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## Intelligent transport systems — Use cases for sharing of probe data

*Systèmes de transport intelligents - Cas d'usages pour le partage des  
données de sondage*

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## Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular, the different approval criteria needed for the different types of ISO documents should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2 (see [www.iso.org/directives](http://www.iso.org/directives)).

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights. Details of any patent rights identified during the development of the document will be in the Introduction and/or on the ISO list of patent declarations received (see [www.iso.org/patents](http://www.iso.org/patents)).

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For an explanation of the voluntary nature of standards, the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the World Trade Organization (WTO) principles in the Technical Barriers to Trade (TBT), see [www.iso.org/iso/foreword.html](http://www.iso.org/iso/foreword.html).

This document was prepared by Technical Committee ISO/TC 204, *Intelligent transport systems*.

Any feedback or questions on this document should be directed to the user's national standards body. A complete listing of these bodies can be found at [www.iso.org/members.html](http://www.iso.org/members.html).

## Introduction

When discussing transportation systems, much attention has been paid to safety, comfort, impacts on the environment and energy efficiency. The use of probe data (specified in ISO 22837) is a key factor in dealing with the above issues.

Probe vehicle data are collected through various vehicles in an ITS system, but the data are typically used only for a specific application by the service provider. To boost efficiency, it is recommended that the vehicle probe data be shared by various service applications through common databases.

Current probe vehicle systems collect and use data, but do not share data with other ITS service applications. Vehicle probe data are valuable for all related services and limiting the use of such data to within one service only ought to be avoided for efficient data use. Sharing probe data among service providers enhances quality of service, as the probe data collected through the sensors and other sources can be utilized by other service providers.

As an example, shared common database can be used for new services, such as an advanced notification safety information provision service, by utilizing roadside sensor data collected by a road authority. Many other new services can be added as the number of CAV (connected and automated vehicle) increases.

This document describes probe data sharing use cases so that additional service can be developed by sharing probe data collected by various probe vehicle systems.

The functionalities of a probe vehicle system (PVS) can be implemented in an ITS station unit according to ISO 21217 and support application protocols specified in other standards. Examples of such protocols are the local dynamic map (LDM) specified in ISO/TS 18750, and generic ITS station facilities layer services specified in ISO/TS 17429. The service architecture classifies ITS services including PVS, and this classification also defines service domains for cooperation between PVSs.

It is noted that this document does not prescribe a physical communication medium for transmitting data/information to or from vehicles. This document is intended to be independent of any communication medium and to be compatible with any medium that is selected by the system developers.

In addition, this document focuses only on the framework for vehicle probe data sharing use cases.

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# Intelligent transport systems — Use cases for sharing of probe data

## 1 Scope

This document describes various use cases for the sharing of probe vehicle data as a common platform for smart city instantiation. When modernizing a city towards a smart city, it is necessary for information flows across various fields, such as transportation, healthcare, energy, water and other government services, to be effectively managed and shared. Despite efforts from many cities, integrating all databases related to all services has proven to be a cumbersome task. One challenge is the lack of a systematic way that can be modelled for data sharing. The ITS data sharing model for vehicle probe data can serve as the basis for instigating this type of work. To elaborate how vehicle probe data work can be applied to achieve this objective, this document:

- gathers use cases and examples of vehicle probe data sharing around the world, and
- provides use cases for data sharing that are appropriate for smart city ITS mobility solutions.

By examining these use cases and current and planned data sharing practices around the world, this document demonstrates how this mechanism can help implement many smart city applications.

This document also shows that by combining the vehicle probe data with roadside sensor data, and other important public and private data sources the services can be operated more effectively.

Data collection methods and data or information provisioning are beyond the scope this document. Specifically, this document does not describe items related to the vehicle probe data collection nor the vehicle probe data provision activities as specified by other existing standards such as ISO 19414.

## 2 References

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO 14812:—<sup>1)</sup>, *Intelligent transport systems — Vocabulary*

ISO 19414, *Intelligent transport systems — Service architecture of probe vehicle systems*

ISO 22837, *Vehicle probe data for wide area communications*

ISO 24100, *Intelligent transport systems — Basic principles for personal data protection in probe vehicle information services*

## 3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 14812, ISO 19414, ISO 22837, ISO 24100 and the following apply.

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

- ISO Online browsing platform: available at <https://www.iso.org/obp>
- IEC Electropedia: available at <http://www.electropedia.org/>

1) Under preparation. Stage at the time of publication: ISO/DTS 14812:2021.

### 3.1 data sharing

activity between two or more service providers where the data can be combined and processed to create data for new application services

## 4 Use cases for the probe vehicle systems data sharing framework

### 4.1 The conceptual framework for vehicle probe system data sharing

Various probe data systems are deployed and successfully operated by service providers independently. However, most likely, the vehicle probe data collected by one ITS systems can only be used for a specific application by the service provider and are not shared among other applications. In exploiting applications and services for a smart city, such data can not be used effectively, for the purpose of solving smart city mobility issues, for example. Part of the issue is that the service providers often work in their own specific application silos and fail to see the value of data sharing from a holistic viewpoint.

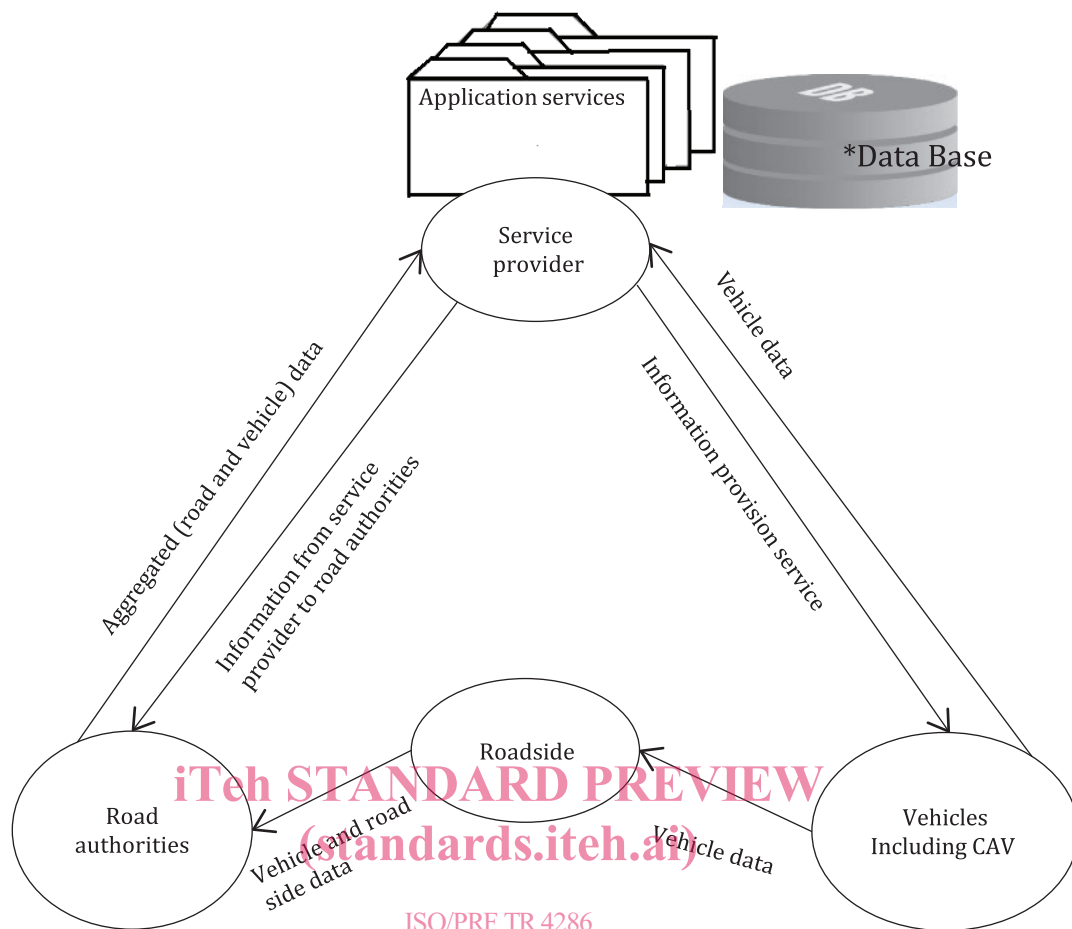
It is recommended that the vehicle probe data be shared among stakeholders; this sharing could support various potential fields of services for smart city service applications via a common database. Ideally, all the data in each application supporting a smart city ought to be exchanged through all fields of services with a common format. However, this is not feasible as most of the vehicle probe data systems in place are deployed at different times and provided by different vendors. In the case of the probe vehicle system, for example, aside from the data gathered from certain applications or services which do follow a set of standards, most of the data collected requires transformation or conversion to ensure data interoperability. From a data access efficiency viewpoint, the best place to implement these data conversions is at the common database.

Although data interoperability is essential when adopting the common database for probe data, data ownership and privacy protection need to be taken into consideration as high priority issues. Probe data might need to be gathered from sources applying proprietary means. Some service providers can consider that such data bear much value and can be reluctant to grant the access to those data freely. Furthermore, some probe data can be associated with an individual and needs to be specially protected according to personal privacy protection regulations.

This document describes useful use cases for sharing vehicle probe data and provides useful examples currently used and planned around the world. This document provides role model descriptions of data sharing only, and does not cover data collection, nor data provision.

The conceptual framework of the vehicle probe system, as shown in [Figure 1](#) below, depicts the relations among stakeholders, such as a service provider, vehicles including connected and automated vehicles (CAV), roadside systems and the roadside operation authorities. The key is to have a common database so that all the service data, regardless of their origins can be fed and stored in the common database. Since the implementation of such a framework for probe data systems can vary, the framework depicted in [Figure 1](#) is for reference only and can not include all the stakeholders and outlines of their roles.





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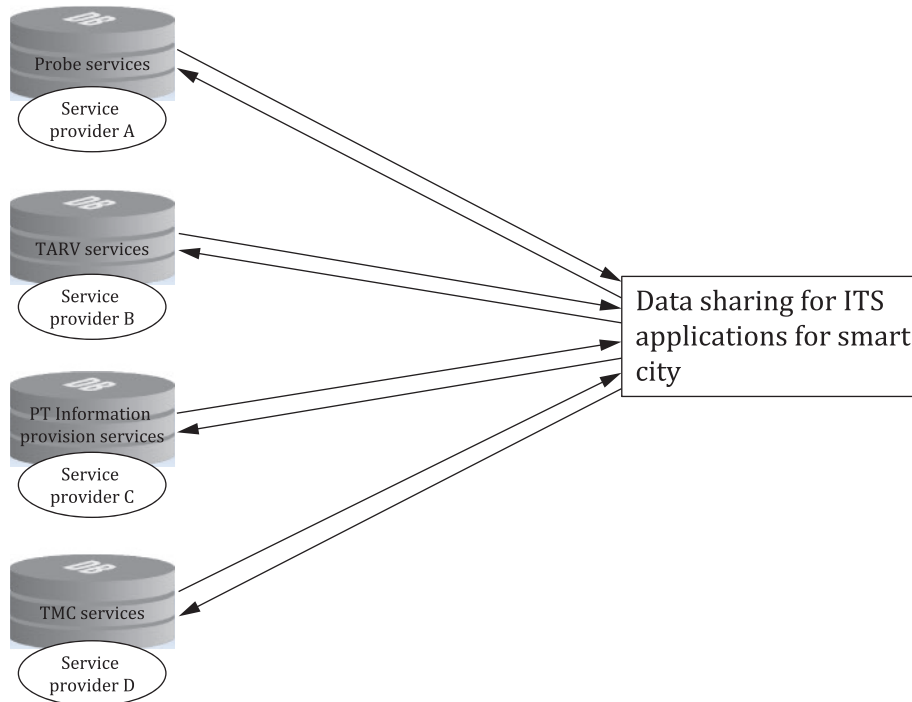
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**Figure 1 — Reference vehicle probe system framework**

As shown in [Figure 1](#), the service provider, through the pre-provision process, requests vehicle data from a vehicle and the vehicle provides vehicle data to the service provider accordingly. The service provider stores data into the database and executes application services with the support of the database, and the processed information of those services are provided back to the vehicle. Likewise, the service provider can exchange information with road authorities. In some cases, the service provider can collect probe data from the vehicle through a road authority. In such a case, the vehicle data are collected by roadside sensors and passed to the road authority. Data collected through other roadside sensors can also be collected by the road authority. The road authority can then aggregate those data and send them to the service provider. In return, the service provider can provide the processed valuable information to the road authority.

#### 4.2 Concept of data sharing of vehicle probe data

Although a common database can help the service provider improve its operational efficiency in its service realm, the real benefit to a probe vehicle system can be further amplified only if multiple probe databases in the probe vehicle system are also shared. [Figure 2](#) provides a conceptual view of how multiple databases are shared in a probe vehicle system. The databases shown on the left are the ones associated with each service provider, such as probe service and other services.



NOTE 1 Service provider A database has vehicle probe data as per ISO 19414.

NOTE 2 Service provider B database has vehicle probe data from commercial vehicle of TARV as per ISO 15638.

NOTE 3 Service provider C database has public transport data as per ISO 17185.

NOTE 4 Service provider D database has traffic management centre data as per ISO 19468.

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**Figure 2 — The conceptual view of data sharing in a vehicle probe system**

The data from TMC (traffic management centre) in [Figure 2](#) includes examples of currently available road authority's traffic data.

Sharing probe data among current service providers and additional service providers enables the creation and realization of additional new application services.

ISO/TS 21177 and ISO/TS 21184 cover secured access to sensor and control networks of ITS stations in general. A standardized data format based on standardized data types is specified to enable data exchange between ITS stations and ITS applications. Secure certificate-based Access Control is specified in ISO/TS 21177, combined with ISO/TS 21184 using configuration data. Required data models are specified in ISO/TS 21184.

### 4.3 Probe data sharing benefits

#### 4.3.1 Introduction

The observations detailed in the following subclauses can be derived through probe data sharing.

#### 4.3.2 Benefits of data sharing

Through the shared common database, where maintenance service is maintained as an advanced service and various functions including the Internet connection can be used, the opportunity to use the

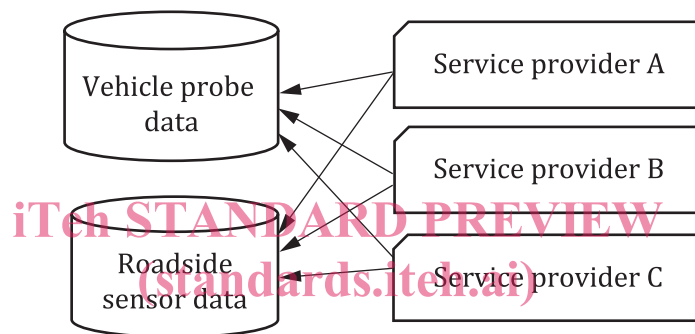
data sharing function has become a common use case for smart city solutions. The merit of this data sharing function can be summarized into the following two points:

- a) Easy exchange of data — Data can be converted into common data format and exchanged quickly and reliably without going through the store and distribute processes. In addition, it is possible to apply various security settings, such as setting access rights for the users for each data element, which can enhance data security.
- b) Simple management of data — As data can be managed centrally, data management is simplified. In addition, there can be minimum time lag while updating the data.

### 4.3.3 Model of data sharing function

To use the data sharing function among service providers, it is required to set up users and user groups according to the role of the users and the controlled accessible data.

As shown in [Figure 3](#), users often have multiple roles, and consideration needs to be given to the grouping method and security setting.



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**Figure 3 — Multiple roles of users (service providers)**

### 4.3.4 Standards

Existing probe data standards and sharing policy standards already defined by the local authority can be utilized.

### 4.3.5 Applicability of data distribution technologies

ISO/TR 23255 can be used as reference document.

### 4.3.6 Metadata

Metadata sharing policies already defined by the local authority can be utilized.

### 4.3.7 Storage and access

General storage and access to shared data integration already defined by the local authority can be utilized.

### 4.3.8 Data ownership and IPR

Clear guidelines already defined by the local authority can be utilized for identifying data ownership and licencing, including IPR, of probe data, supporting data and processing tools.

### 4.3.9 Challenges

There are several challenges which need to be analyzed and solved when deploying probe data sharing among multiple service provider entities:

- It is important to define the rules regarding data storage to respect data privacy.
- The entity in charge of maintaining and processing the collected probe vehicle data and its liability need to be defined.
- The governance rules for such an entity need to be defined.
- Decision-making on the policy needs to be done, whether it is a centralized entity framework or a cloud framework that can be completed through multiple decentralized entities.

## 5 Definition of service domains utilizing shared probe data

### 5.1 General

Sharing of probe vehicle data among current service providers and additional service providers can support the implementation of new service applications needed for smart city services. For example, data sharing could eventually be implemented to satisfy infrastructure assessment needs and to improve safety within cities.

Possible service applications can include:

- critical safety information provision,
- safety driving support,
- infrastructure planning,
- dynamic traffic management,
- traffic rule enforcement,
- dynamic map updates, and
- emergency evacuation support.

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Where applicable, probe data sharing definitions already defined by the local authority can be utilized.

For deployment, further research or development of data sharing is recommended.

### 5.2 Referenced target use cases

#### 5.2.1 General

ITS service applications largely rely upon the big data collected through the applications and services of a smart city that are held and maintained by a smart city data management entity. Those ITS services can be grouped into two categories: the services provided by jurisdiction or the road operator; and the services by the public and private service providers. The applications offered and managed by the jurisdiction or the road operator can be classified in four groups as “infrastructure operation management”, “traffic management”, “road traffic operation management” and “enforcement”. The applications provided by the service providers can be offered through public or private sectors. The classification of an ITS service and applications can be shown in [Figure 4](#).