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## Geographic information — Transfer Nodes

*Information géographique — Noeuds de transfert*

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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)).

Any trade name used in this document is information given for the convenience of users and does not constitute an endorsement.

For an explanation on the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the WTO principles in the Technical Barriers to Trade (TBT) see the following URL: [Foreword - Supplementary information](#)

The committee responsible for this document is ISO/TC 211, *Geographic information/Geomatics*.

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## Introduction

All over the world, the authorities are facing serious problems due to the steady rise in the traffic volume. This rise will sooner or later call for very dramatic measures; one first step might be to persuade or force car users to change modes partly or entirely. In order to help this process, the authorities will need a complete overview of where it is possible to change modes of transport.

Over the last few years, substantial work in this field has been carried out by CEN/TC 278 *Intelligent Transport Systems*. EN 28701 was published in 2012. This work is motivated by the fact that the public transport sector needs data on a number of objects and events in their transport networks in order to have them work efficiently. The work done by CEN/TC 278 has been one of the sources for the motivation and background material for the ISO 19147 work done by ISO/TC 211.

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# Geographic information — Transfer Nodes

## 1 Scope

This International Standard specifies the data types and code lists associated with those types for the implementation of transfer nodes and their services in transport modelling and location based services.

This International Standard includes the following:

- defines transfer nodes in a multimodal way so that the definition is general and valid for all types of transport means and modes;
- links transfer nodes to a location;
- focuses on the attributes defining the transfer node in relation to nodes in mode-specific networks;
- defines the attributes of transfer nodes that are relevant for travel planning and modelling of interoperable transport systems by transport planners;
- defines a set of services and facilities that may be related to transfer nodes and a way to provide information on accessibility, deviations and restrictions related to these services and facilities.

This International Standard is applicable for transport infrastructure owners and operators when defining and/or describing their transport infrastructure and for transport-related Service Providers when providing information to travellers and others.

This International Standard is limited to the transport of persons and is also limited to the static getting-on and getting-off points and the main focus is on transfer nodes being part of public transport networks, that are located in road networks, but this International Standard is also applicable for transfer nodes in rail networks and in air and sea transport networks.

## 2 Normative references

The following documents, in whole or in part, are normatively referenced in this document and are indispensable for its application. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO 639, *Code for the representation of names of languages*

ISO 3166, *Codes for the representation of names of countries and their subdivisions*

ISO 19103:—<sup>1)</sup>, *Geographic information — Conceptual schema language*

ISO 19107, *Geographic information — Spatial schema*

ISO 19108, *Geographic information — Temporal schema*

ISO 19133, *Geographic information — Location-based services — Tracking and navigation*

ISO 19134, *Geographic information — Location-based services — Multimodal routing and navigation*

ISO 19136, *Geographic information — Geography Markup Language (GML)*

ISO 19155, *Geographic information — Place Identifier (PI) architecture*

1) To be published. (Revision of ISO/TS 19103:2015)

### 3 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

#### 3.1 access point

*location* (3.8) where travellers can enter or exit a *transfer node* (3.18)

Note 1 to entry: An access point may not be a *stop point* (3.15). An access point may for example be the entrance to a railway station or the connection between a parking area and a railway station.

#### 3.2 accessibility

ability to access and benefit from the functionality provided by a *service* (3.14) or a *facility* (3.5)

Note 1 to entry: Accessibility is often associated with disabilities. According to the concept of universal design, accessibility is, however, a matter that permanently or temporarily is relevant to all of us, e.g. people with heavy luggage, people with broken legs, people with small children, elderly people, etc.

#### 3.3 accessibility information

information about *accessibility* (3.2) issues

Note 1 to entry: According to the concept of universal design, accessibility information should be addressed in a neutral way, i.e. not directed towards people with specific disabilities.

#### 3.4 deviation

divergence from a plan or the normal situation

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Note 1 to entry: These may be deviations with respect to the time schedule or the accomplishment of the transport or deviations with respect to the *services* (3.14) or facilities that are provided.

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#### 3.5 facility

physical installation or physical area that may be accessed and used

EXAMPLE Elevators, restaurant areas, waiting areas, seats, toilets, shops.

Note 1 to entry: Such facilities may be available on-board *transport means* (3.19) during the transport, at arrivals to and at departures from a *transfer node* (3.18), and at transfer nodes.

#### 3.6 journey

movement of a person who is travelling between two *locations* (3.8)

Note 1 to entry: May consist of one or more *journey segments* (3.7).

#### 3.7 journey segment

part of a *journey* (3.6) defined by a start and a stop *location* (3.8)

Note 1 to entry: A journey segment may be carried out by means of a *trip* (3.20) or a subset of a trip between locations that may be *transfer nodes* (3.18). A journey segment may also be road use (driving, walking and cycling).

#### 3.8 location

identifiable geographic place

Note 1 to entry: A location may be represented by one or more data types that describe a point position, a curve or an area in the real world. A location may be referenced by coordinates from a coordinate reference system or an address from an address system.



[SOURCE: ISO 19112:2003, 4.4, modified – Note 1 to entry has been added.]

### 3.9

#### location-based service

##### LBS

*service* (3.14) whose return or other property is dependent on the *location* (3.8) of the client requesting the service or of some other thing, object or person

[SOURCE: ISO 19133:2005, 4.11]

### 3.10

#### restriction

formal or informal obligation to refrain from doing something

Note 1 to entry: In this International Standard, a restriction refers to a *transfer node* (3.15) or *transport service* (3.19) criterion that limits permissible courses of action.

[SOURCE: ISO 19152:2012, 4.1.19, modified – Note 1 to entry has been added.]

### 3.11

#### service

distinct part of the functionality that is provided by an entity through interfaces

[SOURCE: ISO 19119:2005, 4.1]

### 3.12

#### stop point

*location* (3.8), e.g. a platform, at a *transfer node* (3.15) where the *transport means* (3.16) stop to enable the traveller to board or alight from the transport means

### 3.13

#### transfer

person's activity to switch between *transport modes* (3.17), *transport networks* (3.18) or *transport means* (3.16)

### 3.14

#### transfer link

link that connects *transfer nodes* (3.15) or *stop points* (3.12) within a transfer node

Note 1 to entry: A transfer link enables travellers to move between the different transfer nodes and stop points within a transfer node.

### 3.15

#### transfer node

*location* (3.8) that facilitates *transfers* (3.13) between *transport modes* (3.17), *transport networks* (3.18) and/or *transport means* (3.16)

Note 1 to entry: A transfer node may contain other transfer nodes and may be related to one or more transport modes and transport networks. It may also contain *stop points* (3.12) and facilities for the users of the transfer node. A transfer node may host *services* (3.11) that are provided to the users of the transfer node, e.g. information services, ticket sales, etc.

Note 2 to entry: A transfer node may be a part of a hierarchy of transfer nodes. Thus, a transfer node may be related to many transport modes and transport networks. However, only transfer nodes that are related to just one transport network will have stop points.

Note 3 to entry: The stop points related to different transfer nodes, which may serve different transport modes and networks, may, in real life, have the same physical locations. A tram and a bus may for example share the same platform, but conceptually they may belong to different transfer nodes.

**3.16**

**transport means**

any type of vehicle, associated with any *transport mode* (3.17), that is used for the transport of persons or goods

**3.17**

**transport mode**

means that travellers can choose for transport

Note 1 to entry: In this International Standard, the term "transport mode" is frequently shortened to "mode" for convenience. Transport mode is usually covering groups of vehicles, e.g. *transport means* (3.16) used for road transport, rail transport, sea transport, air transport and cable transport. A mode for inland water-borne transport is also added.

[SOURCE: ISO 19134:2007, 4.14, modified – Note 1 to entry has been added.]

**3.18**

**transport network**

physical network infrastructure for mobility of *transport means* (3.16), containing infrastructure and equipment that facilitate traffic management

Note 1 to entry: A transport network is associated to a specific transport mode and specific types of transport means. The road network, consisting of streets in a city may for example support several transport networks such as transport networks for pedestrians, bicycles and use private cars. The network served by a *bus service* (3.11) is also a transport network.

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**3.19**

**transport service**

*service* (3.14) that is offered to a person with a transport demand (standards.iteh.ai)

Note 1 to entry: This may be services supporting mobility (e.g. public transport services) or services such as luggage handling, assistance, etc.

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**3.20**

**trip**

instance of a *transport service* (3.19) supporting mobility, for example, a specific flight, a specific ferry departure or a specific taxi tour

Note 1 to entry: May follow a pre-defined *trip pattern* (3.21) or the trip may be *ad hoc* according to specific mobility demands. Depending on the nature of the trip, it may start and stop at several *transfer nodes* (3.15).

Note 2 to entry: A trip may serve many travellers, and the travellers may make use different part of a trip (e.g. different legs between different bus stops), and these parts may be whole *journeys* (3.6) or *journey segments* (3.7).

**3.21**

**trip pattern**

pre-defined path defined by means of two or more *transfer nodes* (3.15) and the links and waypoints in between

Note 1 to entry: Defines a path to be followed by a *transport service* (3.19); also called route.

**4 Symbols and abbreviated terms**

**4.1 Acronyms**

- GML Geographic Markup Language
- LBS Location-Based Service
- UML Unified Modelling language

## 4.2 UML Notation

The diagrams that appear in this International Standard are presented using the Unified Modelling Language (UML). UML notation is used as described in ISO 19103 and in the UML standard OMG Unified Modelling Language (OMG UML), Superstructure, Version 2.2.

## 4.3 Package abbreviations

Two letter abbreviations are used to denote the package that contains a class. Those abbreviations precede class names, connected by a “\_”. The International Standard in which those classes are located is indicated in parentheses. A list of those abbreviations follows.

GM	geometry (ISO 19107)
AD	address (ISO 19133)
NT	network (ISO 19133)
TM	temporal (ISO 19108)
TN	transfer node
SF	services and facilities
AT	accessibility types
DT	deviation types
FT	facility types
RT	restriction types
ST	service types

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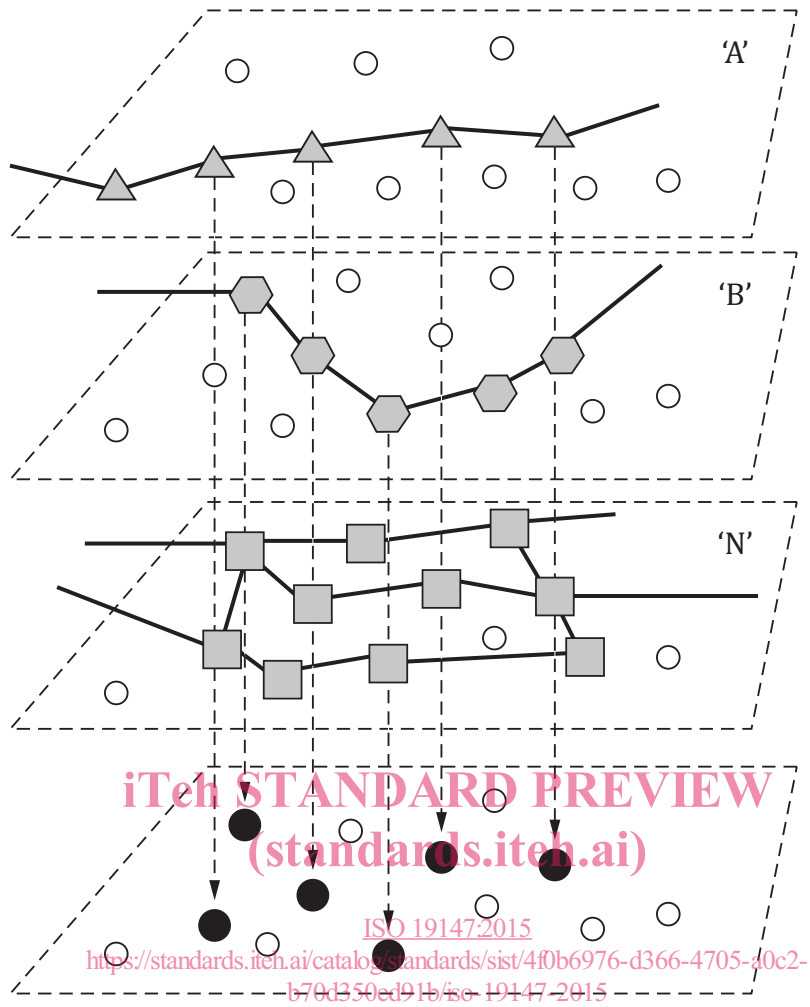
## 5 Transfer node requirements

### 5.1 Transfer node context

Systems being compliant with this International Standard shall be built on the following context.

The transfer node context is based on the fact that within a geographically limited area there may be several transport networks. Each network can be described by a set of nodes and links (see layer A, B and N in [Figure 1](#)). Examples of such networks are rail networks, metro networks, bus network, public roads (private cars network) and pedestrian and cyclist networks.

Nodes that enable a transfer of persons between transport networks, as well as nodes that enable persons to transfer between two different transport means within the same transport networks, are in this International Standard called transfer nodes. Such a transfer node may include several nodes from different networks.



**Key**

○	node in other transport networks	⬡	node in transport network 'B'
▲	node in transport network 'A'	■	node in transport network 'N'
●	transfer node		

**Figure 1 — Transfer node context**

Indicated with vertical lines in [Figure 1](#) and illustrated in [Figure 2](#) there will be transfer nodes in the different networks that from a topological (location) point of view coincide with other transfer nodes in other networks. Such aggregations of transfer nodes (the lowest level in [Figure 1](#)) are in this International Standard also called transfer nodes. This implies that there may be a hierarchy of transfer nodes, and a transfer node may serve one network or be an aggregated transfer node that serves several networks. The principle is illustrated in [Figure 2](#). The geographical limitation of the transfer nodes in the 'cylinder' is an aggregated transfer node. It will include the transfer nodes for the different networks and may in addition also include common facilities.

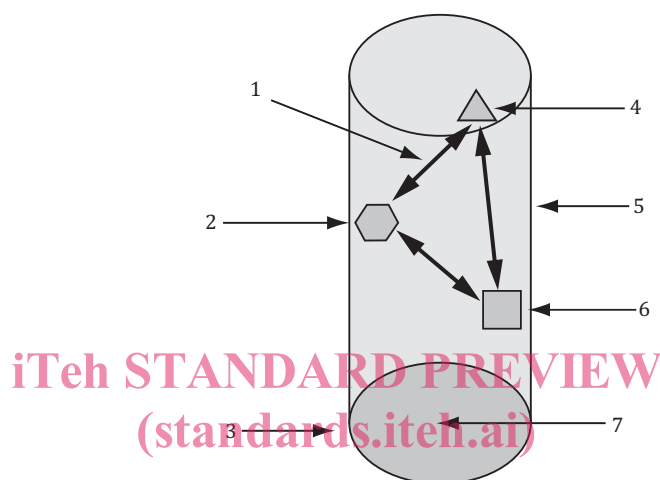
The decision on when different transfer nodes are to be aggregated into another transfer node is a practical concern. If they are co-located, if they have a common name, or if it is desirable to define

common services and facilities and transfer links between the transfer nodes or their stop points, they should be aggregated.

Transfer nodes may also include multiple nodes from the same type of network.

**EXAMPLE 1** Both a bus stop and a bus terminal are transfer nodes. In both cases, a transfer from a pedestrian network or private car network to a bus network is supported, or they may also support a transfer from one bus to another bus.

**EXAMPLE 2** Large airports are likely to be aggregated transfer nodes. They consist of transfer nodes connected to different networks such as one or more rail networks, the private car network, the bus network, and air network. The transfer node for the air network may also be an aggregated transfer node that may consist of a transfer node for all the different types of network, networks, a transfer node for domestic flights and a transfer node for international flights included.



**Key**

- 1 transfer link(s) between nodes in 'A' and 'B'
- 2 node in network B
- 3 location (geographical limits for the transfer node)
- 4 node in network A
- 5 transfer node 'cylinder'
- 6 node in network N
- 7 transfer node

**Figure 2 — Transfer nodes principle**

**5.2 Semantics**

Systems being compliant with this International Standard shall be built on the following semantics as defined below and in [Annex A](#) and [Annex B](#):

The transfer node is described by means of two packages.

- Transfer node – a leaf package which specifies information directly related to the transfer nodes.
- Services and facilities – a package which specifies additional information that may be of interest to the users of transfer nodes such as available facilities and services; and deviations, restrictions and accessibility related to these services and facilities.

In addition, appropriate types and classes from other International Standards are used (see [Figure 3](#)):

- ISO 639 Language codes – which provides data types for language specification;
- ISO 3166 Country codes – which provides data types for country codes specification;
- ISO 19103 Conceptual schema language – which provides data types for date and clock time;

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- ISO 19107 Spatial schema – which provides data types for coordinate geometry;
- ISO 19108 Temporal schema – which provides data types for time duration specifications;
- ISO 19133 Tracking and navigation – which provides data types for addresses and network;
- ISO 19134 Multimodal navigation – which provides some terms and definitions;
- ISO 19136 GML – which provide data types for information links (URIs);
- ISO 19155 Place Identifier (PI) architecture – which provides data types for places.

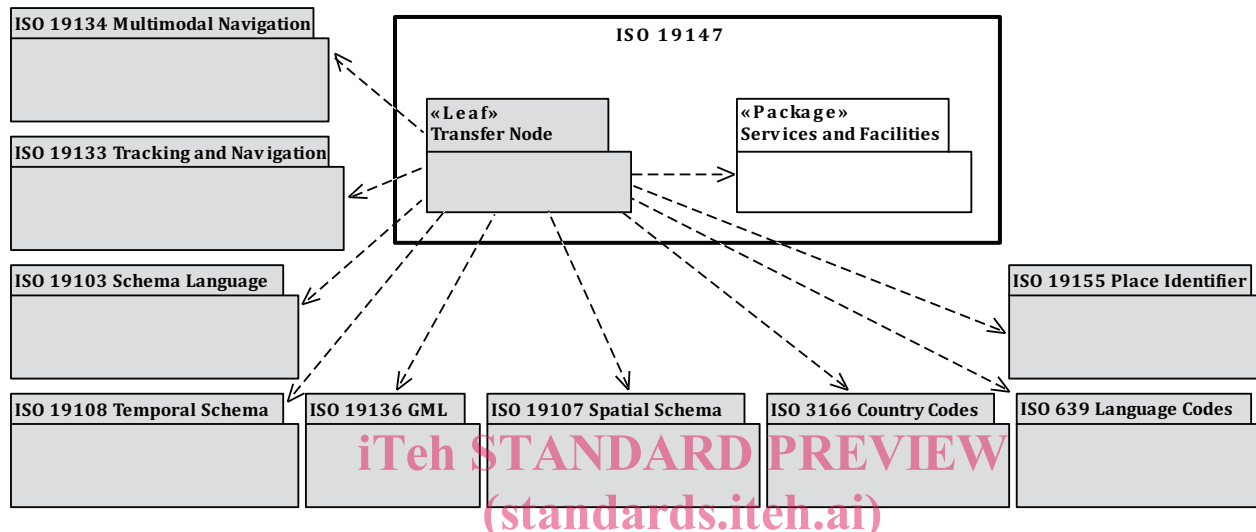


Figure 3 — Context diagram for ISO 19147

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## 6 Conformance

This International Standard defines the requirements for transfer node specifications and has no specific conformance test defined herein.

Conformance to any other International Standard referenced in this International Standard shall be ascertained according to the requirements of the referenced standard or specification.

Conformance to this International Standard is therefore a matter of self-declaration of compliance or by submission to a test house to ascertain that the provisions of the clauses of this International Standard have been adhered to.

The specification of a transfer node is compliant with this International Standard if it includes the following:

- compliant with the normative references in [Clause 2](#);
- uses the terms and definitions in [Clause 3](#) and symbols and abbreviated terms in [Clause 4](#);
- fulfil the requirements in [Clause 5](#);
- uses the information model defined in [Annex A](#);
- uses the services and facilities defined in [Annex B](#).

# Annex A (normative)

## Transfer nodes information model

### A.1 Semantics

The transfer nodes information model is defined in [Figure A.1](#).

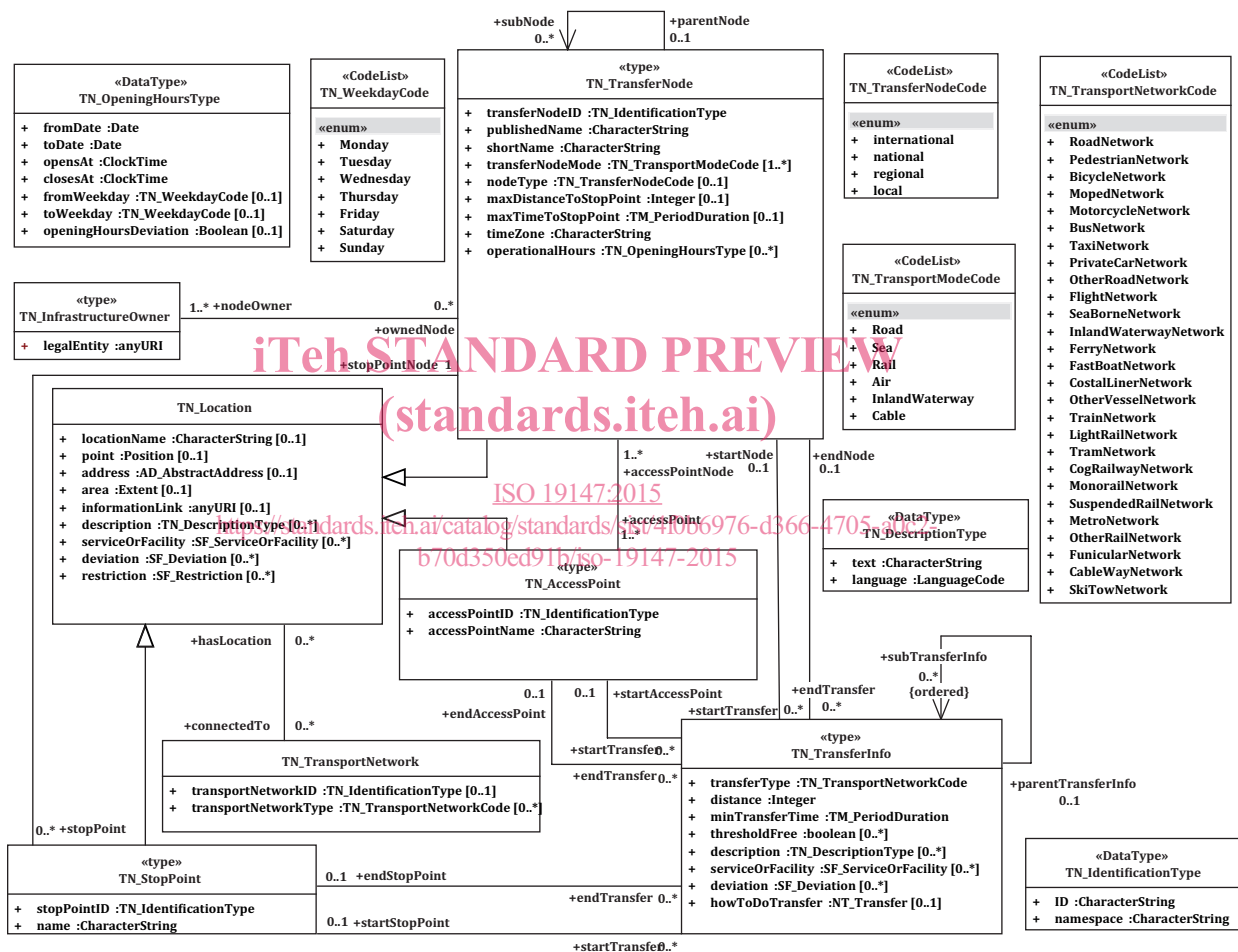


Figure A.1 — Context diagram for transfer node

The transfer node leaf package contains types, data types and code lists that specify overall aspects related to the transfer node infrastructure like the following:

- relations to other transfer nodes;
- stop points at the transfer node;
- transfer node access points;
- transfers to, from, between and within the transfer nodes and stop points.