

U.S. Department of Homeland Security

SCIENCE AND TECHNOLOGY DIRECTORATE

2022 Biometric Technology Rally Technical Webinar



Science and
Technology

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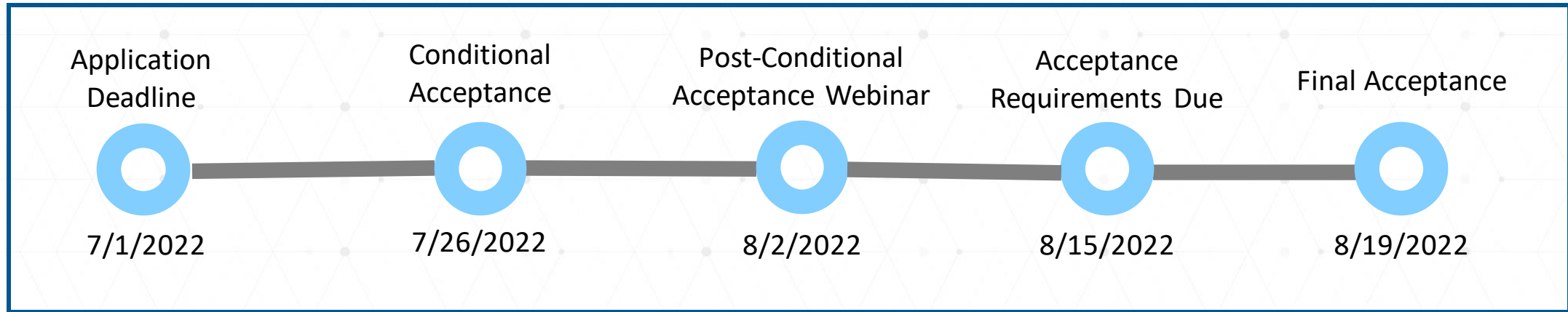
Outline

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 - Rally Timeline
 - Rally Test Location
 - Rally Test Overview
 - Acquisition System Physical Layout
- System Requirements
 - API
 - Metrics
 - Selection Process
- System Provider Responsibilities
- Questions & Answers

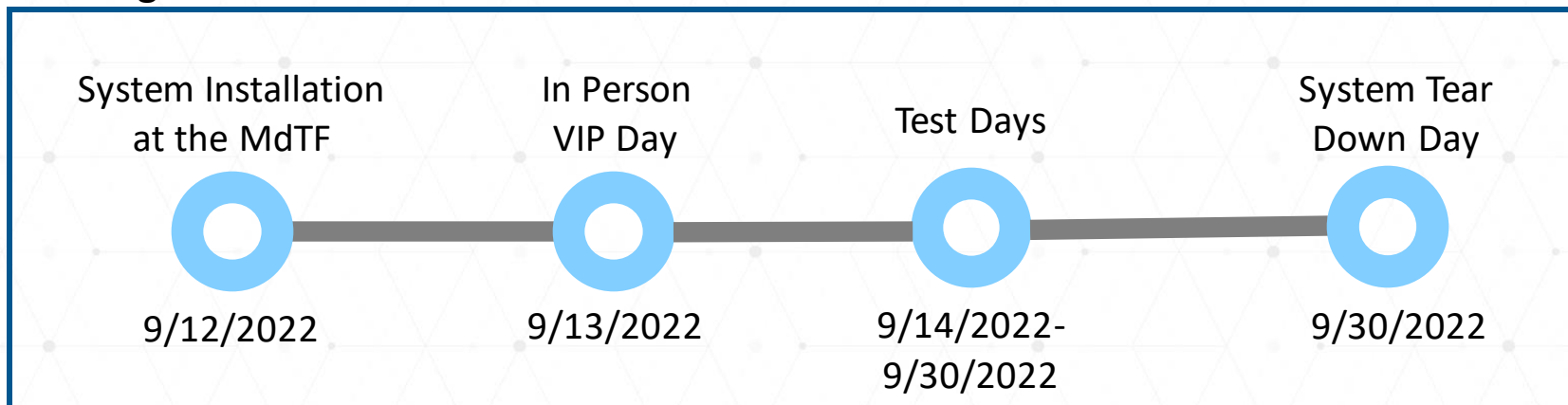


Timeline

Before Testing



Testing



Rally Test Location

- The 2022 Biometric Technology Rally will be held at the Maryland Test Facility (MdTF)
 - Located just outside the DC Metropolitan Beltway (near FedEx Field)
 - Designed for testing large groups of volunteers in configurable scenarios
 - Provides software APIs for integrating biometric systems
- The VIP Day for acquisition systems will be held at the MdTF
- All acquisition systems to be delivered to MdTF for the Rally
- All matching systems to be executed on MdTF systems



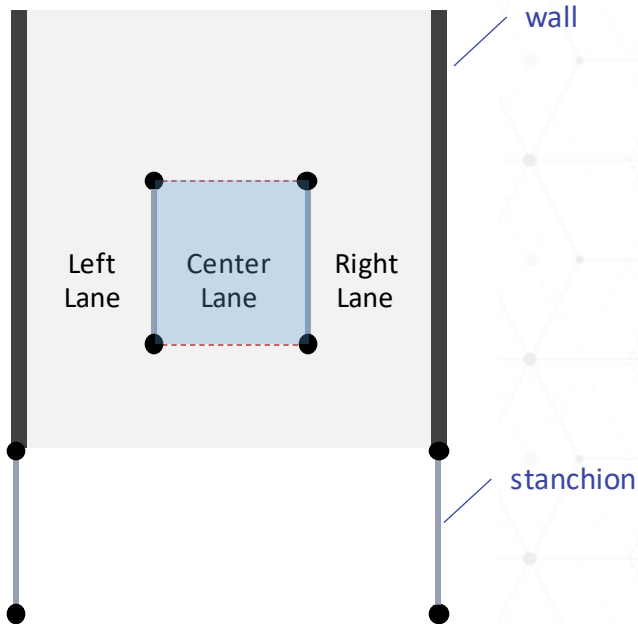
2022 Rally Overview

- For the 2022 Rally, DHS S&T will accept applications from providers of biometric face acquisition and matching systems.
- Acquisition systems will acquire images from small groups of volunteers using the system at the MdTF and submit an image of each individual present in the capture volume.
 - Evaluated on efficiency, satisfaction, effectiveness, privacy, and equitability.
- Matching systems will identify volunteers in images acquired by acquisition systems at MdTF.
 - Evaluated on effectiveness.

Station Physical Specifications



Satisfaction Kiosk



wall

Left Lane

Center Lane

Right Lane

stanchion

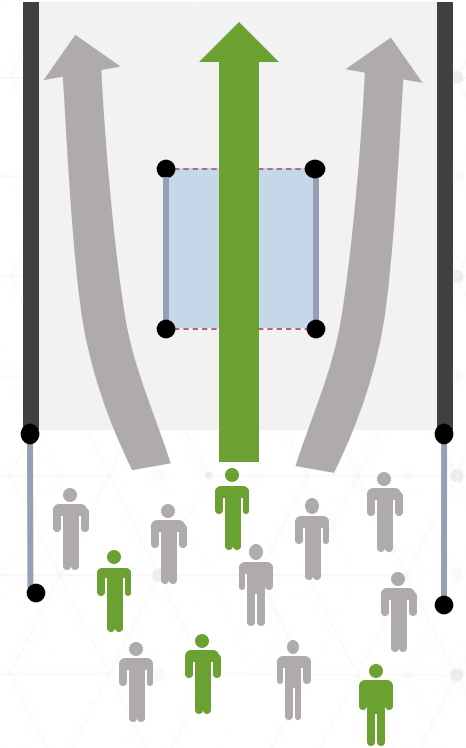
Overhead Schematic of Rally Group Processing Station

- Acquisition systems will fit within a **6'x8' area in the center lane**
- One 6 outlet power strip will be provided
 - Power consumption will be monitored
 - **5 amp maximum** power draw enforced
- One network drop will be provided for Rally API communication
 - Acquisition system providers must use own switch to network any hardware
- **Two lanes will be placed to the left and right of the center lane**

Rally Group Station Process – Lanes Explanation

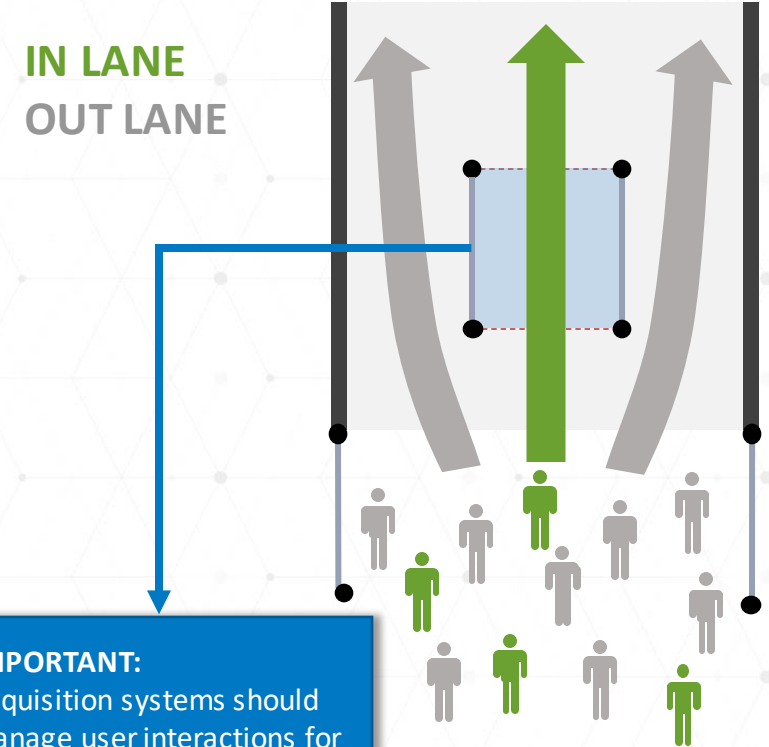
- Many volunteers will enter and pass through the station together
 - Not one at a time like in prior Rally tests
 - On each pass:
 - All assembled volunteers will enter the station at the same time
 - **A group of “IN LANE” volunteers will walk through the center lane:**
 - Instructed to use the acquisition system
 - Other “OUT LANE” volunteers will walk through the left and right lanes:
 - Instructed NOT to use the acquisition system
 - Different volunteers may be designated “IN LANE” or “OUT LANE”
 - Different numbers of volunteers may be designated “IN LANE”
 - The same volunteer may be designated “IN LANE” on multiple passes
- Acquisition systems should:
 - Always submit a single image for each “IN LANE” volunteer on each pass
 - Never submit images for any “OUT LANE” volunteers

IN LANE
OUT LANE



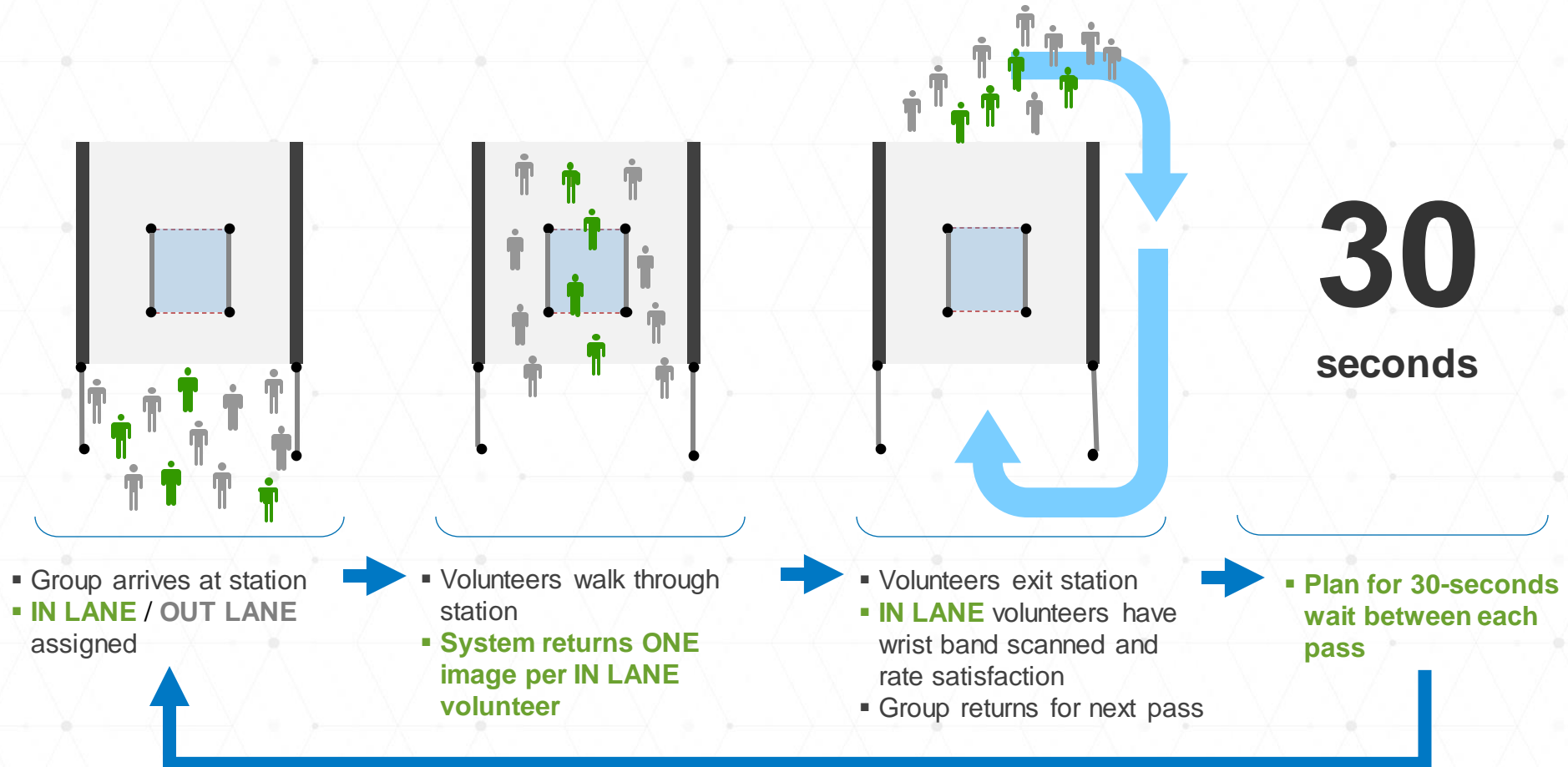
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IMPORTANT:
Acquisition systems should manage user interactions for the IN LANE volunteers within the blue capture volume only. The MdTF will manage all other aspects of volunteer logistics.

Rally Group Station Process



Acquisition System Requirements

- The acquisition system shall:
 - Provide **exactly one** face biometric image per **IN LANE** volunteer on each pass
 - Maintain an average transaction time of at most 6 seconds per volunteer
 - Provide **NO** images of anyone or anything other than **IN LANE** volunteers
 - Operate in an unstaffed mode
 - Operate within a 6 ft wide by 8 ft long by 11 ft high physical footprint
 - Operate within the software infrastructure defined by the MdTF Acquisition API
 - Submit probe images within the period of interaction with the **IN LANE** volunteers

Acquisition API- Overview

- All images will be submitted using the MdTF Rally Acquisition System API:
 - RESTful, HTTP based
 - <http://github.mdtf.org>
- Prior to the Rally, the MdTF will make available:
 - Detailed API documentation (available on GitHub)
 - A cloud-based API instance for testing / debugging API calls
 - Limited troubleshooting support via Slack
- During the Rally, the Rally API will be available only on the MdTF LAN:
 - Acquisition systems will be able to perform integration effort over a cloud-based API but will have to configure the API server address and the Station ID in the API requests after arriving at the MdTF

Acquisition API- Face Capture

- **face-captures** POST request endpoint:
 - FaceImageData – is base64 encoded face PNG image bytes
 - StationID – is a string that will be provided by MdTF during Rally acquisition system installation for configuration of provider systems

```
{  
  "StationID": "Station_A",  
  "FaceImageData": "iVBORw0KGgoAAAANSUhEUgAAAAEAAAABCAIAAACQd1PeAAAAEE1EQVR4nGJiYGAABAAA//8ADAADcZGLFwAAAABJRU5ErkJggg=="  
}
```

↓
POST

/v1/face-captures Associate a face image capture with the ongoing transaction

- System requirements satisfied:
 - *provide* **exactly one** face biometric image per **IN LANE** volunteer on each pass

Acquisition API- When to Submit Images?

- All images must be submitted while the volunteers are using the acquisition system
 - After **IN LANE** volunteers enter the station on each pass
 - Before the last person in the **IN LANE** volunteer group exits the station on each pass
- It is up to the acquisition system to ensure images are submitted within these time constraints
- Images submitted outside these time constraints may reduce the measured performance of the acquisition system

Matching System Requirements

- A Rally matching system shall:
 - Conform to the Rally Matching System API (<http://github.mdtf.org>)
 - Be commercially available from the provider
 - Be packaged in a Docker image
 - Docker image must be <1.5GB in size
 - Docker image must be uploaded to the MdTF via webpage on <https://mdtf.org>
 - Reliably return a template in less than 1000 milliseconds
 - Reliably return a list of 1000 comparison objects from a list of 1000-templates in less than 300 milliseconds
 - Work for at least one calendar year without access to external networks and without license constraints
 - Operate without internet access

Matching API- Overview

- Testing and packaging scripts available at <http://github.mdtf.org>.
 - We strongly encourage their use.
- Docker container resource requirements:
 - Handle HTTP Matching System API requests on port **8080**
 - Conform to MdTF resource constraints (CPU/memory):
 - **8 CPU Cores, 8 GB RAM, NO GPU**
- Docker container endpoints requirements:
 - *accept* individual, base 64 encoded PNG image bytes and return *a template*
 - *accept* templates, perform comparisons, and *return* similarity score for each comparison
 - *provide* information on the algorithm (include threshold values for various FMRs)

Matching API- Template Generation

- **/v1/create-template** POST request endpoint:
 - Accept individual (single), base 64 encoded, PNG image bytes
 - Returns biometric feature templates in the form of bytes
 - Note:
 - Failure to generate a template should set an appropriate status code indicating a failure and return an explanatory error response

```
{  
  "ImageData": "iVBORw0KGgoAAAANSUUhEUgAAAAEAAAABCAIAAACQd1PeAAAAEE1EQVR4nGJiYGAABAAA//8ADAADcZGLFwAAAABJRU5E rkJggg=="  
}
```



POST

/v1/create-template Generate a template from the provided biometric image



```
{  
  "Template": "dGhpcyBzZW50ZW5jZSBpcyBhbiBleGFtcGx1IHRlbXBsYXR1Li4K"  
}
```

- Requirements satisfied:
 - *accept* individual, base 64 encoded, PNG image bytes and return *a template*

Matching API- Template Matching

- **/v1/compare-list** POST request endpoint:
 - Accepts:
 - (1) A single template as returned from create-template
 - (2) A list of templates as returned from several create-template calls
 - Returns matching scores of template (1) against a list of templates (2)

```
{
  "SingleTemplate": {
    "Template": "dGhpcyBzZW50ZW5jZSBpcyBhbiBleGFtcGx1IHRlbXBsYXR1Li4K"
  },
  "TemplateList": [
    {
      "Template": "dGhpcyBzZW50ZW5jZSBpcyBhbiBleGFtcGx1IHRlbXBsYXR1Li4K"
    }
  ]
}
```

POST

/v1/compare-list Compare a single template to a list of templates

```
[
  {
    "Score": 8734
  }
]
```

- Requirements satisfied:
 - *accepttemplates*, performs matches, and return **similarity score**

Matching System API- Algorithm Information

- **/v1/info** GET request endpoint

GET /v1/info Returns basic information for the algorithm.

```
{
  "AlgorithmName": "AlwaysTrue",
  "AlgorithmVersion": "1.0.1",
  "AlgorithmModality": "Face",
  "CompanyName": "MdTF",
  "TechnicalContactEmail": "rally@mdtf.org",
  "RecommendedCPUs": 4,
  "RecommendedMem": 2048,
  "Test": "MDTF_2022_RALLY",
  "Thresholds": {
    "1:500": "0.5",
    "1:1e3": "0.6",
    "1:1e4": "0.7",
    "1:1e5": "0.8",
    "1:1e6": "0.9"
  }
}
```

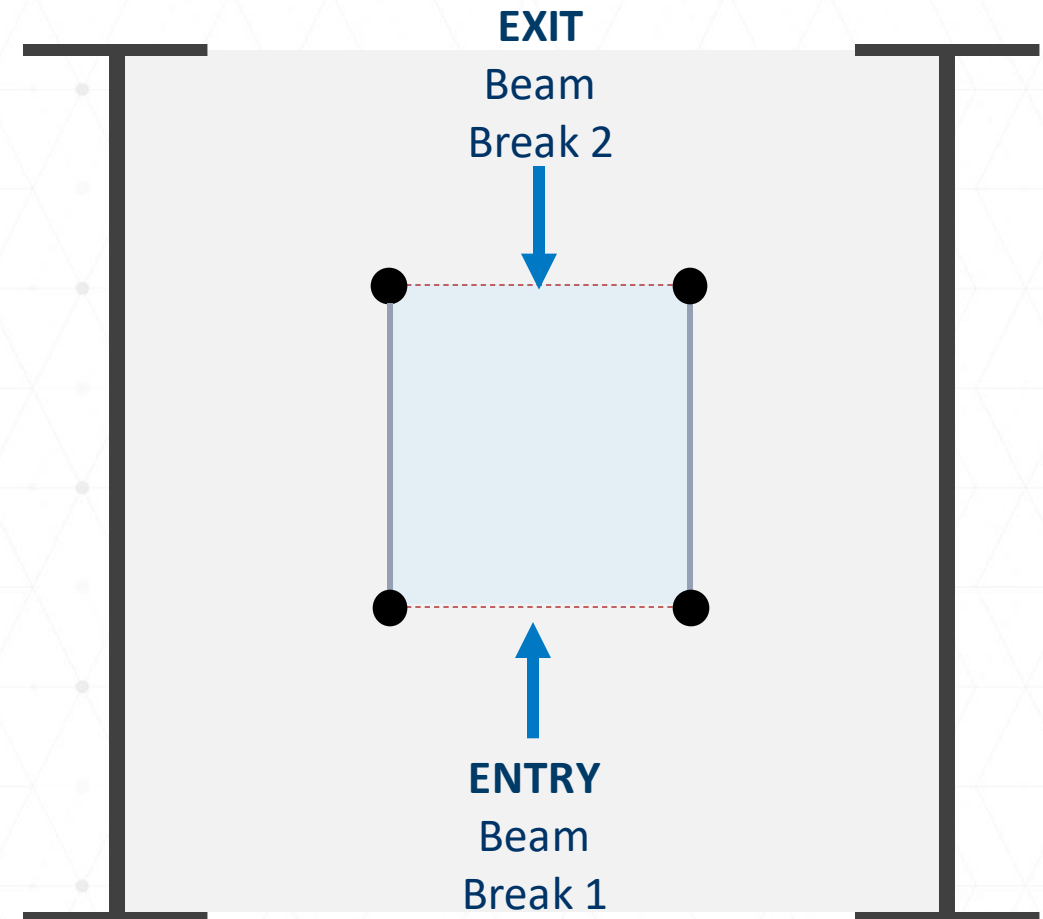
- Requirements satisfied:
 - *provides* information on the algorithm

Metrics Overview

- The 2022 Rally will calculate several performance metrics to evaluate acquisition systems, matching systems, and combinations of acquisition systems and matching systems:
 - Acquisition Systems:
 - Efficiency
 - Satisfaction
 - Acquisition-Matching System Combinations:
 - Effectiveness
 - Privacy
 - Equitability
- Metrics will be assessed against two benchmarks:
 - Threshold – Minimum acceptable level of performance for this use case
 - Goal – Difficult level of performance to achieve, aims to challenge Rally systems

Metrics- Efficiency

- **Average Transaction Time**
- The time, per **IN LANE** volunteer, spent using the system
 - The difference between the **last EXIT** beam break time and **first ENTRY** beam break time, divided by the number of **IN LANE** volunteers
- Threshold value: ≤ 6 seconds
 - A group of two should take 12 seconds or less, a group of twelve should take 72 seconds or less
- Goal value: ≤ 3 seconds



Metrics- Satisfaction

- **Percent Satisfaction**

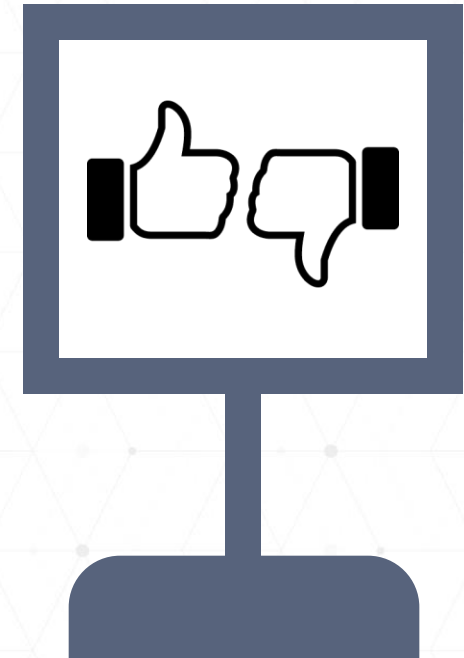
- After using the system, volunteers will be directed to rate their experience by selecting a response on a four-button kiosk
- The button options on the kiosk indicate the degree they liked or disliked the system

- Proportion of positive (“Happy” or “Very Happy”) satisfaction ratings

- Only **IN LANE** volunteers will rate their experience

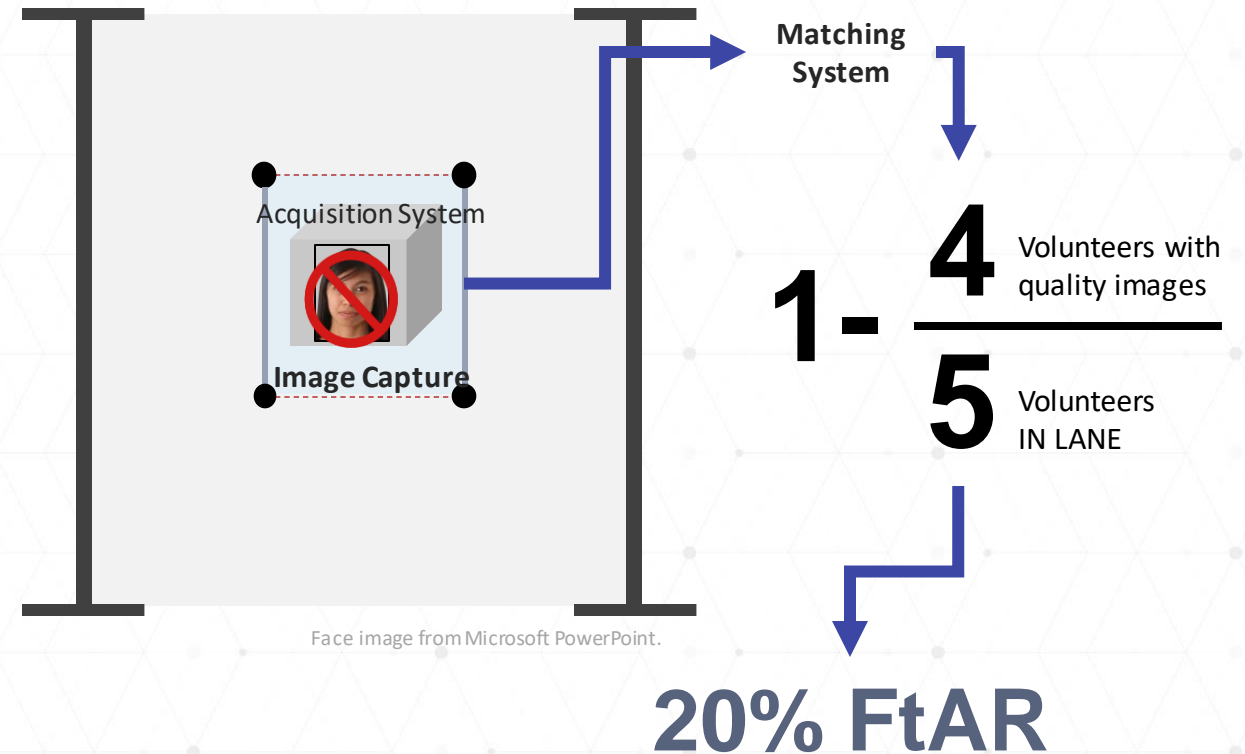
- Threshold value: $\geq 90\%$

- Goal value: $\geq 95\%$



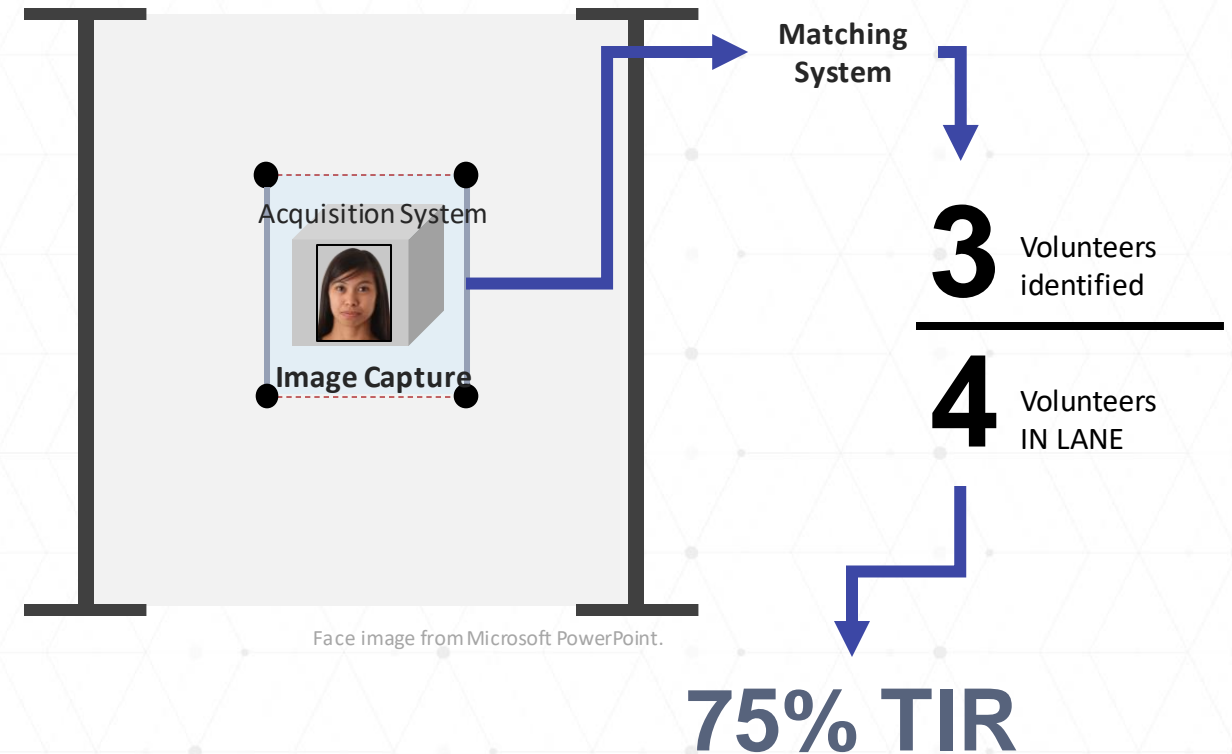
Metrics- Effectiveness

- **Failure to Acquire Rate (FtAR)**
- Percentage of **IN LANE** volunteers for which an **image of sufficient quality** is not submitted
 - Calculated with each matching system-acquisition system combination
 - Quality: Image must generate a template **and** match at Rank 1 against a high-quality same-day reference image
- Threshold value: $\leq 5\%$
- Goal value: $\leq 1\%$



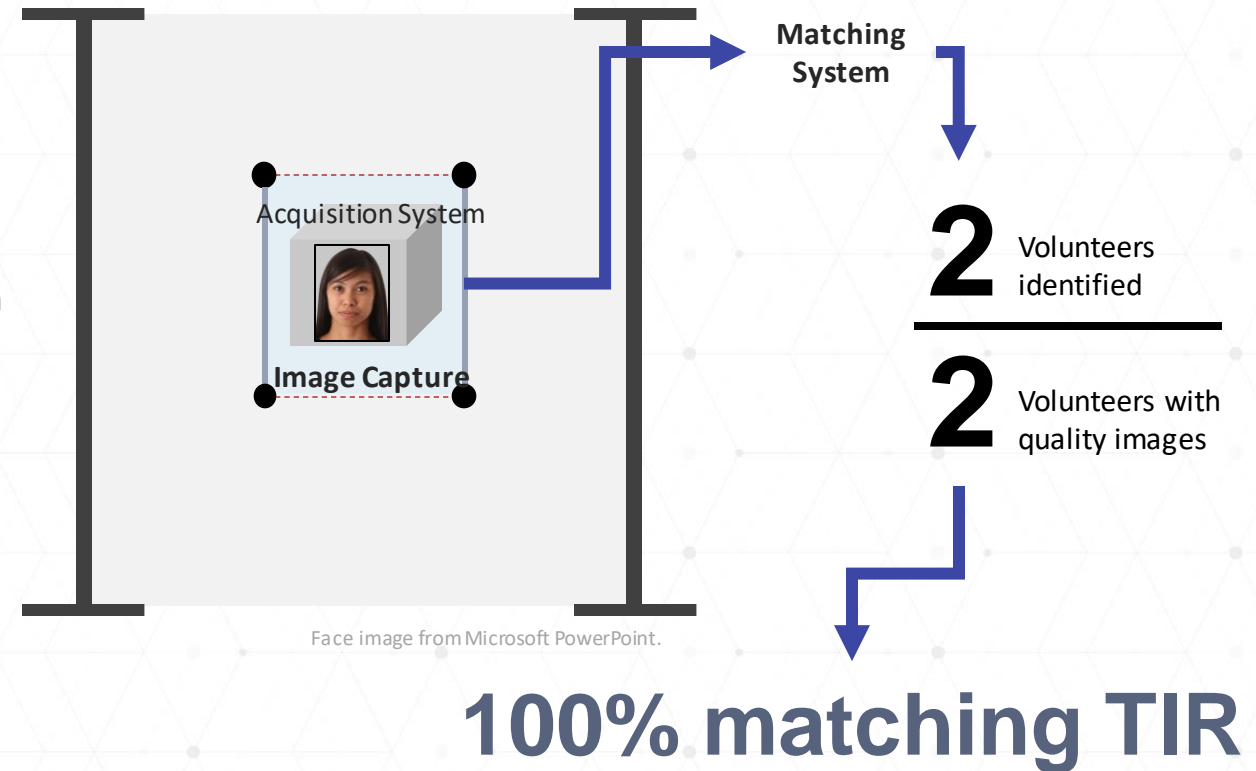
Metrics- Effectiveness

- True Identification Rate (TIR)
- Percentage of **volunteers correctly identified**
 - Calculated for each matching system acquisition system combination
 - A true identification is counted if **any** capture is identified as an **IN LANE** volunteer
 - Matching operations performed at a threshold of FMR = 1:100,000 using a small gallery comprised of MdTF images acquired on a variety of cameras
- Threshold value: $\geq 95\%$
- Goal value: $\geq 99\%$



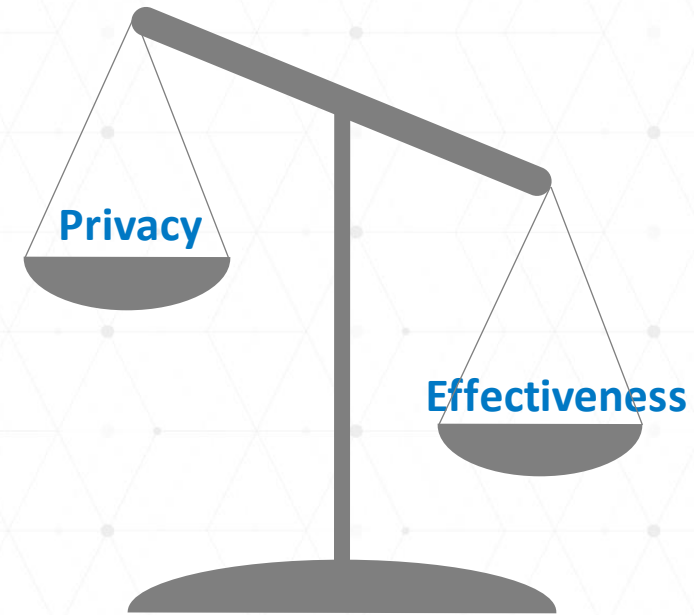
Metrics- Effectiveness

- **Matching Focused True Identification Rate (matching TIR)**
- Percentage of **volunteers correctly identified** using acquired images
 - Calculated for each matching system acquisition system combination
 - Quality: Image must generate a template **and** match at Rank 1 against a high-quality same-day reference image
 - A true identification is counted if **any** capture is identified as an **IN LANE** volunteer
 - Matching operations performed at a threshold of FMR= 1:100,000 using a small gallery comprised of MdTF images acquired on a variety of cameras
- Threshold value: $\geq 95\%$
- Goal value: $\geq 99\%$



Effectiveness vs. Privacy

- Acquisition system providers should balance system effectiveness and privacy when designing their systems
- Systems should be selective regarding which captures are submitted to the API
- Systems should limit the number of captures only to those necessary
- Capturing more images may benefit effectiveness metrics, but may negatively impact privacy metrics



Metrics – Privacy

- Non-User – Identification Rate (NU-IR)
- Proportion of image captures that result in an **identification of an individual NOT using the system**
 - A capture is counted as a non-user – identification if it is identified as anyone other than an **IN LANE** volunteer

1 Image identified as not IN LANE

8 Images captured

13% NU-IR

- Extra Acquisition Metric (EAM)
- Actual number of **image captures in excess of the minimum** number of image captures required
- Minimum required number of image captures is set to one capture per **IN LANE** volunteer on each pass

1 Excess image captured

4 Images required

25% EAM

- Threshold value: $\leq 10\%$, Goal value: 0%

Metrics – Equitability

- True Identification Rate (TIR) and Matching Focus True Identification Rate (matching-TIR) will be computed and reported separately (disaggregated) based on different demographic factors
 - Self-reported race and gender
 - Objective skin tone measures
- Systems will be assessed on if performance meets threshold and/or goal values for each disaggregation

- **Race (self-reported)**

- Black or African American
- White
- Asian (as a group)

- **Gender (self-reported)**

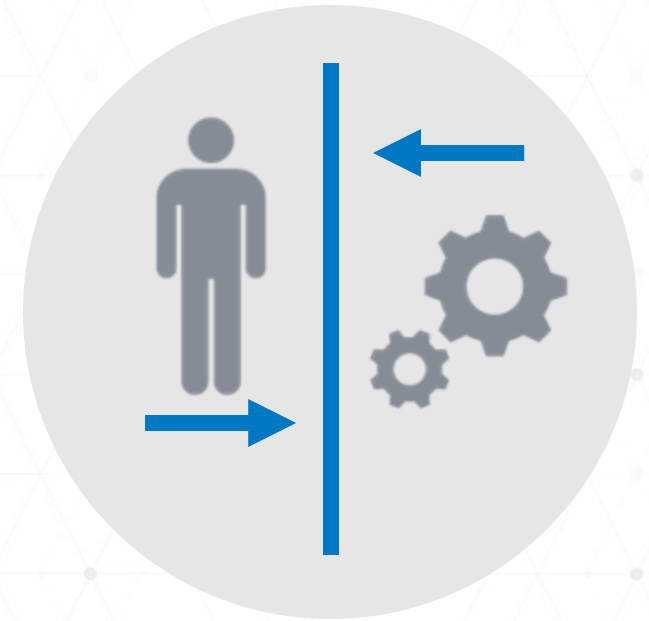
- Male
- Female

- **Skin Tone (calibrated instrument)**

- High Reflectance
- Moderate Reflectance
- Low Reflectance

Human Factors Considerations

- Acquisitions systems should include signage or instructions to guide the volunteers:
 - Systems must operate in an unstaffed mode, i.e., without an operator or instructor
- Staff will not provide any assistance to volunteers asking for help using the system
- Consider the following when creating instructional signage:
 - Size of display
 - Complexity of instructions
 - Amount of text
 - Complexity of text
 - Location of signage in relation to the system



Selection Process

- DHS will have sole discretion in selecting acquisition systems and matching systems for inclusion
 - DHS S&T will select a maximum of eight (8) acquisition system applications
 - DHS will down select the number of matching systems
 - DHS will be advised in this process by a panel of biometric experts
- If a single organization submits multiple whitepapers for matching systems, or multiple whitepapers for acquisition systems, the preferred system for inclusion should be indicated
 - No commitment is made to abide by this preference
- Detailed application instructions will be available in a separate document on <https://mdtf.org>

Selection Process

- Acquisition system white papers will be judged on how well they demonstrate the ability of the acquisition system to:
 - Acquire quality biometric images from small groups of users in crowded environments
 - Have provisions to ensure privacy of non-users
 - Operate within the required time / space constraint
 - Have a process that does not require staffing
 - Readily integrate into the test environment at MdTF
 - Be relevant to known DHS use-cases
- Matching system whitepapers will be judged on how well they demonstrate the ability of the matching system to:
 - Achieve a high true identification rate
 - Achieve a low failure to process rate
 - Be appropriately containerized and integrated into the test environment
 - Operate within set computational constraints

Acquisition System Responsibilities- Before Test

- Acquisition system providers are responsible for:
 - Procuring all hardware to maintain and operate their system
 - Integrating their device/system within the MdTF API
 - MdTF staff will provide minimal assistance
 - Any and all hardware/software testing, including proper communication with the MdTF API
 - The full installation and breakdown of their own equipment within the MdTF
- Steps to be taken in between conditional acceptance and final acceptance will be briefed in detail after conditional acceptances are distributed
 - System safety information
 - Human-subjects ethics training

Acquisition System Responsibilities- During Test

- Acquisition system providers will be able to view data sent to the Rally API by their system following each pass through their station
- Acquisition system providers will be responsible for informing MdTF staff of any issues with their system's performance during testing
 - MdTF staff will log these issues and determine whether intervention is allowable
 - **Up to two usability / human factors** adjustments to acquisition systems will be allowed:
 - During the first two days of testing
 - Acquisition system providers may make repairs to their systems in case of breakage
- **All modifications/repairs must be made when volunteers have left the test environment**

Matching System Provider Responsibilities

- Test and packaging scripts are available at <https://github.mdtf.org>
- Please consider ease of integration into the MdTF infrastructure upon receipt of the algorithm
 - DHS has sole discretion in disqualification if the algorithm requires an excessive effort to achieve functionality

Questions & Answers

- Contact information
 - Questions about the CRADA: peoplescreening@hq.dhs.gov
 - Technical and logistics questions: 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>

