

Phase 2 Interface Control Document (ICD)

University of Washington ITS4US Deployment Project

www.its.dot.gov/index.htm

Final Report — October 25, 2022



U.S. Department of Transportation

Produced by University of Washington
U.S. Department of Transportation
Intelligent Transportation Systems Joint Program Office
Federal Highway Administration
Office of the Assistant Secretary for Research and Technology
Federal Transit Administration

Notice

This document is disseminated under the sponsorship of the Department of Transportation in the interest of information exchange. The United States Government assumes no liability for its contents or use thereof.

The U.S. Government is not endorsing any manufacturers, products, or services cited herein and any trade name that may appear in the work has been included only because it is essential to the contents of the work.

Technical Report Documentation Page

1. Report No. N/A	2. Government Accession No.	3. Recipient's Catalog No.	
4. Title and Subtitle Phase 2 Interface Control Document (ICD) University of Washington ITS4US Deployment Project		5. Report Date October 25, 2022	
		6. Performing Organization Code N/A	
7. Author(s) Kristin Tufte, Adam Danczyk, Anat Caspi, Mark Hallenbeck, Nick Bolten, Alice Marecek		8. Performing Organization Report No.	
9. Performing Organization Name and Address The Taskar Center for Accessible Technology Department of Computer Science & Engineering University of Washington Box 352350 Seattle, WA 98195-2350		10. Work Unit No. (TRAIS) N/A	
		11. Contract or Grant No. 693JJ321C000004	
12. Sponsoring Agency Name and Address U.S. Department of Transportation ITS Joint Program Office 1200 New Jersey Avenue, SE Washington, DC 20590		13. Type of Report and Period Covered N/A	
		14. Sponsoring Agency Code HOIT-1	
15. Supplementary Notes Kate Hartman, AOR			
16. Abstract <p>The Interface Control Document (ICD) describes the interfaces and data flows shown in the System Architecture Document (SAD). The ICD describes the relationship between the Source and the Destination that appear in the SAD, the interface requirements, defines the message structure and protocols that govern the interchange of data, and identifies the communications paths along which the project team expects data to flow. The purpose of the ICD is to identify the nature of required interfaces between the Transportation Data Equity Initiative (TDEI) and other systems and to capture the information necessary to define the TDEI system interfaces and to describe the networking and data standards that are used. The intended audience for this ICD is Data Generators who will produce data for the TDEI and Application Developers who will consume data from the TDEI as well as any Transportation Service Provider who may wish to have their data stored in the TDEI.</p>			
17. Keywords ITS4US; Complete Trip; Deployment; ITS; Intelligent Transportation Systems; SAD; Interface Design		18. Distribution Statement N/A	
19. Security Classif. (of this report) N/A	20. Security Classif. (of this page) Unclassified	21. No. of Pages 25	22. Price N/A

Revision History

Name	Date	Version	Summary of Changes	Approver
Kristin Tuft, University of Washington	15 September 2022	0.1	Initial Draft	
Kristin Tuft, University of Washington	25 October 2022	0.2	Revised Draft	

This page intentionally left blank.

Table of Contents

Revision History	i
Table of Contents	iii
1 Introduction.....	5
1.1 Purpose of the Interface Control Document	5
1.2 Document Overview	5
1.3 Assumptions.....	5
1.4 Risks	7
2 Standards	9
2.1.1 Communication Networking Standards	9
2.1.2 Data Schema Standards.....	9
2.1.3 Security Standards	10
3 Interfaces.....	11
3.1 Interface Document	11
3.2 Functional Allocation.....	11
3.2.1 Data Generator Systems <> TDEI System	12
3.2.2 TDEI System <> Data Consumer Systems	12
3.3 Security Integration	13
3.3.1 Security Integration Concepts	13
3.3.2 Data Generator Systems <> TDEI System	14
3.3.3 TDEI System <> Data Consumer Systems	18
4 Requirements	21
4.1 Requirement Interface.....	21
4.1.1 Requirements Interface #1 – Data Generator Systems <> TDEI System	21
4.1.2 Requirement Interface #2 TDEI System <> Data Consumer Systems	22
4.2 Traceability Table.....	22
5 Appendix A Definitions, Acronyms, and Abbreviation	25

List of Tables

Table 1 Data Generator Systems <> TDEI System Interface.....	12
Table 2 TDEI System <> Data Consumer Systems Interface	12
Table 3. Traceability Table	22

List of Figures

Figure 1 Registration and Approval Flow for Data Generators	15
Figure 2 Authorization Flow for Data Generators	16
Figure 3 Registration and Approval flow for Transportation Service Provider Point of Contact	17
Figure 4 Registration and Approval flow for Transportation Service Provider Representative	18
Figure 5 Registration and Approval flow for Data Consumers	19
Figure 6 Authorization flow for Data Consumers	19

1 Introduction

The Interface Control Document (ICD) describes the interfaces and data flows shown in the System Architecture Document (SAD). The ICD describes the relationship between the Source and the Destination that appear in the SAD, the interface requirements, defines the message structure and protocols that govern the interchange of data, and identifies the communications paths along which the project team expects data to flow.

1.1 Purpose of the Interface Control Document

The purpose of the ICD is to identify the nature of required interfaces between the Transportation Data Equity Initiative (TDEI) and other systems and to capture the information necessary to define the TDEI system interfaces. Networking and data standards are used when available. The intended audience for this ICD is Data Generators who will produce data for the TDEI and Application Developers who will consume data from the TDEI as well as any Transportation Service Provider who may wish to have their data stored in the TDEI.

1.2 Document Overview

The document describes the interfaces between the physical system of interest and external parties. In the TDEI, these interfaces are managed with APIs using standard networking protocols over the public internet and data standards to structure the messages. The interfaces, including data exchange between source and destination, are described in Section 3.2, the message structure and protocol are provided in Section 4.1, and security implementations are included in Section 3.3.

1.3 Assumptions

Key assumptions pertaining to external components for the implementation of the TDEI system include:

- The TDEI exchanges information with external groups using Application Programming Interfaces (APIs) over Hypertext Transfer Protocol Secure (HTTPS)¹ over the public internet. It is assumed that the external parties will continue using the public internet and its associated communication protocols.

¹ "RFC 9110 HTTP Semantics." June 2022. <https://www.rfc-editor.org/rfc/rfc9110> (accessed Sept 6, 2022)

- The TDEI will use Representational State Transfer (REST)ful² APIs where such design meets user needs.
- Data schema exchanged across the interface will be in the OpenSidewalks³, GTFS-Pathways⁴, or GTFS-Flex v2⁵ format, due to these standards being a core requirement for achieving the goals defined for this effort.
- OAuth 2.0⁶ and OpenID Connect⁷ (OIDC) standards will be used for authentication and Constraints

The TDEI system is designed with the following constraints:

- The TDEI system is reliant on independent data generators to interface with the TDEI system for data submission to occur. Data generators will need to comply with interface requirements.
- The TDEI system is reliant on third-party application developers to interface with the TDEI system to consume data. These third-party application developers will need to comply with interface requirements.
- The TDEI system is using OpenSidewalks, GTFS-Pathways, and GTFS-Flex data standards for the data to be sent over the interfaces. The use of these standards has the potential to constrain what data is sent over the interface. However, as a part of the ITS4US project, these standards are being evaluated and where the standards unduly constrain the data to be transferred, especially with regards to accessible transportation, changes to these standards will be proposed to the relevant standards governing organizations.

² Restful web API design. Microsoft. July 5, 2022. <https://docs.microsoft.com/en-us/azure/architecture/best-practices/api-design> (accessed Sept 7, 2022)

³ "Open Sidewalks." <https://www.opensidewalks.com> (accessed Sept 6, 2022)

⁴ "GTFS Schedule Reference", May 9, 2022, <https://gtfs.org/schedule/reference/> (accessed September 6, 2022)

⁵ GTFS Flex V2", Nov 9, 2021. <https://github.com/MobilityData/gtfs-flex/blob/master/spec/reference.md> (accessed Sept 6, 2022)

⁶ OAuth 2.0. <https://oauth.net/2/> (accessed Sept 7, 2022)

⁷ OpenID Connect. <https://openid.net/connect/> (accessed Sept 7, 2022)

1.4 Risks

Key risks associated with the interfaces described here include:

- Independent data generators may not be able to meet the interface requirements to send data. To help mitigate this risk, the project is developing a data translation tool to help data generators translate their data into the data formats accepted by TDEI.
- Third-party application developers may not be able to effectively use the TDEI APIs to query and consume data or may lose the business case to interface with the TDEI system. To help mitigate this risk, the UW team is designing the TDEI system with ongoing engagement with application developers.

2 Standards

The TDEI is a data system that transmits data to data consumers and receives data from data generators over the public internet using APIs. As such, the data standards used by the TDEI are communication networking standards for communication over the public internet, data schema standards for the data to be transmitted, and security standards for authenticating and authorizing API requests. These standards are described below.

2.1 Communication Networking Standards

The TDEI system uses HTTPS⁸ over public internet; HTTPS is a well adopted standard for this communication medium. In addition, the TDEI will use RESTful API design⁹. RESTful APIs are considered best practice in API design and such design will be considered for all TDEI APIs. In such cases, where RESTful functionality does not meet user needs, APIs may use alternate designs.

2.2 Data Schema Standards

Data schema standards are used to digitize and transmit the sidewalks, transit pathways, and transit flex data. The use of these standards is outlined below:

- The OpenSidewalks standard is used for describing the pedestrian-built environment including sidewalks. The OpenSidewalks standard is maintained by the Taskar Center for Accessible Technology¹⁰ (TCAT) and is described at the following resources.
 - The OpenSidewalks website³ describes the OpenSidewalks project.
 - The OpenSidewalks GitHub site¹¹ provides the Open Sidewalks schema.

⁸ "RFC 9110 HTTP Semantics." June 2022. <https://www.rfc-editor.org/rfc/rfc9110> (accessed Sept 6, 2022)

⁹ Restful web API design. Microsoft. July 5, 2022. <https://docs.microsoft.com/en-us/azure/architecture/best-practices/api-design> (accessed Sept 7, 2022)

¹⁰ Taskar Center for Accessible Technology. <https://tcat.cs.washington.edu> (accessed Sept 6, 2022)

¹¹ The Open Sidewalks Schema. <https://github.com/OpenSidewalks/OpenSidewalks-Schema> (accessed Sept 6, 2022)

- The GTFS-Pathways standard is used for describing transportation stations, particularly pathways through those stations. The GTFS-Pathways standard is maintained by Mobility Data¹² and is described at the following resources:
 - The GTFS-Pathways document¹³ is a collaborative working tool for the GTFS-Pathways extension proposal and is a living document which evolves based on community feedback.
 - The current GTFS-Pathways standard specification can be found in the GTFS Reference⁴.
- The GTFS-Flex-v2 standard is used for demand-responsive travel services (excluding real-time feeds). The GTFS-Flex-v2 standard is maintained by Mobility Data¹² and is described at the following resources:
 - The GTFS-Flex-v2 document¹⁴ is the GTFS-Flex v2 extensions proposal working document and may evolve based on community feedback.
 - The GTFS-Flex-v2 GitHub site¹⁵ provides information about GTFS-Flex-v2.
 - The current GTFS-Flex-v2 standard can be found on the GitHub site¹⁶.

2.3 Security Standards

The OAuth 2.0⁶ standard is used for authentication and authorization in the TDEI. The OAuth 2.0 Authorization Framework specification¹⁷ is maintained by the Internet Engineering Task Force (IETF) OAuth Working Group¹⁸. The OIDC⁷ standard will also be used for authentication and authorization, OIDC is a layer on top of OAuth 2.0. OIDC is maintained by the OpenID Foundation (OIDF)¹⁹.

¹² MobbityData. <https://mobilitydata.org> (accessed Sept 6, 2022)

¹³ GTFS Pathways. <http://bit.ly/gtfs-pathways> (accessed Sept 6, 2022)

¹⁴ GTFS Flex v2 extensions proposal. <http://bit.ly/gtfs-flex-v2> (accessed Sept 6, 2022)

¹⁵ GTFS Flex v2. <https://github.com/MobilityData/gtfs-flex> (accessed Sept 6, 2022)

¹⁶ GTFS Flex v2 Specification. <https://github.com/MobilityData/gtfs-flex/blob/master/spec/reference.md> (accessed Sept 6, 2022)

¹⁷ OAuth 2.0 Authorization Framework specification. <https://www.rfc-editor.org/rfc/rfc6749> (accessed Sept 7, 2022)

¹⁸ IETF OAuth 2.0 Working Group <https://www.ietf.org/mailman/listinfo/oauth> (accessed Sept 7, 2022)

¹⁹ OpenID Foundation. <https://openid.net/foundation/> (accessed Sept 7, 2022)

3 Interfaces

This section identifies the interfaces in the TDEI system and provides information about source and destination of the interfaces, the type of interaction and what triggers flows over the interfaces.

3.1 Interface Document

This part of the ICD includes all physical object to physical object flows that are identified in the SAD. Refer to the SAD for details on the physical objects. In the context of that architecture, two primary external facing interfaces exist:

- **Data Generator Systems <> TDEI System:** This represents the interface that facilitates data submission from data generators to the TDEI system, such as if an agency submits an OpenSidewalks data file for use by the TDEI system. On the TDEI system physical view identified in the SAD, this represents the movement of data from a “field” device (representing a location where a computer with a TDEI-developed data translation tool exists, likely at an agency with infrastructure data) or a “support” device (representing other data sources that can provide infrastructure data, such as an agency with data already structured in the right data schema) and the TDEI system. This interface also serves as sending archive status information back to a data generator, such as an affirmative message saying that data has successfully been submitted. This interface will use the HTTPS, REST, OAuth 2.0, and OIDC communication and security standards in addition to the three data schema standards.
- **TDEI System <> Data Consumer Systems:** This represents the interface that facilitates data distribution from the TDEI system to the data consumers, such as if an application developer submits a request to the TDEI system for sidewalk data in a particular geographic region. On the TDEI system physical view identified in the SAD, this represents the movement of data from the TDEI system to either a “support” device (representing an application developer’s server and/or system) or a personal device (representing a device with a mobile application that consumes data). This interface serves as the method through which a query can be submitted to request data. This interface will use the HTTPS, REST, OAuth 2.0, and OIDC communication and security standards in addition to the three data schema standards.

3.2 Functional Allocation

The two primary TDEI system interfaces (Data Generator Systems <> TDEI System and Data Consumer Systems <> TDEI System) are responsible for exchanging key data and information. The sections below identifies the operations being performed including the source and destination the type of interaction and what events trigger the movement using the interface being defined.

3.2.1 Data Generator Systems <> TDEI System

Data generators (DG) are expected to include staff from Transportation Service Providers (TS) (e.g. public transportation agencies) staff or entities to which the TS has delegated data generation authority. Data generator systems interact with the TDEI primarily via API calls over the public internet, specifically DGs interact with the API Gateway described in the SAD. Table 1 below shows the interactions over the Data Generator Systems <> TDEI System interface. The registration and approval process for the data generators is described in Section 3.3.2.

Table 1 Data Generator Systems <> TDEI System Interface

Source	Destination	Interaction	Trigger
DG requests token to upload data	TDEI receives request to for token	API request	DG makes API request for token
TDEI authentication / authorization system checks DG's permissions to upload specified data	DG is sent token	API response	TDEI authentication / authorization system is called upon TDEI's receipt of the request for an upload token
DG submits OpenSidewalks (or GTFS-Flex or GTFS-Pathways) data with token	TDEI receives data	API request	DG makes API request to upload data
TDEI notifies DG of successful storage of data	DG receives notification of successful storage of data	API response	Request to upload data triggers data storage in the TDEI system

3.2.2 TDEI System <> Data Consumer Systems

Data Consumers (DC) include application developers who create and manage mobile travel applications and personal devices with trip planning applications. Data Consumers are expected to include Application Developers and Personal Devices with applications deployed on them. Data Consumer Systems interact with the TDEI via API calls over the public internet, specifically DCs interact with the API Gateway described in the SAD. Table 2 below shows the interactions over the TDEI System <> Data Consumer Systems interface. The registration and approval process for the data generators is described in Section 3.3.3.

Table 2 TDEI System <> Data Consumer Systems Interface

Source	Destination	Interaction	Trigger
DC submits request for geographically targeted Opensidewalk (or GTFS-Pathways or GTFS-Flex) data	TDEI receives request for geographically targeted Opensidewalk (or GTFS-Pathways or GTFS-Flex) data	API request	DC makes API request for data
TDEI system sends geographically targeted Opensidewalks (or GTFS-	DC receives geographically targeted Opensidewalk (or	API response	Request for data triggers response by TDEI system

Source	Destination	Interaction	Trigger
Pathways or GTFS-Flex) data in response to query	GTFS-Pathways or GTFS-Flex) data from TDEI system in response to query		

3.3 Security Integration

Security across the interfaces will be done using the OAuth 2.0⁶ and OIDC⁷ standards to authorize and authenticate API calls. TDEI staff and Transportation Service Provider (transportation agency) staff will have access via a web portal to administer and manage access for individual users – data consumers and data generators. The security for the Data Generator Systems <> TDEI System and TDEI System <> Data Consumer Systems interfaces is described below prefaced by some background and concepts to facilitate understanding of the interfaces.

3.3.1 Security Integration Concepts

This section provides background and concepts in security integration to facilitate understanding of the Data Generator Systems <> TDEI System and TDEI System <> Data Consumer Systems interfaces.

To support security, persons who interact with the TDEI will be required to register as TDEI users, and users will be assigned different roles with different permissions depending on the user's role in the TDEI. For example, a user that is a data consumer will have permission only to read data from the TDEI. The roles that will likely be defined for the TDEI system are Data Consumer, Data Generator, Transportation Service Provider (TS) Point of Contact, and TS Representative. Data Consumer, Data Generator and Point of Contact are required roles and will be implemented in the first version of the TDEI authorization service. TS Representative will be implemented in a later release of the TDEI system, but is included here for completeness. Note that, in most cases, a TS is expected to be a transportation agency.

The TDEI roles are outlined below.

Data Consumer: A data consumer is a user who will read data from the TDEI. Any person can register with the TDEI to be a data consumer.

Data Generator: A data generator is a user who will contribute data to the TDEI. A data generator may be approved to generate data for one or more TSs. Data generators must be approved by the TS Point of Contact.

TS Point of Contact: Each TS must identify a designated Point of Contact (PoC) who is employed by the TS. The TS PoC will have the authority to approve access for data generators for that TS. The purpose of the PoC is to ensure that staff from the Transportation Service Provider with the proper authority are approving access for data generators.

TS Representative: To allow TS to delegate administrative responsibility for approving data generators, the TS Representative role is being defined. A TS may designate one or more TS Representatives. These representatives may not be employed by the TS. The TS Representative(s) will have the authority to approve access for data generators.

As indicated before, all users, regardless of role, will register as TDEI users. Registered TDEI users will receive an API key and access credentials. Users are differentiated by the role, permissions they are assigned, and how they use the API key and access credentials given to them. In general, API keys are used to retrieve data from the TDEI and access credentials are used to retrieve API keys, recover lost API keys, and to upload data to the system. The API keys are not time-limited. Users will obtain API keys by logging into a portal with their credentials and retrieving their API key. User that lose their API key can use the portal and their credentials to obtain a new API key.

User registration and management of roles and permissions will be provided through a registration endpoint, which is planned to be a web-based administration endpoint supported by RESTful² APIs.

3.3.2 Data Generator Systems <> TDEI System

Data generator access will be managed by the TS PoC and Representative(s). Each Data generator must be granted access by the TS PoC or a TS Representative for the TS for whom that data generator is generating data.

3.3.2.1 Data Generator Registration and Approval

The registration process for a Data Generator is as below and is shown in Figure 1.

1. Data Generator registers as a TDEI user
2. Access credentials (username, password) and an API key for the new user will be generated
3. The API key and access credentials will be stored
4. The Data Generator provides their access credentials and requests the API key
5. The API Gateway validates the credentials using the database
6. The API Gateway retrieves the API key from the database
7. The API key is provided to the Data Generator
8. An (authorized) TS PoC or Representative provides their access credentials and requests the (new) user be granted the Data Generator Role for that TS
9. The system stores the Data Generator access for the user for that TS; the user is now authorized to act as a Data Generator for that TS.

If a Data Generator is already registered as a TDEI user, steps 1, 2, 3, 4 and 5 are not necessary, the TS PoC can simply grant appropriate data generator access to that user.

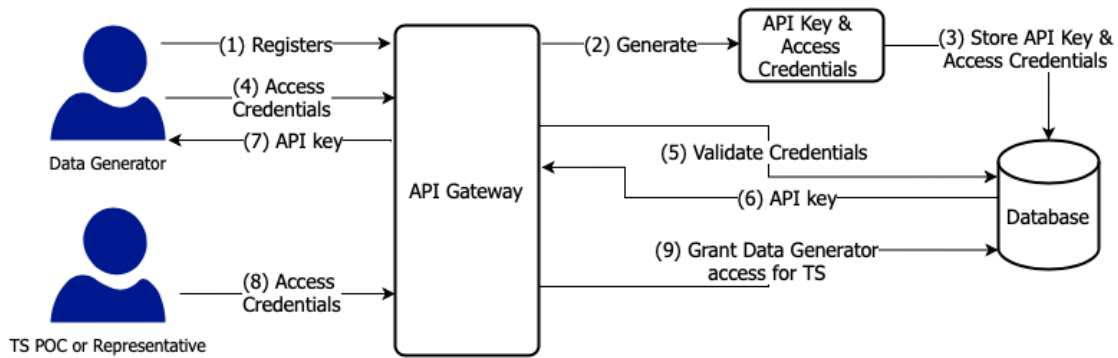


Figure 1 Registration and Approval Flow for Data Generators

Access for data generators is specific to a transportation service provider. It is also worth noting that a user may be authorized to generate data for multiple agencies and may have different permissions for different agencies. For example, a user may be a representative for one agency, and data generator for another agency.

All API calls to upload data to the TDEI will flow through the API Gateway. The authorization flow for data generators to the TDEI is shown in Figure 2. In the context of this figure, the 'Protected Resource' is access to the API call to upload data. Through the flow shown in this figure, the API Gateway will assess whether the user is authorized and then pass requests on to the TDEI system. This will maintain security so that only authorized parties are contributing data to the system, and that parties are deemed authorized by a human verifier. In this figure, step 5 (request data) will occur if a valid access token has been returned and step 8 (request data upload) will occur if the access token is validated. If authorization fails, access token validation fails or data upload fails, a response will be returned to the user with information on the failure.

The APIs for the Data Generator Systems <> TDEI System interface will run over HTTPS to ensure security of data transmission.

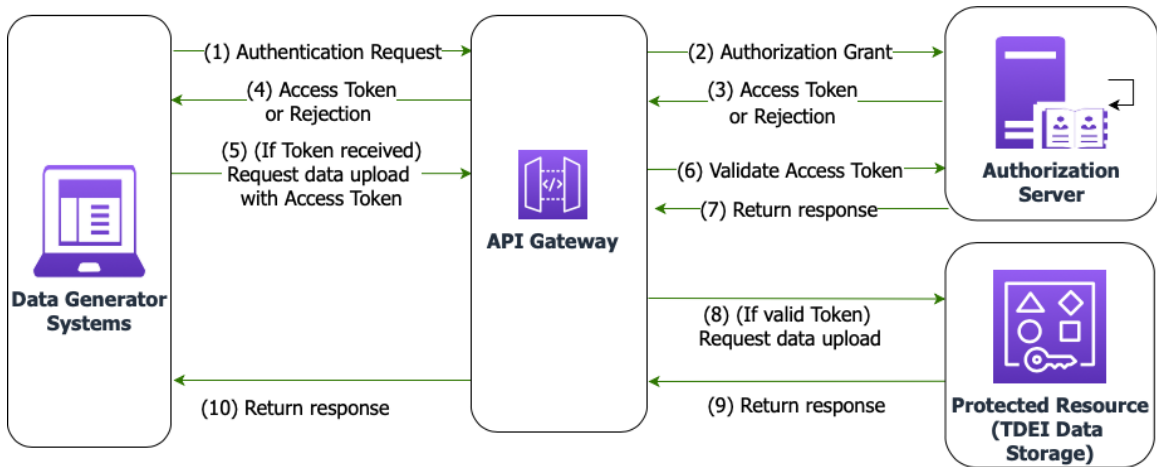


Figure 2 Authorization Flow for Data Generators

3.3.2.2 Transportation Service Provider Point of Contact Registration and Approval

The registration and approval process for the PoC for a Transportation Service Provider is as below and is shown in Figure 3.

1. PoC registers as a TDEI user
2. Access credentials (username, password) and an API key for the new user will be generated
3. The API key and access credentials will be stored
4. The PoC provides their access credentials and requests the API key
5. The API Gateway validates the credentials using the database
6. The API Gateway retrieves the API key from the database
7. The API key is provided to the PoC
8. TDEI administrative staff verifies in writing the PoC designation with the Transportation Service Provider and then uses their access credentials to request the (new) user be granted the PoC Role for that TS
9. The system stores the PoC access for the user for that TS; the user is now authorized to act as a PoC for that TS.

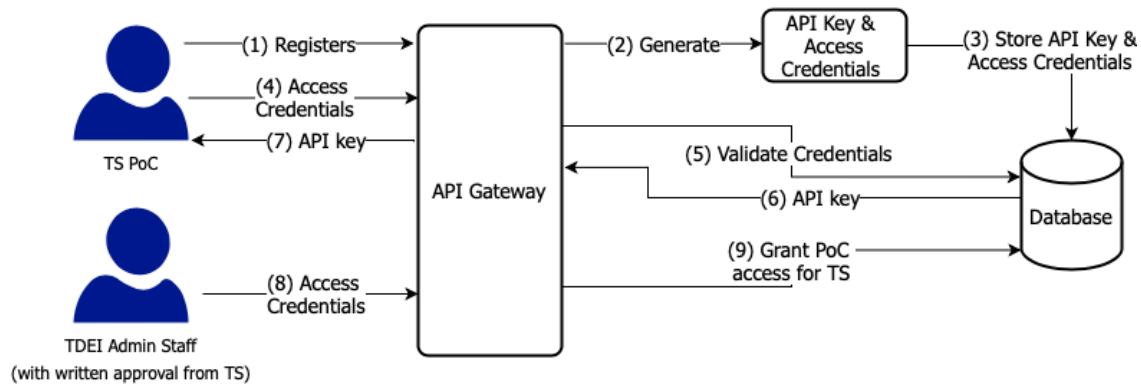


Figure 3 Registration and Approval flow for Transportation Service Provider Point of Contact

If the proposed PoC is already registered as a TDEI user, steps 1, 2, 3, 4 and 5 are not necessary.

The API key and user credentials are active when the user receives the key; however, at that point, the permissions are set so the API key can only be used to consume data and the user credentials have been given the role of data consumer. That is after step 5 above, the API key is active but the user is authorized for data consumption only. After TDEI administrative staff designate the user as PoC (steps 6 and 7 above), user's permissions are set so that the user's credentials can be used to perform tasks associated with the PoC role, such as approval of data generators for the organization.

The written verification of the PoC will be contained in the MOU signed between the organization and the TDEI. Updates to the PoC will be accepted via email. The written verification will be stored along with the other contracts for this project in an electronic filing system maintained by TDEI staff.

3.3.2.3 Transportation Service Provider Representative Registration and Approval

The registration and approval process for Transportation Service Provider Representatives is as below and is shown in Figure 4.

1. The Representative registers as a TDEI user
2. Access credentials (username, password) and an API key for the new user will be generated
3. The API key and access credentials will be stored
4. The Representative provides their access credentials and requests the API key
5. The API Gateway validates the credentials using the database
6. The API Gateway retrieves the API key from the database
7. API key is provided to the Representative
8. TS Poc uses their access credentials to request the (new) user be granted the Representative role for that TS
9. The system stores the Representative access for the user for that TS; the user is now authorized to act as a Representative for that TS.

If the proposed Representative is already registered as a TDEI user, steps 1, 2, 3 and 4 are not necessary.

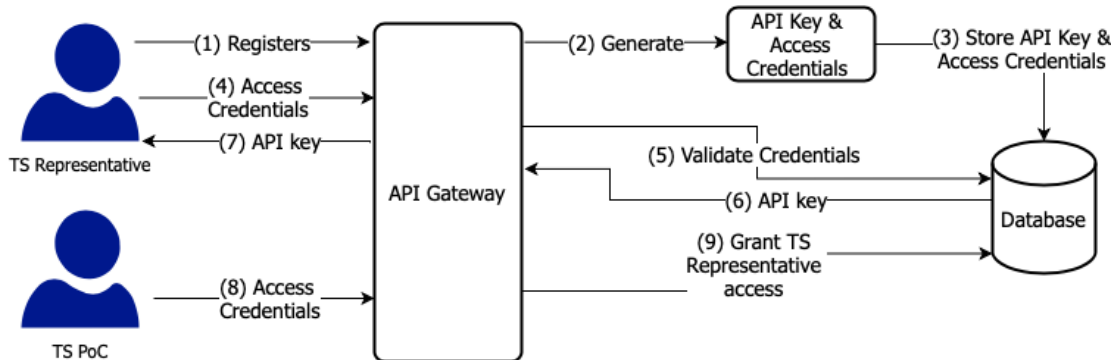


Figure 4 Registration and Approval flow for Transportation Service Provider Representative

3.3.3 TDEI System <> Data Consumer Systems

Data Consumer access is less restricted as TDEI data will be accessible to all Application Developers and any member of the general public who wishes to access data. Users who wish to consume data from the TDEI will need to register with TDEI and obtain an API key and agree to a data use agreement. Requiring registration serves several purposes: it ensures TDEI staff can communicate with users in case of updates to APIs or data formats, it enables TDEI to know who is using their data, and it enables TDEI staff to disable user access should that data user's account behave inappropriately – e.g., inadvertently (or intentionally) overwhelm the system.

The registration process for a Data Consumer is as below and is shown in Figure 5.

1. Data Consumer registers as a TDEI user by completing a web form
2. Access credentials (username, password) and an API key for the new user will be generated
3. The API key and access credentials will be stored
4. The Data Consumer provides their access credentials and requests the API key
5. The API Gateway validates the credentials using the database
6. The API Gateway retrieves the API key from the database
7. The API key is provided to the Data Consumer

On the backend, registration as a data consumer is an automated process that does not require manual intervention on the part of TDEI staff. Once registered, these data consumers can log in and retrieve an API key specific to them. From there, these data consumers can make data requests to the TDEI using the API key. Requests across this interface will be rate limited, meaning that a cap is placed on how often a data consumer can repeat a request within a certain timeframe.

The authorization flow for data consumed from the TDEI is shown in Figure 6. In the context of this figure, the 'Public Resource' is TDEI data, which is publicly accessible. This figure shows that

the Data Consumer provides the API key with a request for data, the API Gateway will validate that request and obtain the data from the TDEI data store. If the validation is successful and the data exists, the data will be returned to the consumer. If the validation is not successful or the data does not exist, the Data Consumer will receive a response so indicating.

The APIs for the Data Consumer Systems <> TDEI System interface will run over HTTPS to ensure security of data transmission.

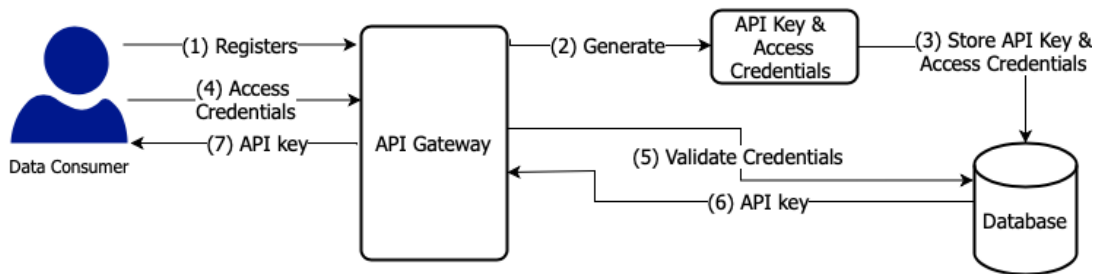


Figure 5 Registration and Approval flow for Data Consumers

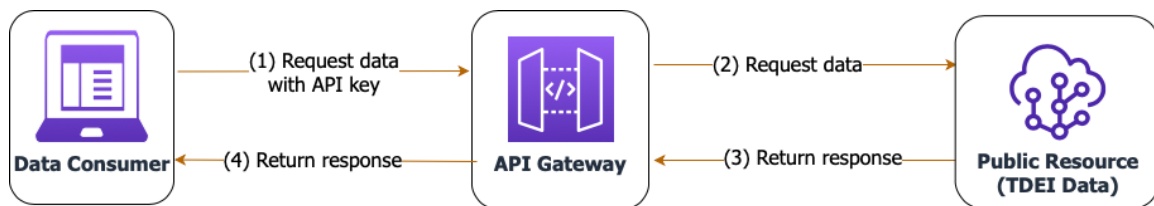


Figure 6 Authorization flow for Data Consumers

4 Requirements

4.1 Requirement Interface

This section specifies requirements for the interfaces between the TDEI system and external parties. It describes the data protocols, communication methods, and processing priority associated with the two interfaces that exist in this system.

4.1.1 Requirements Interface #1 – Data Generator Systems <> TDEI System

This section describes the requirements associated with the interface between the Data Generators Systems and the TDEI system. This interface handles the submission of data from the Data Generator to the TDEI system. An API is used to facilitate this data movement and an API Gateway is used to verify that the data generator is an approved user.

4.1.1.1 Data Protocols

This interface requires data submissions to be structured as a OpenSidewalks³, GTFS-Pathways⁴, or GTFS-Flex v2⁵ files. Users are required to submit metadata about the file, including information about how and when the data was collected and valid dates of the file. The TDEI provides an API response in JavaScript Object Notation (JSON)²⁰ format when the file is stored in the TDEI. An error message will be returned if the user is not authorized or if the file does not pass the data quality checks.

4.1.1.2 Communication Methods

This interface sends data over HTTPS⁸ over public internet.

4.1.1.3 Processing Priority

Data submissions are processed in the order in which they are received. No need exists to prioritize one approved data generator over another approved data generator in terms of reviewing a data submission.

4.1.1.4 System Requirements

The proposed interface is anticipated to address several system requirements identified in the Phase 1 SySR, including INT-01 and INT-02. Other system requirements of that type involve

²⁰ Introducing JSON. <https://www.json.org/json-en.html> (accessed Sept 8, 2022)

internal interfaces that are built within the TDEI system ecosystem that are not relevant to this ICD.

4.1.2 Requirement Interface #2 TDEI System <> Data Consumer Systems

This section describes the requirements associated with the interface between the TDEI system and the Data Consumer Systems. This interface handles the distribution of data from the TDEI system in response to a request made by a data consumer. An API is used to facilitate this data movement and an API Gateway is used verify that the data consumer is an approved user.

4.1.2.1 Data Protocols

This interface requires data distributions to be structured as a OpenSidewalks³, GTFS-Pathways⁴, or GTFS-Flex⁵ file that is returned as an octet-stream. Data consumers provide structured query information with geographic information and an approved API key in order for the TDEI system to provide the relevant data.

4.1.2.2 Communication Methods

This interface sends data over HTTPS⁸ over public internet.

4.1.2.3 Processing Priority

Data distributions are processed in the order in which they are received. No need exists to prioritize one approved data consumer over another approved data consumer in terms of sending data.

4.1.2.4 System Requirements

The proposed interface is anticipated to address several system requirements identified in the Phase 1 SySR, including EXT-01, EXT-02, and INT-07. Other system requirements of that type involve internal interfaces that are built within the TDEI system ecosystem that are not relevant to this ICD.

4.2 Traceability Table

Table 3 provides summary information about the interfaces in the TDEI system.

Table 3. Traceability Table

Interface Type	Source	Destination	Description of Interface	Protocol
API Gateway	Data Generators	TDEI System	Facilitates submission of data to the TDEI system, and confirmation of submission from the TDEI system to the data generator.	Communications: HTTPS, REST Data: OpenSidewalks, GTFS-Pathways, GTFS-Flex

				Security: OAuth 2.0, OIDC
API Gateway	TDEI System	Data Consumers	Facilitates distribution of data to the approved data consumers in response to a query made to the TDEI system.	Communications: HTTPS, REST Data: OpenSidewalks, GTFS-Pathways, GTFS-Flex Security: OAuth 2.0, OIDC

5 Appendix A Definitions, Acronyms, and Abbreviation

Acronym	Definition
AD	Application Developers
AOR	Agreement Officer's Representative
API	Application Programming Interface
ConOps	Concept of Operations
DG	Data Generators
DOT	Department of Transportation
DS	Data Service Providers
DU	Digital Device End Users Experiencing Travel Barriers
GTFS	General Transit Feed Specification
GTFS-Flex	The Flex route extension to the General Transit Feed Specification, designed to describe demand-responsive or paratransit service
GTFS-Pathways	The Pathways extension to the General Transit Feed Specification which defines pathways linking together locations within stations
HTTP	Hypertext Transfer Protocol
HTTPS	Hypertext Transfer Protocol Secure
ICD	Interface Control Document
IETF	Internet Engineering Task Force
ITS	Intelligent Transportation System
ITS JPO	Intelligent Transportation Systems Joint Programs Office
JSON	JavaScript Object Notation
MOU	Memorandum of Understanding
OIDC	OpenID Connect
OIDF	OpenID Foundation
REST	Representational State Transfer
SAD	System Architecture Document
SyRS	System Requirements Specification
Taskar Center or TCAT	Taskar Center for Accessible Technology at the University of Washington
TDEI	Transportation Data Equity Initiative
TRAC	Washington State Transportation Center
TS	Transportation Service Providers
U.S.	United States
USDOT	United States Department of Transportation
UW	University of Washington