

U.S. Customs and Border Protection Vehicle Biometric Vendor Technical Demonstration

Mariposa, AZ Port of Entry

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Mariposa Port of Entry
Nogales, Arizona

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2. Executive Summary

2.1 Background

U.S. Customs and Border Protection (CBP) is congressionally mandated to implement a biometric entry-exit system¹. In response, CBP has implemented facial biometrics as the primary method of biometric identity verification at air, sea, and pedestrian ports of entry (POE) to streamline the entry process and provide the highest security controls for travelers entering the United States. CBP is expanding the use of facial biometrics to vehicle occupants at land border POEs. In the privately-owned vehicle (POV) environment, CBP's preferred biometric solution will capture and biometrically confirm 85% to 100% of passengers in a vehicle prior to arrival at the primary inspection zone.

The goal is to capture facial images of travelers in the pre-primary zone (PPZ) of the vehicle lane so the photos can be processed, matched, and a traveler's identity verified by the time the vehicle approaches the primary inspection zone. Confirmation of a traveler's identity prior to arrival at the primary booth reduces the number of identities that must be confirmed at the booth and allows the Customs and Border Protection Officer (CBPO) to focus on enforcement. CBP uses the Traveler Verification Service (TVS) for traveler identification and verification.

2.2 Approach

Building on lessons learned in the previous technical demonstrations at Anzalduas, TX and Stanton Street, TX POEs, CBP conducted a technical demonstration at the Mariposa, AZ POE. The goal of the Mariposa demonstration was to evaluate the performance of three different facial capture solutions at inbound POV lanes. The solutions include one CBP in-house solution and two commercial participants, referred to as Vendors A, B, and C in random order.

All solutions were fully integrated into the lane's operations and with the Simplified Arrival-Vehicle (SA-V) primary processing application. The three biometric solutions were evaluated for their ability to capture quality photos of as many unique vehicle occupants as possible, i.e., photos that were good enough to be templated for a TVS match attempt.

¹ The following statutes require DHS to take action to create an integrated entry-exit system: Section 2(a) of the Immigration and Naturalization Service Data Management Improvement Act of 2000 (DMIA), Public Law 106-215, 114 Stat. 337; Section 110 of the Illegal Immigration Reform and Immigrant Responsibility Act of 1996, Pub. L. No. 104-208, 110 Stat. 3009-546; Section 205 of the Visa Waiver Permanent Program Act of 2000, Pub. L. No. 106-396, 114 Stat. 1637, 1641; Section 414 of the Uniting and Strengthening America by Providing Appropriate Tools Required to Intercept and Obstruct Terrorism Act of 2001 (USA PATRIOT Act), Pub. L. No. 107-56, 115 Stat. 272, 353; Section 302 of the Enhanced Border Security and Visa Entry Reform Act of 2002 (Border Security Act), Pub. L. No. 107-173, 116 Stat. 543, 552; Section 7208 of the Intelligence Reform and Terrorism Prevention Act of 2004 (IRTPA), Pub. L. No. 108-458, 118 Stat. 3638, 3817; Section 711 of the Implementing Recommendations of the 9/11 Commission Act of 2007, Pub. L. No. 110-53, 121 Stat. 266, 338; and Section 802 of the Trade Facilitation and Trade Enforcement Act of 2015, Pub. L. No. 114-125, 130 Stat. 122, 199

This evaluation was conducted at the Mariposa POE from May 20, 2024, through June 16, 2024. The Mariposa POE was selected based on the availability of lanes with a consistent footprint and traffic patterns for the evaluation.

2.3 Objective

The primary objective of this vendor technology demonstration was to identify the most effective, operationally viable and commercially available biometric technology for capturing quality photos of 85%-100% of travelers as they travel through the inbound POV lanes at the land border.

During this evaluation, a vendor's biometric capture system was assessed for its ability to:

- Capture live photos of all occupants while the vehicle passed through the PPZ.
- Send photos of unique occupants that are of sufficient quality to be templated by TVS for a match attempt.

Additionally, OFO evaluated the end-to-end biometric verification process from an operational standpoint to determine the efficacy of traveler verification in the vehicle environment. The end-to-end process begins with the traveler's live photo capture and is completed with the biometric confirmation. The performance of the biometric technology in the lane and the quality of the live photos contribute to the success or failure of the end-to-end biometric confirmation process. The end-to-end process includes CBP's ability to:

- Retrieve the travel document source photo(s) on file in Government holdings to compare to the live photo(s). When a travel document contains a photo in Government holdings, it is considered an eligible document.
- Conduct facial comparison of the live and source photos using TVS' facial matching capability for the purpose of identity verification.
- Provide automated notification of a traveler's identity verification to the CBPO for use in the admissibility decision.
- Document the biometric confirmation in CBP systems.

2.4 Findings

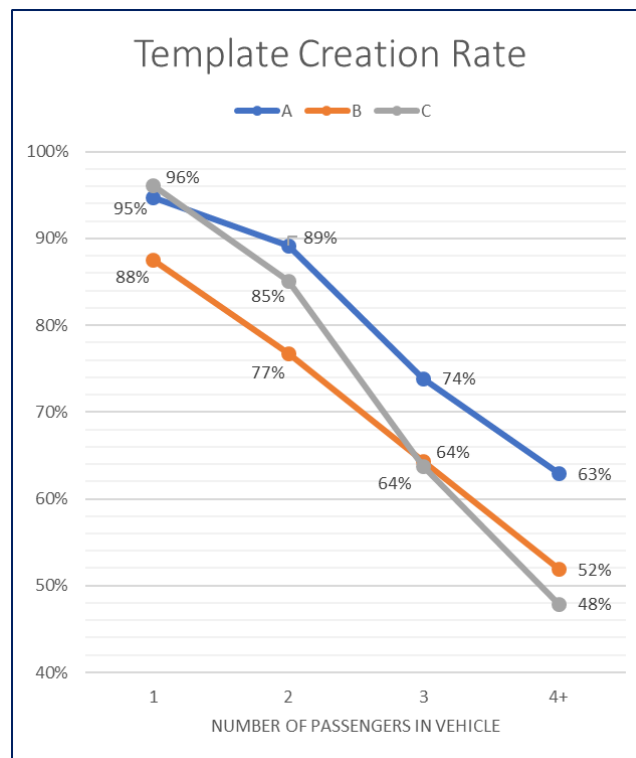
Vendors were evaluated based on their ability to capture quality photos that could be "templated" by TVS. Templating is a step in the facial comparison process wherein TVS prepares a live photo for a match attempt with a document photo. A photo must meet certain quality criteria to be templated. For this evaluation, the Template Creation Rate (TCR) describes the number of templates created divided by the number of travelers in biometrically processed vehicles. The vendors performed as follows:

- Vendor A had a TCR of almost 81% of all the travelers in their lane.
- Vendor C had a TCR of 74% of travelers.
- Vendor B had a TCR of just over 68% of travelers.

It is more operationally relevant to view TCR in relation to the number of passengers in each vehicle. Most vehicles crossing into the United States carry 1- or 2- passengers. Chart 1 provides a view of how well each biometric solution captured front seat-only passengers (1- and 2-

passenger vehicles) compared to front seat and back seat passengers (3- and 4+ passenger vehicles).

Chart 1 Template Creation Rate by Vehicle Occupancy, May 20-June 16, 2024



- When a single passenger was in a vehicle, Vendor C performed at 96% slightly better than Vendor A at 95%.
- Vendor A consistently performed better than all other vendors with 2 to 4+passenger vehicles.
- Vendor B captured almost 10% fewer passengers in 1- and 2-passenger vehicles than the other two vendors, but surpassed Vendor C in capturing 3 or more passengers in a vehicle.

On average, Vendor A performed at a higher level than the other two vendors in all scenarios, but differences in performance between vendors become more prevalent with more people in the vehicle. The vendors at Mariposa, together, had higher photo capture and template creation rates than the two previous tech demos at Anzalduas POE in 2021/22 and at Stanton St. POE in 2023, depicted in Table 1.

Table 1 Performance Comparison of Previous Technology Demonstrations

Consolidated Biometric Solution Tech Demo Comparison: Anzalduas, Stanton St. and Mariposa POEs						
Date	Port	Total Travelers	Total Photos Captured in the Lane	Photo Capture Rate	Total Photos Templated By TVS	Template Creation Rate
Sept. 20, 2021 – Feb. 19, 2022	Anzalduas	321,387	219,728	68.4%	179,340	55.8%
May 23 – Sept. 24, 2023	Stanton St.	527,198	413,599	78.5%	381,564	72.4%
May 20 – June 16, 2024	Mariposa	94,748	76,620	80.6%	70,701	74.6%

3. Technology Demonstration Overview

3.1 Public Communication

Prior to the technical demonstration, the Tucson Field Office issued a press release to inform the public about what to expect during testing in the biometric lanes and options for opting out of biometric verification.

Signage at the port of entry also alerted the public to the testing. Dynamic signage above the selected test lanes was configured to alternate between “All Traffic” and “Biometric Lane,” as shown in Figure 1.

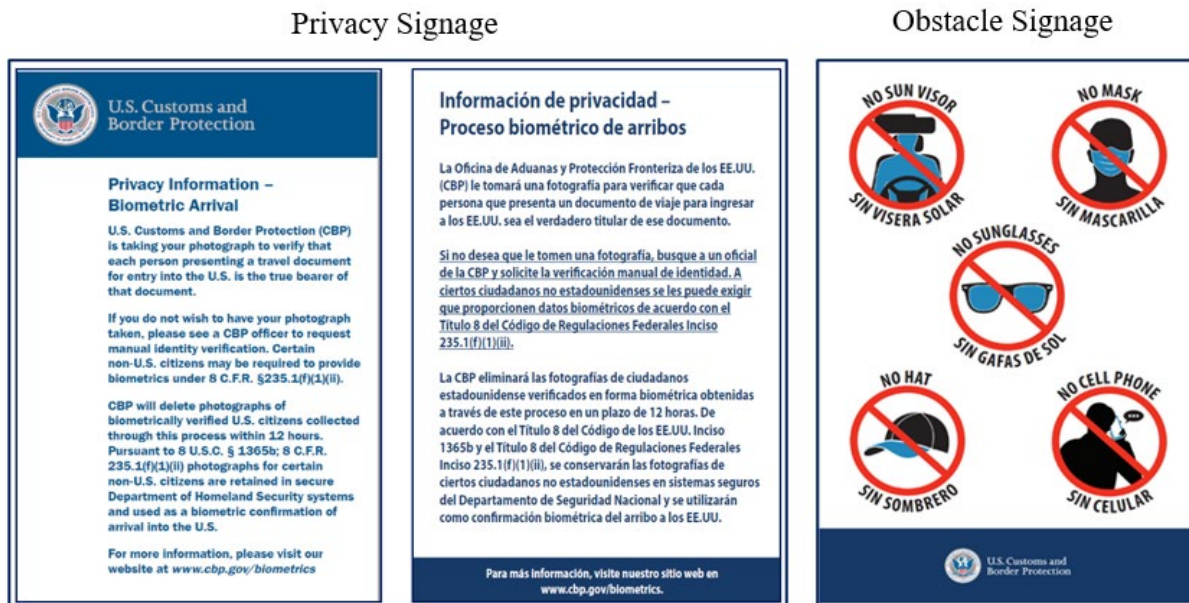
Figure 1 Dynamic Signage in the Lanes



This allowed travelers to select an alternative lane if they wished to opt-out of biometric verification and use a static “All Traffic” lane.

Additional signage for the technical demonstration was installed at ground-level at the entrance to each test lane: Privacy signage in English and Spanish, which provides instruction on how to opt out of biometric testing and request manual processing, and obstruction signage, which uses icons and text to request travelers remove obstacles to good photo capture (see Figure 2).

Figure 2 Privacy and Obstacle Signage for Biometric Test Lanes



3.2 Evaluation Approach

For a fair and objective assessment of facial capture systems, the evaluation approach followed the guidelines below:

- Each biometric solution was tested in a separate lane, independent of each other.
- Each biometric solution was tested at the same time and at the same location.
- Selected lanes for installation had consistent traffic patterns and hours of operation.
- Selected lanes had a consistent layout/footprint, infrastructure, and services (power, network, etc.).
- Selected lanes had consistent environmental conditions, such as sun exposure, orientation, and amount of artificial lighting in the lanes.
- Each facial capture system was evaluated using the same evaluation criteria.

At Mariposa, there are 14 inbound lanes; lanes 2 through 13 are standard POV lanes. Test lanes 3, 5, and 9 were randomly selected by the participating vendors.

3.3 Lane Installation and Configuration

Each facial capture solution was installed using the following guidelines:

- Solution not permitted to alter or use existing infrastructure (e.g., bollards), to mount devices.
- Solution devices need to fit within the boundary of the safety/protection bollards in the lane.
- Solution devices cannot obstruct existing lane devices (e.g., front license plate reader).
- Network/power conveyance would be temporary, above the ground (due to lack of underground conduits in the lanes) and would need to be secured with cable guards.
- Solution's footprint should not be intrusive to port operations.

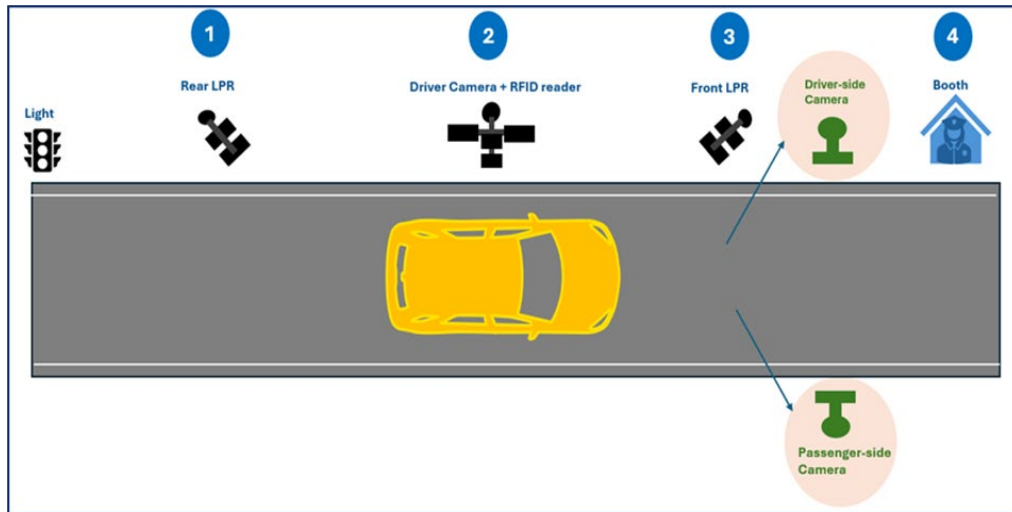
3.3.1 Test Lane Configurations

Each vendor biometric solution installed in test lanes 3, 5, and 9 was unique. Lane diagrams in Figures 3, 4, and 5 illustrate each configuration:

3.3.1.1 Lane 3 Biometric Solution

- Driver-side camera assembly with constant light illuminators.
- Passenger-side camera assembly with constant light illuminators.
- Video image capture.

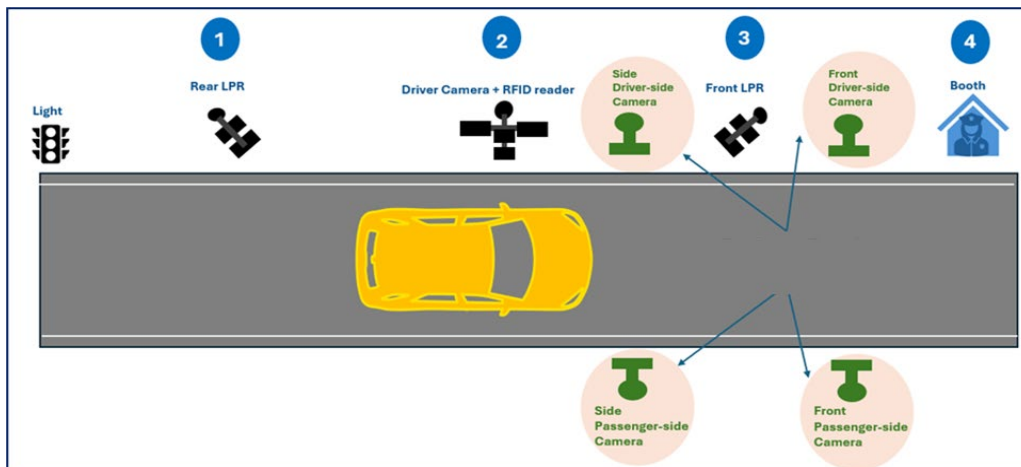
Figure 3 Lane 3 Facial Capture System



3.3.1.2 Lane 5 Biometric Solution

- 2 Driver-side camera assembly with built-in illuminators.
- 2 Passenger-side camera assembly with built-in illuminators.
- Still image capture.

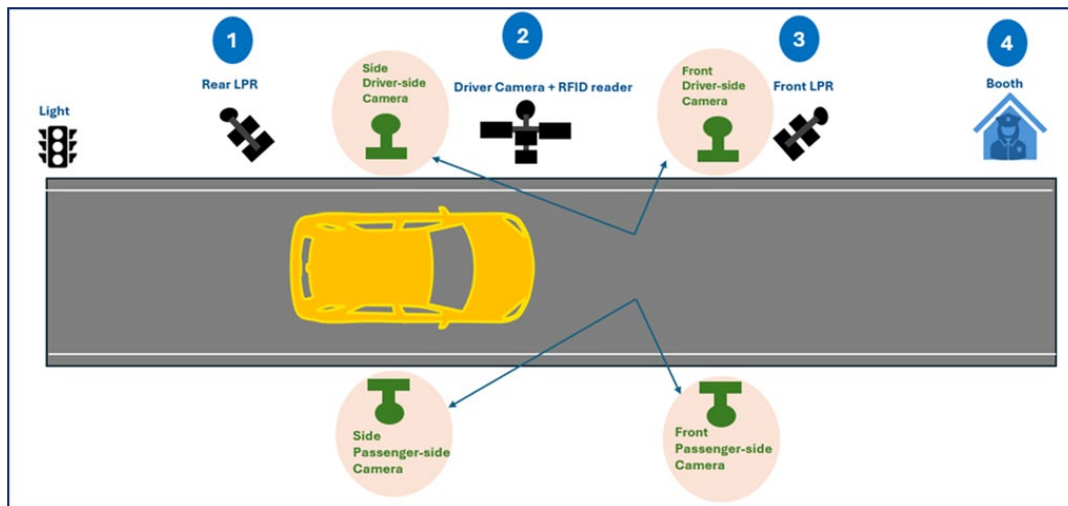
Figure 4 Lane 5 Facial Capture System



3.3.1.3 Lane 9 Biometric Solution

- a. 2 Driver-side camera assembly with mounted illuminators
- b. 2 Passenger-side camera assembly with mounted illuminators.
- c. Still image capture.

Figure 5 Lane 9 Facial Capture System



4. Concept of Operations

The port processed traffic throughout the day, from 6:00 a.m. to 10:00 p.m. Mountain Time. The traffic pattern in each lane was controlled with a red light at the entrance of each lane. Each vehicle waited at the red light until the officer signaled the vehicle to approach the inspection booth. This traffic pattern served to maintain lower vehicle speeds for capturing facial images of travelers in the pre-primary zone of the lane.

- Cable ramps in the lanes covering the temporary power cords helped control vehicle speeds in the PPZ.
- No notable tailgating was observed (tailgating can potentially lead to travelers in the vehicle behind getting captured and added to the wrong vehicle package).
- The controlled traffic and standard length of the lane provided sufficient time for processing images sent to SA-V.
- All lanes were covered by a large, grilled canopy that provided shade during the peak hours of sunlight. As a result, the systems were not exposed to peak sun hours even though the technical demonstration was conducted during the summer months.

4.1 Biometric Capture

As a vehicle passes through the PPZ, the following occurs:

- The vehicle activates the sensor triggering the license plate reader, scene camera, and the biometric technology.

- The Radio Frequency Identification (RFID) reader captures the travel documents.
- The plate, scene, facial images, and RFID document code are added to one “vehicle package” and sent to the SA-V primary processing application.

4.2 Simplified Arrival-Vehicle Biometric Application

Upon receiving the vehicle package, SA-V performs the following:

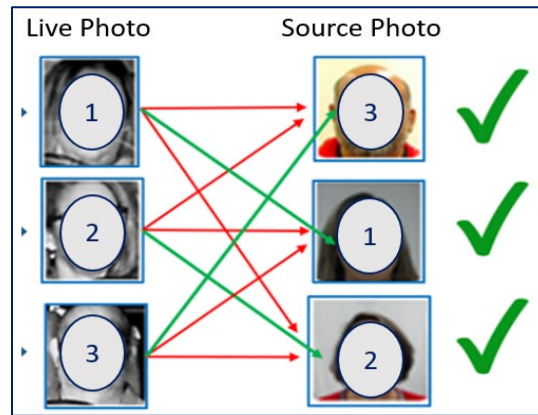
- Uses the RFID code, e-Chip, or machine-readable zone to retrieve the traveler biographic data and source photo from the Travel Document Encounter Database (TDED).
- If both live and source photos are present, SA-V sends them to the Traveler Verification Service (TVS) for matching.
 - A vehicle must have at least one passenger with an eligible travel document for SA-V to send the live photos to TVS for matching.
 - If the eligibility criteria are met, ALL live photos in the vehicle package are sent to TVS for templating, even those of the travelers in the vehicle without eligible documents.
 - If an RFID document is not available or not read in the PPZ, the officer will scan or manually enter the document at the booth and the live and source photos are sent to TVS.
 - TVS returns the live photos of the “validated” identities (i.e., matched to the source photo) for SA-V to display to the officer.
 - If a live photo was not captured in the lane but the source photo was, the source photo is displayed in SA-V and the officer confirms the identity manually.
 - If the live photo was captured but failed to match to the source photos captured in the lane, SA-V holds the photo in the background to be matched to the source photos captured at the booth (if any).
 - If the live photo was captured but did not match the source photo (either captured in the lane or at the booth), no TVS result is returned; the officer confirms the identity manually and admits, or refers, the package.
 - Unmatched live photos are dropped by SA-V when the package is closed.

4.3 Traveler Verification Service

In the POV environment, multiple live photos and source photos of passengers can be captured (or missed) in the lane; additional source photos may be added at the booth.

- Because multiple live and source photos are in the same “package,” TVS performs a 1: few or few: few matching, depending on how many passengers in the vehicle have a live photo captured (Figure 6: each live photo has a match attempt against each source photo).
- TVS returns only the successfully “Verified” matches to SA-V.

Figure 6 TVS Few: Few Matching



5. Performance Evaluation

5.1 Facial Capture Solutions: Performance Metrics

Performance data was gathered and evaluated from May 20th through June 16th, 2024. Table 2 outlines the metrics provide to the vendors prior to the demonstration. Biweekly biometric reports were generated and distributed to CBP and vendor stakeholders.

Table 2 Solution Performance Metrics

Table 1 – Vendor Solution Evaluation Metrics	
Metric	Description
Live Photo (probe) Capture Rate	Percentage of distinct passengers for whom a live photo was captured in the PPZ and sent to SA-V
Template Creation Rate (total Travelers)	Percentage of distinct passengers for whom a photo was captured that could be templated by TVS for facial matching comparison. (Templatization is a step in TVS process to ensure a live photo is suited for conducting subsequent matching.) This rate implicitly determines the image quality of live photo captures.
Template Creation Rate by Vehicle Occupancy	Percentage of distinct passengers for whom a photo was captured that could be templated by TVS, for vehicles with 1, 2, 3 and 4+ passengers

5.1.1 Facial Capture Solution: Cumulative Performance

The consolidated view in Table 3 shows the percentage of travelers in biometrically processed vehicles who had a photo captured in the lane and the percentage of those photos that were of sufficient quality for TVS to template them (i.e., the template creation rate).

Table 3 Consolidated Solution Performance, May 20-June 16, 2024

Consolidated Vendor Performance for 5/20/2024 – 6/16/2024					
Vendor	Travelers	Photos Captured	Photo Capture Rate*	Photos Templated by TVS	Template Creation Rate (TCR)**
A	31,941	27,547	86.2%	25,773	80.7%
B	27,396	21,817	79.6%	18,732	68.4%
C	35,411	27,256	77.0%	26,196	74.0%

* Unique probe photos / Total Travelers in biometrically confirmed vehicles

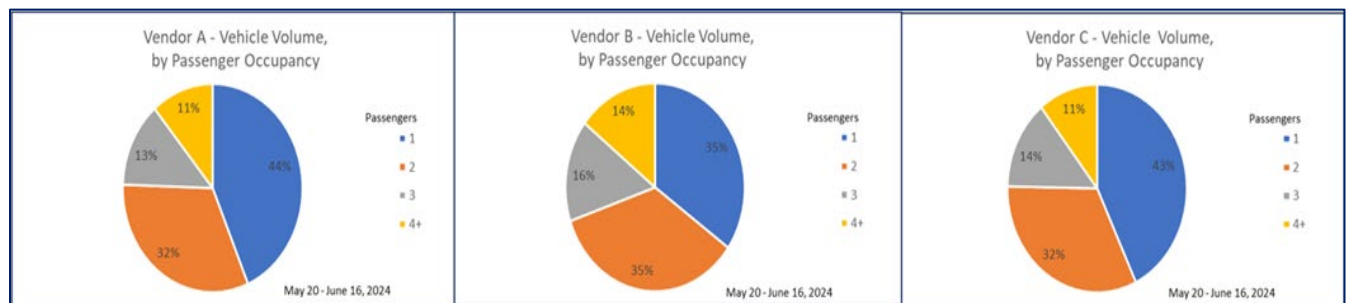
** Photos templated by TVS / Total Travelers in biometrically confirmed vehicles

- Vendor A captured the most unique photos of travelers in the lane (86%) and even though not all photos were of high enough quality for templating, Vendor A had the highest TCR at almost 81% of travelers.
- Vendor B captured the second highest number of traveler photos in the lane, almost 80%; however, 11% of these photos were unable to be templated, bringing their TCR down to 68%. This may indicate a need to improve the quality of the photos captured in the lane.
- Vendor C captured the third highest number of lane photos at 77% and was able to template 74% of travelers (only a 3% drop and more templates than Vendor B); this may indicate that Vendor C's photo quality was high.

5.1.2 Facial Capture Solution Performance by Vehicle Occupancy

Looking at a vendor's performance through the lens of vehicle occupancy adds an important operational perspective to the Mariposa results because most vehicles entering at a U.S. land port of entry carry 1- or 2- passengers, most likely in the front seat. Chart 2 illustrates the proportion of 1-, 2-, 3-, and 4+ passenger vehicles passing through each vendor's lane during the test.

Chart 2 Proportion of Vehicle Occupancy by Lane

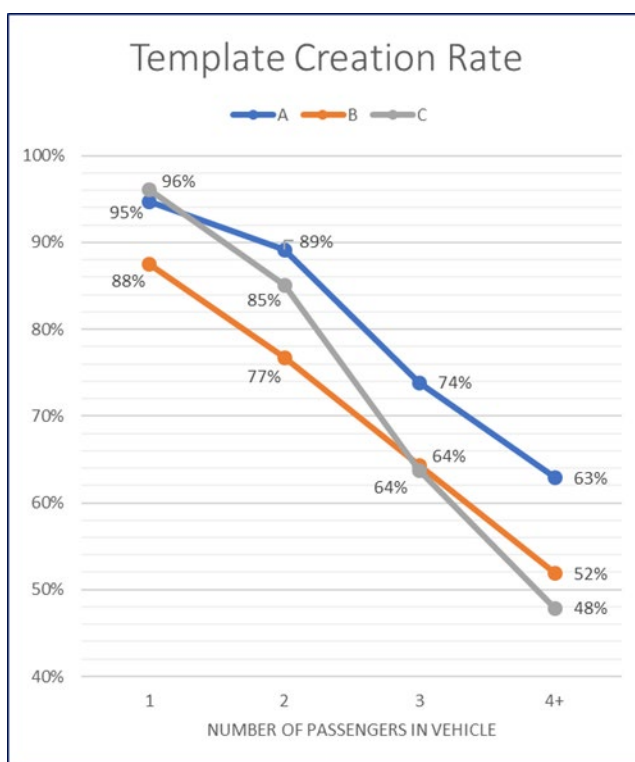


- Though Vendor B had a slightly higher percentage of 3 and 4 passenger vehicles, the passenger proportions were very close to Vendors A and C, who had an almost identical breakdown.
- 1- and 2- passenger vehicles were the bulk of traffic: 70% – 76% of vehicles in each lane.

5.1.3 Template Creation by Vehicle Occupancy

By the end of the test period, the data shows all vendors produced a photo capture rate of 100% for drivers in 1- passenger vehicles, but not all captured photos were templated. Chart 3 provides a breakdown of traveler photos templated for 1 – 4+ passenger vehicles, for all vendors.

Chart 3 TCR by Vehicle Occupancy, May 20-June 16, 2024



- All vendors had a high rate of capture and templating for 1- and 2- passenger vehicles, though two stood out:
 - Vendor C had the most templated travelers in 1- passenger vehicles at 96%, followed closely by Vendor A at 95%.
 - Vendor A achieved a TCR of 89% for 2- passenger vehicles over Vendor C with 85%.
- Vendor A surpassed the others in templating 2-, 3-, and 4+ passenger vehicles, with a 4%, 10%, and 11% lead over the next highest performer, respectively.
- Vendor B templated more travelers than Vendor C for 4+-passenger vehicles.

5.2 End-to-End Biometric Verification Process Evaluation

Alongside the performance of the vendor's biometric technology, the success of CBP's end-to-end biometric (or traveler) verification process is dependent on the RFID read rates in the lane, availability of source documents, and the ability of TVS to match the live and source photos to confirm an identity. These metrics are described in Table 4.

Table 4 End-to-End Biometric Process Metrics

Biometric Process Evaluation Metrics	
Metric/Analysis	Description
RFID Read Rate	Percentage of travelers with RFID documents read in the lane or at the booth.
Biometric Confirmation Rate (BCR)	Percentage of biometrically confirmed travelers, i.e., the traveler had a live photo that matched to a source photo retrieved from CBP holdings. (Number of Matches / Number of travelers = BCR)

5.2.1 RFID-read Rates in Pre-primary and Primary

While not all documents are RFID-enabled, the RFID read rates are important to the biometric process for returning the source photo associated to an eligible travel document; without the source photo, TVS cannot perform a match to the live photo.

If the RFID document is captured in the PPZ, advance identity validation is possible before the traveler reaches the primary booth. If the document is not read in the PPZ, the officer must scan the document at the booth before TVS can perform the match.

In Mariposa, it was observed that travelers did not routinely present their RFID documents in the lane; therefore, the officer scanned them at the booth. The RFID system configurations were confirmed to ensure optimization, but no further mitigations could be applied to offset traveler behavior. For the travelers that had RFID documents, the lane and booth read rates had a combined range between 75% - 83%.

Table 5 depicts the lane, booth, and overall read rates for Mariposa POE by test lane.

Table 5 Mariposa Radio Frequency Identifier Document Read Rates

Mariposa RFID Read Rates, May 20 – June 16, 2024							
Lane	Total Travelers	Travelers with RFID Docs	RFID Read in Lane	RFID Read in Booth	In-lane RFID Read Rate	In-booth RFID Read Rate	Overall RFID Read Rate
3	40,727	33,956	10,925	15,233	32.2%	44.9%	77.0%
5	36,013	30,105	9,109	15,999	30.3%	53.1%	83.4%
9	36,010	31,724	7,650	16,346	24.1%	51.5%	75.6%

Onsite observations determined that some documents were in poor condition, intentionally tampered with, or unable to be detected or scanned, which resulted in the officer having to manually enter the traveler's biographic data to retrieve the source photo, before the TVS match could take place. This will be a challenge for any biometric solution at all ports of entry.

5.2.2 Biometric Confirmation Rates

The photo capture, template creation, and biometric confirmation rates are all based on the total number of travelers in biometrically processed vehicles. If a vehicle was not biometrically

processed, no one in the vehicle had an eligible document with a source photo to match against a live photo; therefore, those travelers are not included in the biometric evaluation.

If at least one passenger in the vehicle had an eligible document, ALL live photos captured for that vehicle are sent to TVS for templating, regardless of the document status of the other passengers.

In Table 6, the TCR calculation (blue column) includes all templated travelers. The BCR calculation subtracts the travelers without eligible documents before calculating.

Table 6 Consolidated End-to-End Biometric Performance Metrics

Consolidated End-to-End Biometric Process Performance 5/20/2024 – 6/16/2024							
Vendor	Travelers	Photos Captured	Photo Capture Rate*	Photos Templated by TVS	Template Creation Rate (TCR)**	Biometric Matches	Biometric Confirmation Rate***
A	31,941	27,547	86.2%	25,773	80.7%	21,454	73.8%
B	27,396	21,817	79.6%	18,732	68.4%	13,991	55.3%
C	35,411	27,256	77.0%	26,196	74.0%	21,767	67.4%

* Unique probe photos / Total Travelers in biometrically confirmed vehicles

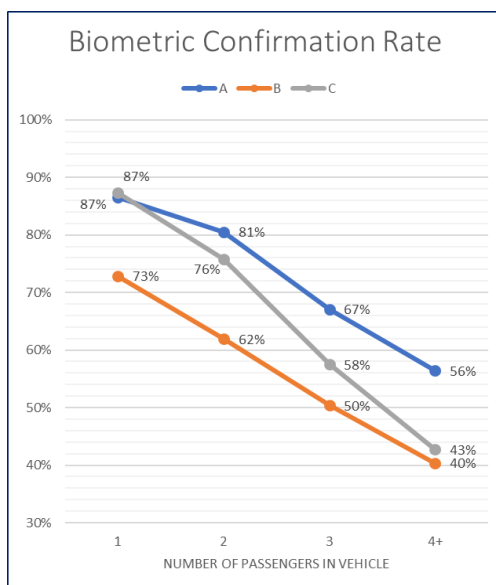
** Photos templated by TVS / Total Travelers in biometrically confirmed vehicles

*** BCR = TVS biometric matches / (Total Travelers in biometrically confirmed vehicles - Passengers w/o RFID travel document in biometrically confirmed vehicles)

5.2.3 Biometric Confirmation Rate by Vehicle Occupancy

Chart 4 displays the Biometric Confirmation Rates broken down by 1-, 2-, 3-, and 4+ passenger vehicles providing a more targeted view of the end-to-end performance of vehicle biometric processing, in a way that consolidated numbers cannot.

Chart 4 Biometric Confirmation Rates by Vehicle Occupancy, May 20-June 16, 2024



- Vendor solutions A and C biometrically confirmed 87% of travelers in 1- passenger vehicles.
 - This number includes matching from both lane and booth document reads, it is not all advance identity verification (OFO's stated goal is 85%-100% lane biometric confirmations).
- Vendor A surpassed Vendors B and C for 2- to 4+ passenger vehicle biometric confirmations.
 - As previously shown in Chart 1, Vendor A had the greatest number of templated photos of travelers in this category for TVS to conduct a match attempt with a source photo.
- TVS was unable to biometrically confirm ~7% to 8% of Vendor A's templated photos, ~12% to 15% of Vendor B's photos, and ~5% to 9% of Vendor C's photos.
 - This attrition may be explained by a combination of template quality issues and the effectiveness of the TVS matching algorithm.

5.2.4 End-to-End Biometric Process at-a-Glance by Vendor

Figures 7, 8, and 9 provide an at-a-glance view of vendor performance and how it contributes to the end-to-end biometric confirmation process in vehicle.

Figure 7 Vendor A Performance Visualization

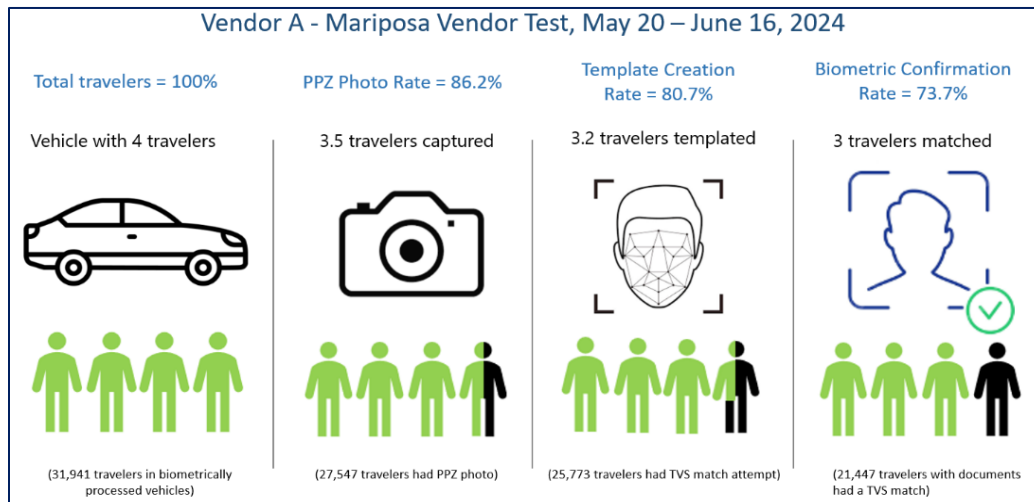


Figure 8 Vendor B Performance Visualization

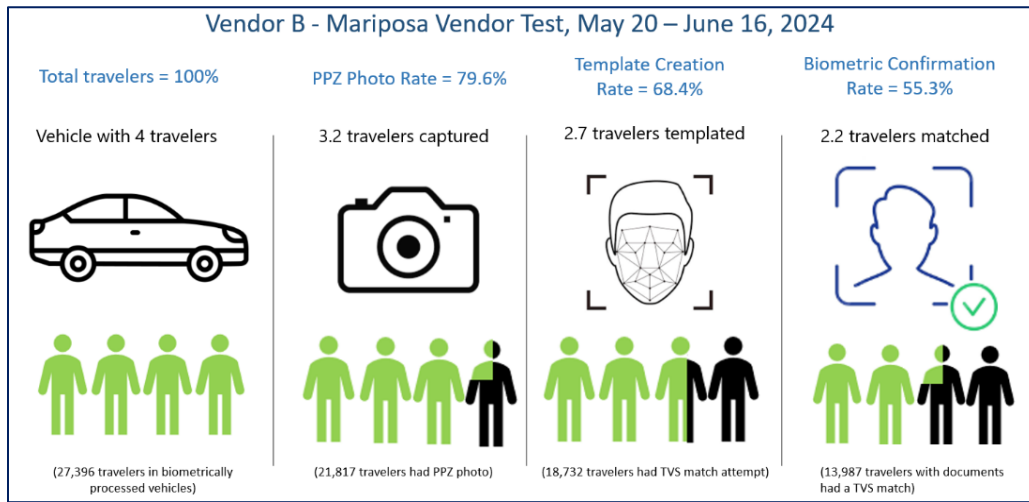
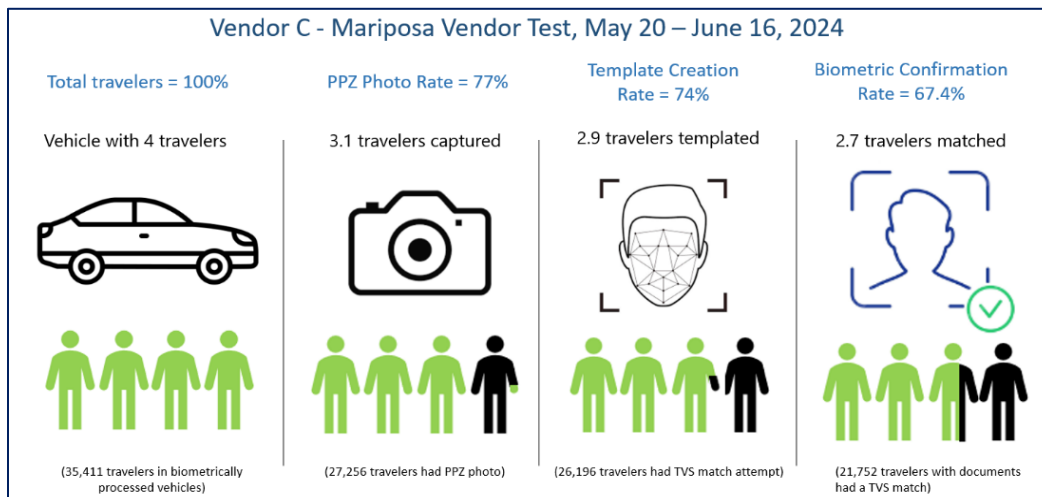


Figure 9 Vendor C Performance Visualization



Note: Travelers in vehicles that were not biometrically processed, are not included in these numbers. To be biometrically processed, a vehicle must have at least 1 traveler with an eligible travel document with a good source photo. Live photos from the PPZ sent for templating, include the photos of passengers in the same vehicle without an eligible document; these passengers are subsequently dropped when calculating the biometric confirmation rate.

6. Challenges

6.1 Technical Challenges

6.1.1 Entry-Exit Radar Sensors

The entry-exit radar sensors did not detect the presence of similar vehicle type (e.g. small sedans) consistently. All facial capture solutions were required to integrate and operate in the inbound lanes without having to make changes to the existing infrastructure. The lanes use radar sensor technology to detect a vehicle in the lane. The sensors are pre-programmed for specific

beam profile and the same settings are used for both entry and exit sensors in all the inbound lanes.

During system integration, a vendor observed that the entry sensor did not detect small sedans with a low profile until the vehicle had moved further, thereby delaying captures. Teams on site could not resolve the issue. After a few trials with configuration changes, this issue was mitigated by adjusting the angle of the sensor to detect the vehicle earlier. CBP confirmed this adjustment had no effect on the regular lane operations.

6.1.2 Factors Impacting Templatization

Physical conditions, obstacles, and human behavior all impact the success of quality photo capture in the POV environment. There were many instances where photo templatization failed when face detection was unsuccessful due to factors such as poor image quality or facial composure. As a result, not all live photos taken by facial capture solutions could be successfully templatized.

Live facial captures can fail templatization for various reasons, such as insufficient lighting or a face being partially blocked. These factors were observed for all systems. Some examples of live facial images that failed the quality threshold for templatization are displayed in Figure 10.

Figure 10 Obstacles to Templatization



6.1.3 Duplicate Facial Captures in same Encounter

All solutions saw duplicate facial images appearing in the same encounter, i.e., a package contained more live images than the number of passengers in the vehicle (see Table 7). This can occur when more than one camera is used. The number of duplicates was not part of the evaluation criteria but is presented here to demonstrate the technical challenge. Over two days, the percentage of duplicates ranged from <1% to <5%.

Table 7 Percentage of Duplicate Images by Lane for June 15 & 16, 2024

Date	Lane 3	Lane 5	Lane 9
6/15	0.79%	2.54%	4.71%
6/16	0.66%	3.65%	3.87%

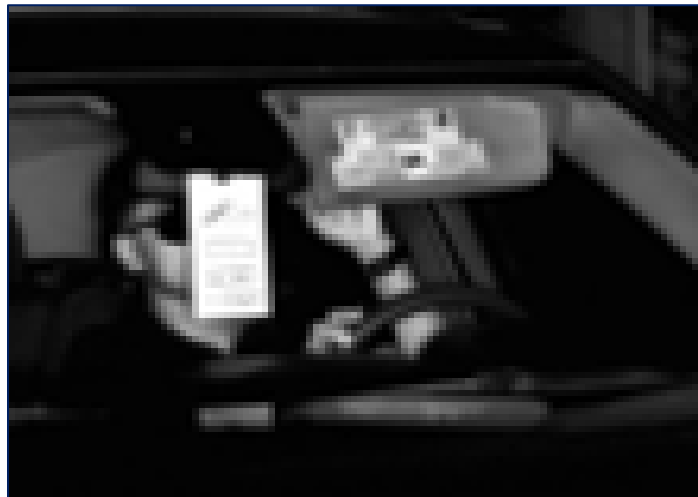
6.2 Operational Challenges

The effectiveness of detecting facial images in a moving vehicle does not solely depend on the technical configuration of the capture solution; external factors can also impact face detection.

6.2.1 Environmental conditions

Vehicles with dirty windshields or obstructions inside the vehicle (e.g., stickers, visor, items hanging from the rearview mirror, etc.) can obstruct faces (Figure 11).

Figure 11 Face Obstructed by Mirror Tag



6.2.2 Human factors

Travelers are not aware of the cameras and may be looking sideways or down or be obscured by the vehicle when leaning to present their RFID travel document resulting in faces not being detected (Figure 12).

Figure 12 Face Blocked by Vehicle's A-frame



6.2.3 Tailgating

In rare instances, solutions picked up faces of travelers behind the vehicle due to tailgating (Figure 13). Traveler images from another vehicle are not displayed to the officer and the extra images are dropped from the package when the officer admits the package. These instances were infrequent due to the controlled traffic pattern at Mariposa but not all ports are configured the same.

Figure 13 Tailgating Facial Capture



7. Conclusion

7.1 Mariposa Vendor Technical Demonstration Results

For two of the solutions, the technical demonstration at Mariposa was the first, real-world CBP system-integrated experience in a biometric POV lane at a land port of entry. The evaluation metrics discussed in this report illustrate the following outcomes:

- Both Vendor A and Vendor C met or exceeded CBP's minimum goal of 85% template creation rate for both 1- passenger vehicles (95% and 96%, respectively) and 2- passenger vehicles (89% and 85%, respectively).
- Vendor B's templates may have been of a lower quality, which may account for Vendor C's higher biometric confirmation rates for 3- and 4+ passenger vehicles, even though Vendor C captured fewer templated faces.
- The following enhancements may improve quality photo capture in the PPZ:
 - Repositioning the cameras in the lane.
 - Adding more cameras in the lane.
 - Improving lenses, filters, illumination, etc.
 - Improving the cameras' face-detection algorithms.

7.2 End-to-End Biometric Process Evaluation

A high-performing lane camera solution that captures templatable photos of the most travelers is vital to the success of CBPs biometric solution for POV; however, equally important is CBP's ability to return a source photo for the match attempt to validate an identity.

The technical demonstration at Mariposa demonstrated the following impacts to CBP's POV biometric process:

- Low lane RFID reads (between 24%-32%) prevents advance identity validation prior to the vehicle reaching the booth.
 - Advance notification is desired to provide the officer with enforcement alerts on the traveler (e.g., Armed & Dangerous).
 - Modifying traveler behavior through education and signage instruction may help alleviate low PPZ RFID reads on the Southern Border
- Low booth RFID read rates (between 45%-53%) necessitate manual entry to retrieve the source photo for a delayed identity validation.
- Possible explanations for the low read rates:
 - Many travelers have tampered with the RFID device in the travel document in the mistaken belief that CBP uses it to track their whereabouts.
 - Documents are well-used and damaged causing the RFID to no longer works.

7.3 Recommendations for Next Steps

CBP recognizes the difficulty capturing photos and biometrically confirming 100% of POV travelers. To optimize capture and confirmation, CBP is pursuing three avenues: improve the biometric solution in the pre-primary zone, add a camera at the booth to capture missing travelers, and optimize the TVS matching algorithm used in the vehicle environment.

7.3.1 Pre-Primary-zone Camera Solution

Building on the real-world experience and the performance metrics of the three biometric solutions at Mariposa, CBP would like to continue testing enhancements to the biometric solutions. The Mariposa test was conducted under ideal weather conditions at a newly renovated port. Future testing should evaluate performance in inclement weather conditions, such as snow, and/or in a less-than-ideal lane footprint.

7.3.2 Primary Camera Solution

CBP will explore biometric solutions for use at the primary booth. A camera at the booth will enable photo capture of travelers missed in the lane, especially the occupants of 3 and 4+ passenger vehicles. SA-V will send the added facial images to TVS to biometrically confirm all travelers with eligible documents.

7.3.3 Matching Algorithm Analysis

CBP continues to partner with DHS Science & Technology to research different matching algorithms to optimize biometric confirmations in the vehicle environment.

- The matching algorithm for vehicle should be able to match off-axis (profile) photos, overcome some environmental factors, and match lower-quality templates.
- CBP is collaborating with DHS S&T to test a variety of algorithms with Mariposa facial images. The shared images contain no personally identifiable information.

Appendix A: Consolidated Performance by Vehicle Occupancy

Table 8 illustrates the template creation rate and biometric confirmation rate data by vehicle occupancy for each vendor (chart formats are presented on pages 10 & 13).

Table 8 Consolidated Solution Performance by Vehicle Occupancy

Mariposa Consolidated Vendor – Vehicle Occupancy 5/20/2024 – 6/16/2024					
Vendor	Occupancy	Vehicle Count	Photo Capture Rate*	Template Creation Rate**	Biometric Confirmation Rate***
A	1 passenger	7071	100.0%	94.7%	86.5%
	2 passengers	5185	93.4%	89.2%	80.5%
	3 passengers	2156	80.0%	73.9%	67.1%
	4+ passengers	1817	69.9%	62.9%	56.4%
B	1 passenger	4401	100.0%	87.6%	72.9%
	2 passengers	4408	87.5%	76.8%	61.9%
	3 passengers	1998	75.9%	64.3%	50.4%
	4+ passengers	1821	62.9%	51.9%	40.4%
C	1 passenger	7702	100.0%	96.1%	87.4%
	2 passengers	5820	87.9%	85.1%	75.8%
	3 passengers	2502	66.9%	63.8%	57.5%
	4+ passengers	1929	50.2%	47.9%	42.7%

* Unique probe photos / Travelers

** Photos templated by TVS / Travelers

*** Biometric Confirmation Rate: TVS biometric matches/ (Total Travelers in biometrically confirmed vehicles - Passengers w/o RFID travel document in biometrically confirmed vehicles)

Appendix B: 100% Passenger Biometric Confirmation Rates

Table 9 illustrates the percentage of vehicles in which a vendor was able to capture templatable photos of *100% of occupants AND 100% of those occupants were biometrically confirmed* for 1, 2, 3, and 4+ occupancy vehicles.

Table 9 100% Passenger Biometric Confirmation Rates by Vehicle Occupancy

Vendor A – 100% Vehicle Biometric Rates 5/20/2024 – 6/16/2024				
For what percentage of vehicles did we capture 100% quality photos and achieve 100% biometric confirmation, by occupancy?				
Occupancy	Vehicle Count	Vehicle Percent	100% Template Creation Rate**	100% Biometric Confirmation Rate***
1 passenger	7071	43.6%	94.7%	86.5%
2 passengers	5185	31.9%	79.7%	56.5%
3 passengers	2156	13.3%	36.8%	19.9%
4+ passengers	1817	11.2%	13.8%	5.7%

Vendor B – 100% Vehicle Biometric Rates 5/20/2024 – 6/16/2024				
For what percentage of vehicles did we capture 100% quality photos and achieve 100% biometric confirmation, by occupancy?				
Occupancy	Vehicle Count	Vehicle Percent	100% Template Creation Rate**	100% Biometric Confirmation Rate***
1 passenger	4401	34.9%	87.6%	72.9%
2 passengers	4408	34.9%	57.0%	33.5%
3 passengers	1998	15.8%	24.7%	8.7%
4+ passengers	1821	14.4%	7.9%	2.0%

Vendor C – 100% Vehicle Biometric Rates 5/20/2024 – 6/16/2024				
For what percentage of vehicles did we capture 100% quality photos and achieve 100% biometric confirmation, by occupancy?				
Occupancy	Vehicle Count	Vehicle Percent	100% Template Creation Rate**	100% Biometric Confirmation Rate***
1 passenger	7702	42.9%	96.1%	87.3%
2 passengers	5820	32.4%	71.8%	49.5%
3 passengers	2502	13.9%	18.6%	9.2%
4+ passengers	1929	10.7%	0.3%	0.1%

*The percentage of VEHICLES with 1-4-passengers where ALL the occupants had a photo templated.
 ○ e.g., Vendor A templated 100% of occupants for 36.8% of 3-passenger vehicles.

** The percentage of VEHICLES with 1-4-passengers where ALL the occupants were biometrically confirmed.
 ○ e.g., Vendor B biometrically confirmed 100% of occupants for 8.7% of 3-passenger vehicles.