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# Smart community infrastructures — Smart transportation for energy saving operation by slowly driving intentionally



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# Foreword

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This document was prepared by Technical Committee ISO/TC 268, *Sustainable cities and communities*, Subcommittee SC 1, *Smart community infrastructures*.



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# Introduction

Energy savings is a priority issue for all cities. ISO 37154, and especially ISO 37161, has addressed how, where and in what situations energy consumed in transportation services can be saved.

Rail services are indispensable as one of the most efficient means to convey people, delivery items and freight within cities, between cities and in a large city zone. Rail services are comprised of many service and technical aspects. To save energy in rail services, there are many options to review for improving energy efficiency. Energy savings by slowing the speed of the train and still achieving minimum service schedules is a method that is frequently employed. This method of operation is applicable to other transportation services or modes that are based on scheduling. Energy saving by modifying speed profiles offers great energy savings when widely applied to all transportation services.

The principle of this method is rather simple. All trains, buses, trucks and ferries typically run on a service line or sailing route at the maximum speed technically allowed. Reducing the running speed will reduce the energy consumption. Commonly, all transportation modes, passengers and freight, are scheduled to include standing-by time to provide passengers and freight shippers with convenient service schedules, providing good connections and avoiding odd time for pickup and delivery. Service schedules can be designated so that when passing another service at a station with more tracks or lanes on a single-track line or traffic road, or at a wider point on a narrow sailing route, a train, bus, truck or ferry should come to the station or point by the time designated. If the designated arriving time is set later than the expected arrival time at a maximum speed, the train or other transportation mode can run slower. Overall, this will lead to a reduction in the amount of energy to be consumed.

Slow running avoids high acceleration and deceleration, compared to when running at a higher speed. Passenger-friendly driving will additionally be realized when operating in this energy saving method. From an environmental standpoint, slow running will contribute to a reduction in carbon monoxide emission, hydrocarbons, nitrogen oxides, sulphur oxides, lead and aromatic compounds, if services by engine-driven vehicles.



This document describes how to save energy in scheduled transportation services by modifying speed profiles.

In the development of this document, ISO Guide 82 has been taken into account in addressing sustainability issues.

# Smart community infrastructures — Smart transportation for energy saving operation by slowly driving intentionally

## 1 Scope

This document describes how to organize smart transportation to save energy consumed in operation, by modifying speed profiles of trains, buses, trucks and ferries, which is also able to offer passenger-friendly driving of transportation vehicles.

## 2 Normative references

There are no normative references in this document.

## 3 Terms and definitions

For the purposes of this document, the following terms and definitions 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/



**3.1**
**transportation dispatch**
services operated by using vehicles along with *service schedules* (3.2)

Note 1 to entry: The vehicles used are normally trains, buses, trucks, ferries and others as listed in ISO 37154, 2.5.4.

**3.2**
**service schedule**
timetable to be followed when driving for *transportation dispatch* (3.1)

**3.3**
**section**
tracks, lanes or sailing routes active for operation of *transportation dispatch* (3.1) between stations, stops or terminals

Note 1 to entry: In sailing routes, way points can be placed between ferry terminals to ensure on-time operation if a long distance between terminals. In this case, the route between way points is a section.

**3.4**
**line**
*sections* (3.3) combined

**3.5**
**route**
*lines* (3.4) or part thereof that are combined for through transportation services between lines

**3.6**
**division**
specific parts created and identified on a line or route by dividing a *section* (3.3) thereon to gradually change running speed in a section

**3.7**
**buffer time**
leeway time given to transportation dispatch, with which energy saving can be achieved

**3.8**
**speed profile**
figures illustrating speed changes of *transportation dispatch* (3.1) in divisions

Note 1 to entry: In smart transportation for energy saving operation, speed profiles are useful to find the most effective driving way by identifying divisions where to slowly run as far as service schedules permit. A typical speed profile is illustrated in Annex A for reference.

# 4 Principle of energy saving in transportation operation by modifying speed profiles of running vehicles and applicable city issues

## 4.1 General

In smart transportation as designated in this document, energy consumption can be reduced by modifying the operating speed of transportation service vehicles. That is, by operating the vehicles as slow as the service schedule permits. All transportation dispatch is managed by operating trains, buses, trucks and ferries by adhering to service schedules that include leeway or buffer time generated for customer-friendly transportation services and due to operational reasons. This means that it will take a longer time going from origin to destination, even if vehicles can arrive earlier by running at maximum speed. Having to stand by while en route is common when meeting other services at a station, stop, terminal or to pass another service at an interchange station on a single track-line or single lane-road or a wider point on a narrow sailing route, and still provides arrival time at a destination convenient for customers. The dispatch then has buffer time to be used on the way. There are two options that can be used when operating under this operation as far as scheduled time. One is to stand by at a station after arriving early by running at a maximum speed and the other is to run at a slower speed to consume time while en route. Under the option of running more slowly, the train, bus, truck or ferry will run at a speed lower than that in normal operation. Thus, the energy consumed is lower. This gap in energy consumption by running at a maximum and a lower speed gives a large amount of energy in total in a city, because so many trains, buses, trucks and ferries are dispatched every day.



Smart transportation for energy saving operation by modifying speed profiles is based on how buffer time should be reasonably used to bring out energy saving where allocating additional schedule time is a key to effectively reducing energy consumption.

## 4.2 Applicable city issues and United Nations SDGs

The criteria for smart transportation are appropriate for addressing the city issue of large consumption of energy in transportation services.

Smart transportation supports United Nations Sustainable Development Goals, especially goal 7 “Affordable and clean energy”, goal 8 “Decent work and economic growth”, goal 9 “Industry, innovation and infrastructure”, goal 11 “Sustainable cities and communities”, goal 12 “Responsible consumption and production”, goal 13 “Climate action” and goal 15 “Life on land”.

# 5 Adoption and implementation of smart transportation for energy saving operation

## 5.1 Objectives

As mentioned in 4.1, smart transportation for energy saving operation by modifying speed profiles can work on transportation if the services are scheduled. Smart transportation should be adopted and implemented by following 5.3.

 

## 5.2 Target transportation services

Smart transportation targets all transportation services where dispatch is organized and operated by following service schedules arranged in advance.

## 5.3 Procedure to adopt smart transportation

### 5.3.1 General

Smart transportation can be adopted into transportation services currently organized or being newly started in a city, between cities and in a large city zone, by following the procedure designated in this subclause. The procedure consists of three steps:

— find buffer time that can be created when scheduling transportation dispatch;

— allocate the buffer time to individual divisions in a target section, line or route and

— operate dispatch by following speed profiles where the buffer time is allocated.

### 5.3.2 Selection of transportation services where smart transportation is applied

Select transportation services where smart transportation is applied, which are in the form of:

— rail, including services by BRT (Bus rapid transit);

— bus (e.g. local bus, highway bus);

— truck;

— ferry.



### 5.3.3 Scheduling of transportation dispatch

Schedule each transportation dispatch in regular ways that have been applied in a target section, line or route as usual. When introducing smart transportation into sections, lines or routes which will newly start service, follow the scheduling manners that have been applied on other lines currently serviced.

In rail services, to schedule transportation dispatch also for good ride comfort by passenger-friendly driving, confirm the following parameters on traffic conditions in a target section, line or route when scheduling:

— minimum time to minimize changes in acceleration and deceleration;

— constant speed running;

— depression of jerks at powering and braking (e.g. stepwise changes in acceleration and deceleration);

— restriction of making a brake when stopping at a station, stop or terminal;

— speed-suppressing running.

For rail services, confirm the following specific parameter as well:

— coasting time when switching from powering to braking operation and vis versa.

### 5.3.4 Preparation of primary speed profiles of transportation dispatch

Draw a primary speed profile of each transportation dispatch in each section by minimizing the running time each section. A typical speed profile is illustrated in Figure A.1.

#### 5.3.5 Identification of buffer time between stations, stops, terminals or way points

Identify buffer time between stations, stops, terminals or way points by scheduling transportation dispatch based on 5.3.3.

#### 5.3.6 Allocation of buffer time to each division

Allocate buffer time to divisions by considering the following conditions:

a) Rail services

- maximum running speed;
- coasting;
- suppression in acceleration and deceleration on the way to enter and leave a speed-limited section;
- suppression in acceleration in a section sandwiched by two speed limited sections;
- acceleration;
- deceleration.

b) Local bus services

- passenger-friendly driving (e.g. sudden starts, engine revolution, rapid acceleration and deceleration);
- constant speed running (e.g. maximum speed);
- turning-off of engines when stopped.



NOTE 1 Local bus services are public transportation services by bus running on a service route allocated on general roads in and between cities.

c) Highway bus services

- starting by creeping without an accelerator (i.e. not by stepping on an accelerator);
- gradual acceleration;
- constant speed running (e.g. keeping designated speed with minimum acceleration, no additional acceleration);
- gear shifting-up without knocking;
- coach temperature control without air conditioners in cold weather (e.g. use of heaters in order not to activate air compressors);
- restraint of air conditioner use at mild temperature (e.g. avoidance of pre-heating function operation).

d) Truck services

- small acceleration when starting moving;
- gear changing by matching the timing for acceleration;
- constant speed running (e.g. maximum speed);
- long intervals to other vehicles ahead;
- use of engine brakes;

 