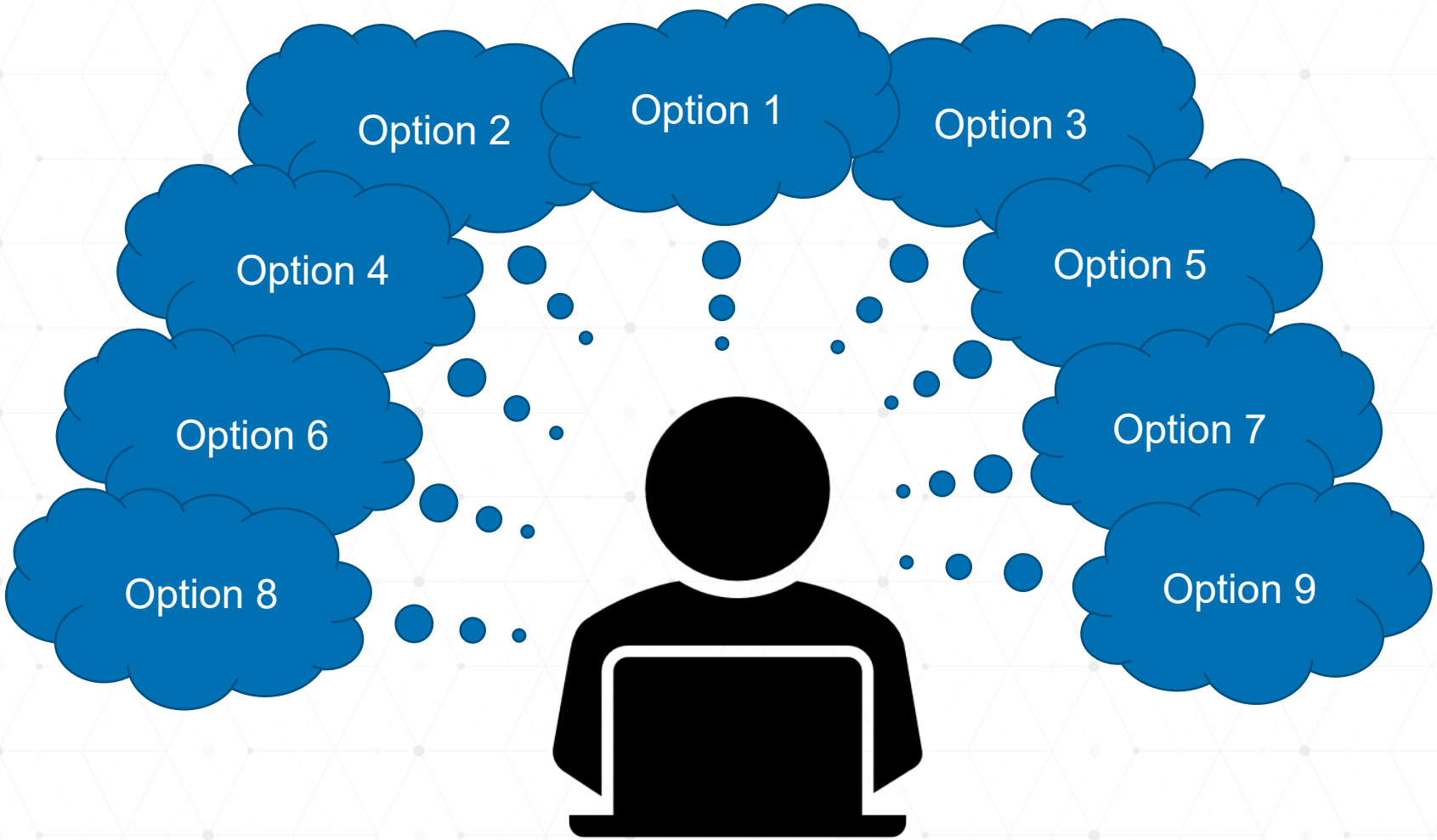
Choosing Between Options



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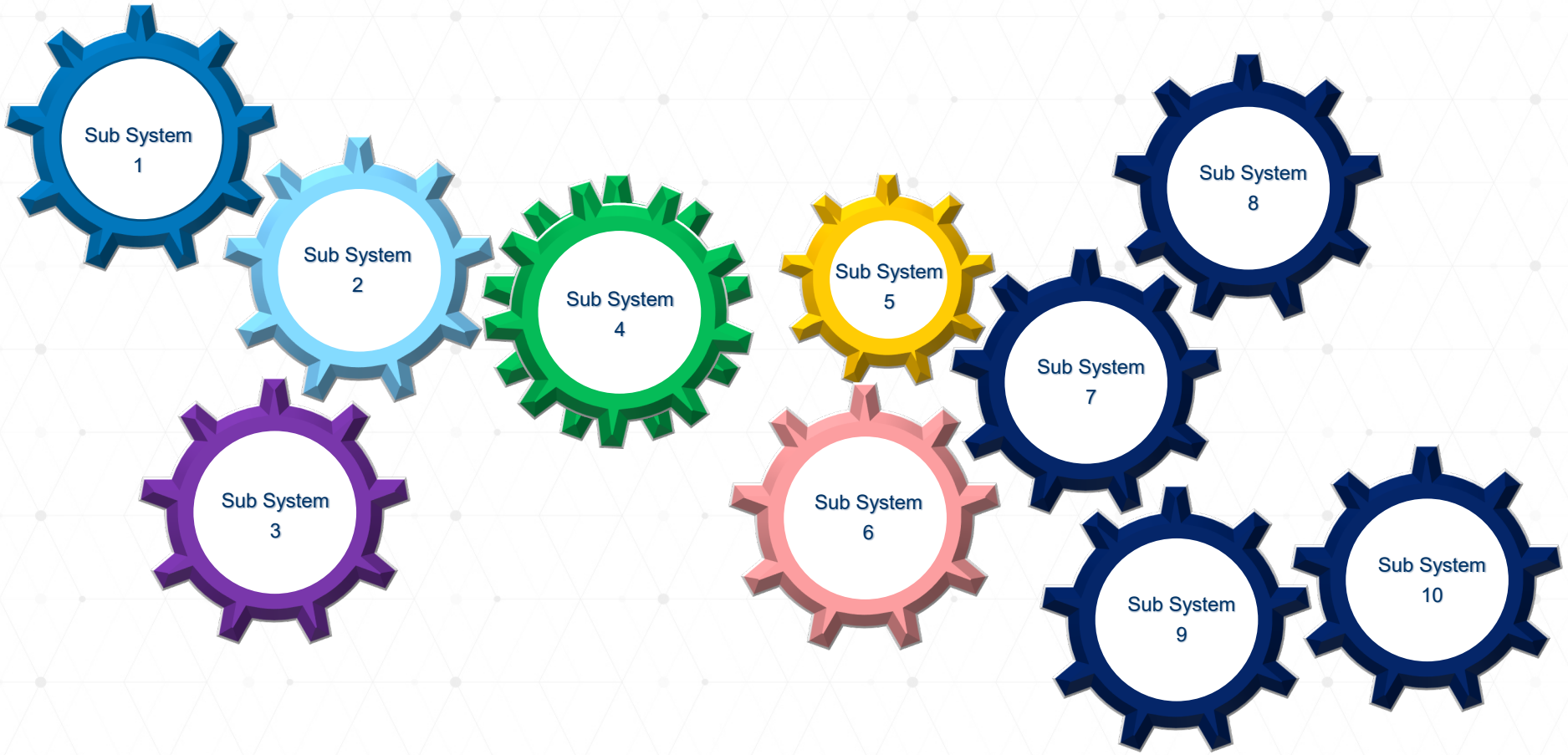
Technologies and Capabilities May Not Function Together as Expected



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It is important to identify and manage the different types of errors that can occur throughout the system

Different subsystems can also cause unexpected interactions and introduce systematic errors that affect the entire system

Questions & Answers

- Contact information
  - peoplescreening@hq.dhs.gov
  - rally@mdtf.org

- Visit our websites for additional information
  - To see additional work DHS S&T supports, visit www.dhs.gov/science-and-technology
  - Detailed application instructions will be available in a separate document on https://mdtf.org
  - To view additional information about this year and prior Rallies, visit https://mdtf.org

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