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Vidiki sistemov Hyperloop - Referenčna arhitektura

Hyperloop Systems Aspects - Reference Architecture

Hyperloop-Systemaspekte - Referenzbauweise

Aspects des systèmes Hyperloop - Architecture de référence

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03.220.99	Druge oblike transporta	Other forms of transport
55.020	Pakiranje in distribucija blaga na splošno	Packaging and distribution of goods in general

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Hyperloop Systems Aspects - Reference Architecture

Aspects des systèmes Hyperloop - Architecture de référence

Hyperloop-Systemaspekte - Referenzbauweise

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European foreword

This document (prEN 17930:2022) has been prepared by Technical Committee CEN-CLC/JTC 20 “Hyperloop system”, the secretariat of which is held by NEN.

This document is submitted to the CEN Enquiry.

Introduction

This document defines the reference architecture of the hyperloop system, its subsystems and interfaces.

The main purpose is to develop an architecture for this novel mode of transportation that can be used by any parties participating in the development of the different aspects of a hyperloop system.

1 Scope

This document specifies the reference architecture for a hyperloop system. It specifies the functions of each (sub)system to define the purpose of each block, its different possible implementations, and highlights how the (sub)systems support each other.

The interfaces of the transportation system are listed, whether it be internal interfaces or exterior interfaces. The characterization considers the technical as well as operational features of the transport service.

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 terminology databases for use in standardization at the following addresses:

— ISO Online browsing platform: available at https://www.iso.org/obp/

— IEC Electropedia: available at https://www.electropedia.org/

3.1
hyperloop system
mode of land transportation capable of high speed and driverless operations, in which a vehicle is guided through a low-pressure tube or system of tubes, for passengers and/or cargo

3.2
payload
total mass of the passengers, luggage and goods

[SOURCE: IEC 60050, definition 811-03-05, modified – “in the train” deleted]

3.3
internal environment within the vehicle
Environment within the vehicle accommodating the passengers and cargo which could include, but is not limited to, air pressure, air quality, temperature, gas composition and humidity

3.4
internal environment within the tube
Environment within the tube accommodating the vehicle travels which could include, but is not limited to, air pressure

3.5
interface
shared boundary between two functional units, defined by various characteristics pertaining to the functions, physical interconnections, signal exchanges, and other characteristics of the units, as appropriate

[SOURCE: ISO/IEC 2382:2015]

4 Hyperloop system

The hyperloop is an electrically powered mode of land transportation with vehicles travelling through a network of low-pressure tubes, capable of high-speed and driverless operations, offering continuous service for transporting passengers and cargo towards their destinations.

The hyperloop system uses electro-magnetic forces for levitation, guidance and propulsion. Magnetic levitation is one the key features of the hyperloop system. This eliminates the direct contact between the moving and static parts of the system. The pressurized hyperloop vehicles operate inside a low-pressure tube. The low-pressure environment reduces both air resistance and energy consumption. The body of the tube lowers noise emissions towards the direct environment.

The hyperloop linear infrastructure enables controlled traffic flow of vehicles through a low-pressure tube or system of tubes that are either elevated on columns above the ground, at ground level, or go underground/underwater. The spatial constraints need to be taken into account when designing the hyperloop transport service.

5 Methodology

The reference architecture of the hyperloop system can be determined in various ways depending on the perspective taken. It can be defined in terms of physical elements of the final system as well as in terms of functions to be performed by the hyperloop system.

In this document a systems engineering methodology is used relying on the functional breakdown of the system. Through this methodology, a high-level architecture is defined. The high-level systems architecture provides a frame of reference for the functional view of the main functional blocks and associated functions of the hyperloop.

This architecture represents the topology of the hyperloop high level functional blocks at the system level and the hyperloop functional blocks at the sub-system level. For each of the functional blocks, a set of key functions is identified. When applicable and necessary, these key functions are associated with physical parts of the hyperloop system.

Each of the functional blocks has several interactions with a set of other functional blocks. These interactions are identified as interfaces.

The description of the hyperloop system through the high-level systems architecture relying on the functions allows for various implementations, while still providing clear guidelines to the hyperloop product developers.

6 Key hyperloop system functions

The main function of the hyperloop system is to transfer passengers and cargo in a low-pressure tube or system of tubes through on driverless vehicles.

Subsequently, in order to achieve this functionality, the hyperloop system will have to provide the following subsequent functions:

— To provide a pressure-controlled pathway for vehicles connecting multiple locations

— To handle cargo loading/unloading and passengers boarding/disembarking

— To move and position the vehicle within the infrastructure

— To coordinate the vehicles and infrastructure operations

— To transport passengers and/or cargo in a pressurized environment

— To ensure system availability, safety, reliability and maintainability

These high-level functions are grouped into three high level functional blocks namely: the infrastructure, the operating system and the vehicle.

— Infrastructure

  — To provide a pressure-controlled pathway for vehicles connecting multiple locations

  — To handle cargo loading/unloading and passengers boarding/disembarking

— Operating system

  — To move and position the vehicle within the infrastructure

  — To coordinate the vehicles and infrastructure operations

— Vehicle

  — To transport passengers and/or cargo in a pressurized environment

The choice for the three high level functional blocks is made in order to reflect and provide the relationship to the main physical entities of the hyperloop: Infrastructure, Operating System and Vehicle.

The presentation of the high-level functional blocks is depicted in a topological view of the Figure 1.

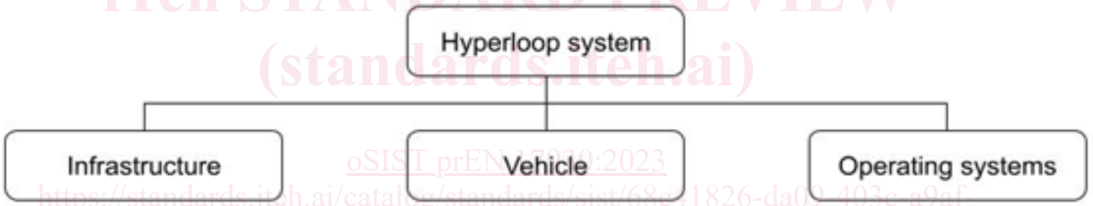

Figure 1 — High level functional block of the Hyperloop System

7 Reference architecture - Building Blocks

The reference architecture is structured as a multi tiers approach including 3 levels:

— tier 1: High level functional blocks

— tier 2: Functional blocks

— tier 3: Functions

The tier 1 is composed of the high-level functional blocks as depicted in Figure 2. This functional structure, implementation independent, is organized further into functional blocks at tier 2 level, as shown in Figure 2. The functional blocks are each specified by a set of different functions at tier 3 level.

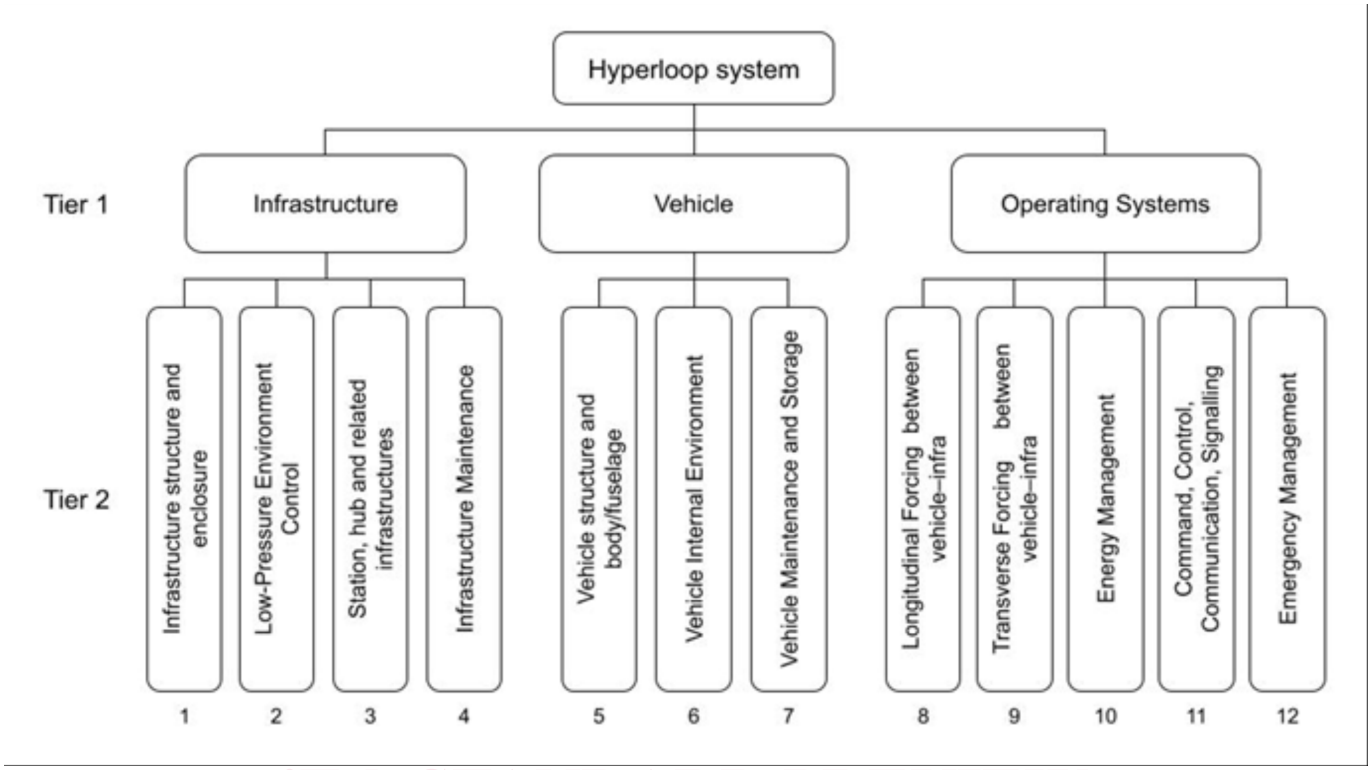

Figure 2 — Hyperloop system's functional structure

The generic description of the functional blocks of the hyperloop system (tier 2) is summarized below.

a) Infrastructure

— F1 - Infrastructure structure and enclosure

This functional block includes functions regarding the infrastructure part that comprise/are part of/form the enclosure of the low-pressure environment through which the vehicle travels.

— F2 - Low Pressure Environment Control

This functional block includes functions regarding the air pressure inside the enclosure.

— F3 - Station, hub and related infrastructures

This functional block includes functions regarding areas where passengers can board/disembark and/or cargo can be loaded / unloaded during regular service.

F4 - Infrastructure Maintenance

This functional block includes functions regarding keeping the infrastructure in a functional and safe state.