STU in Lapland

String Transport of Unitsky (STU) is a transportation system of “the second level” in which a track structure is elevated above the ground on the supports. Its closest analogues include: a mono-rail, a train on a magnet suspension, high-speed elevated railways.

In terms of its material consumption a pre-stressed string rail track structure is 5—10 times less intensive than traditional girder-span structures, therefore the cost of STU will be accordingly by 5—10 times lower.

STU being a rail transport represents a variety of a railway with all its advantages. It is reliable, safe, environmentally friendly and comfortable, it is characterized by a long service life and low operational costs. In particular, in winter time there is no need to remove snow and ice from the rail head. At the same time string transport is free from some disadvantages typical for railway roads, namely: a string rail is designed without any expansion joints, its rolling stock has no heavy and noisy wheel pairs giving rise to the intensive deterioration of a rail head; it is provided with a derailment system.

At travel speeds exceeding 100 km/hour the gear power is mainly used to overcome the air resistance. A rail STU automobile on the steel wheels that is called a unibus is characterized by the unique aerodynamic contours that have been improved as a result of numerous wind tunnel tests. Therefore, aerodynamic rolling resistance of a high-speed unibus will be 4—5 times lower than, for example, that of a sports car of the same size. It is close to a theoretical limit therefore the power of its aerodynamic resistance could be further reduced only through the reduction of the cross section area of a unibus — its maximum midsection.

The smaller the size of a gauge in the track structure and the more compact the cross-sectional dimensions of a unibus the lower the cost of STU and the higher its energy efficiency. At the present time a number of stereotypes have been formed in the existing rail transport. Thus, it is assumed that its rolling stock should be characterized by a large size and high holding capacity (in contrast to the motor vehicles that should be compact and small-size).

Table 1 shows the relationship between the volume of the two-way passenger traffic and carrying capacity and circulation frequency of unibuses (for a double-track STU).

Table 1

Circulation frequency of unibuses	**Volume of passenger traffic, pass./24 hours, depending on the carrying capacity of unibuses**					
	5 pass.	**10 pass.**	**20 pass.**	**30 pass.**	**40 pass.**	**50 pass.**
10 min.	1 440	2 880	5 760	8 640	11 520	14 400
5 min.	2 880	5 760	11 520	17 280	23 040	28 800
2 min.	7 200	14 400	28 800	43 200	57 600	72 000
1 min.	14 400	28 800	57 600	86 400	115 200	144 000
30 sec.	28 800	57 600	115 200	172 800	230 400	288 000

The data given in table 1 show that 20-seat unibuses are capable to handle the high volumes of traffic amounting to 50,000 passengers/24 hours if their circulation frequency is 1 minute. In this case the distance between the two neighboring unibuses moving along the track with the travel speed of 360 km/hour will be 6 km which is a safe interval. The track will be practically “deserted” therefore in future when the control system was further improved it will be possible to reduce this distance, if necessary, by 10 times and carrying capacity of STU could be accordingly increased by 10 times.

Table 2 shows fuel (energy) efficiency of a 20-seat unibus depending on its travel speed and maximum midsection.

Table 2

Maximum midsection of a unibus	**Required power of a unibus gear (aerodynamic resistance and wheel rolling resistance), kWt, depending on the travel speed**					
	120 km/hour	**180 km/hour**	**240 km/hour**	**300 km/hour**	**360 km/hour**	**420 km/hour**
1 m^2	4.6	11.8	25.1	46.5	77.6	121
2 m^2	7.2	20.8	46.3	88.1	150	235
3 m^2	9.9	29.8	67.6	130	221	349
5 m^2	15.2	47.7	110	213	365	577

The data given in table 2 show that a series-produced internal combustion engine used in modern passenger cars having the power of 100—150 kWt (133—200 horsepower) is capable to provide the travel speed of a unibus amounting to 360—420 km/hour. Naturally, if its maximum midsection does not exceed 1.5 m^2. As far as the travel speed of a unibus will be by 3—4 times higher and its average occupancy — by 7—10 times more than that of a conventional passenger car its energy efficiency will be by 20—40 times better than that of a car. Consequently, its fuel consumption to implement similar transportation work will be accordingly lower. Furthermore, environment pollution and ecological problems will be proportionally reduced. For instance, at the travel speed of 360 km/hour (100 m/sec) fuel consumption per 100 km of travel by such 20-seat unibus will be as little as 8—12 liters of fuel or 0.4—0.6 liter/100 pass.-km. It will be by 15—20 times less than, for example, fuel consumption for aviation transportation.

In terms of its energy costs such unibus is 5—8 times more efficient as compared with the high-speed railways requiring 30—50 kWt of power per 1 passenger.

The aforementioned characteristics could be ensured by STU with a gauge of 0.75 m (see fig. 1 and fig. 2) or 1.25 m (see fig. 3 and fig. 4). One- or two-passenger seats will be installed along the whole length of a unibus to form small compartments that in terms of their size are close to the dimensions of a passenger car. The total length of a unibus is 30—35 m. Like any passenger car, a tram or a metro train it has no toilet. However, as in any other public transport there is no need in a toilet because it will take a unibus 1.5—2 hours to cover a distance of 550—800 km. Moreover, if necessary, a unibus could stop and leave the line at the intermediate stations, i.e. every 30—45 minutes.

Of course, it is possible to design STU with a gauge of 1.75 m, with trains having the carrying capacity of 300—500 passengers, with cars provided with the wide passages and toilets. But in this case the cost of such transportation system with a similar productivity will be 3—4 times higher and its energy efficiency will be 3—4 times less.

The cost of a double-track STU transportation system with a 1.25-meter gauge (including infrastructure and the rolling stock) is given in table 3. The given data refer to the design travel speed of 360 km/hour, the span length of 30 m, the average height of the supports of 5 m and the volume of traffic of 20,000 pass./24 hours (to estimate the number and the total cost of unibuses). The given data refer to six tracing alternatives out of which 5 alternatives provide links between the ports of two seas and are transit routes for the city of ROVANIEMI. In 4 alternatives STU comes to the Russian port of MURMANSK, and in one alternative — to the Norwegian non-freezing port of KIRKENES and the freezing Russian port of KANDALAKŠA.

Table 3

No.	STU tracing	Route length, km	Travel time (O-D), hour	Approximate cost, million €		
				route	infra-structure	unibuses
1	ROVANIEMI — MURMANSK	400	1.2	520	35	55
2	KEMI — ROVANIEMI — SODANKYLA — IVALO — KIRKENES	515	1.5	670	65	75
3	KEMI — ROVANIEMI — SODANKYLA — IVALO — MURMANSK	580	1.7	755	65	85
4	KEMI — ROVANIEMI — MURMANSK	510	1.5	665	45	70
5	KEMI — ROVANIEMI — SODANKYLA — MURMANSK	530	1.6	690	55	75
6	KEMI — ROVANIEMI — KEMIJÄRVI — KANDALAKŠA	405	1.2	530	55	55

Unibuses circulating along the route will be designed as passenger (20—40 passengers), freight-passenger (15—30 passengers plus 1 ton of freight) and freight (5—7 tons of freight) vehicles. Therefore, stations will be provided with cargo terminals. At night time when the intensity of passenger flows is reduced the high-speed routes could be predominantly used for freight traffic. Annually a STU route is capable to carry up to 1 million tons of various freights which could considerably increase the feasibility of its construction, its profitability and the amount of profit gained as a result of its operation.

It is assumed that the first STU route will be built as a non-electrified road with a simplified control system (a unibus with a driver). After 3—5 years the profit gained as a result of the system operation could be used to electrify the transportation line (200,000—300,000 €/km) and to provide it with an automatically controlled system (200,000—300,000 €/km). Furthermore, along the STU track structure it will be possible to additionally install the cables of the high-voltage power transmission line (transmitted power up to 1 million kWt, the cost — 100,000—200,000 €/km), fibro-optical communication lines (50,000—100,000 €/km), radio-relay and cellular communication lines, while the STU supports could be used for the installation of wind and solar power plants.

The cost of STU with a gauge of 0.75 m will be by 20%—30% lower and the cost of STU with a gauge of 1.75 m — by 40%—60% higher than the cost of STU with a gauge of 1.25 m which relevant data are given in table 3. The feasibility of various STU alternatives in their application to the transportation tasks of Lapland are in need of investigation. As a result it will be possible to offer to a customer an optimal tracing alternative as well as to find the optimal engineering, technological and organizational solutions including the track structure, supports, stations and terminals, service garages and parks and unibuses.

The cost of a Scoping Study (investigation of possible ways to implement the project which feasibility has been already identified) is estimated at 2 million €. Implementation period is 9 months. A customer will be given: avant-projects for an optimized track structure and supports, passenger, freight and freight-passenger unibuses; draft design of stations, terminals, cargo terminals and service garage-parks; business-plan; operational model of a fragment of the transportation system; demonstrational video-film for the recommended project of STU tracing and construction.

When the Scoping Study has been finalized it is possible to start design/survey and project/ development works and STU construction. Implementation period is 27 months, for the cost see table 3. Therefore, the whole project could be implemented during 3 years. Of course, it could be possible only with the provision of the relevant financing, land allocation and support from the government bodies of Lapland and Finland.

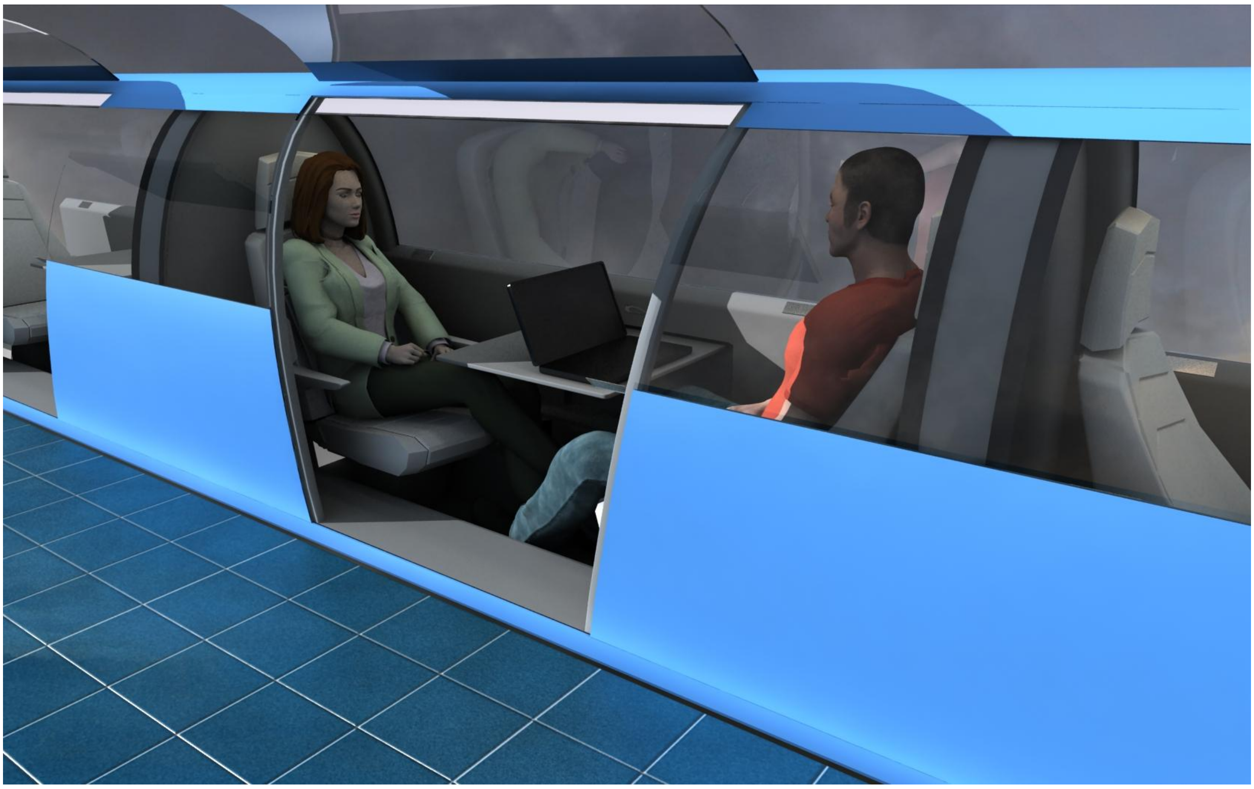
Experimental-industrial testing and certification of the innovative STU project could be facilitated either in Russia exclusively by the efforts of the Russian developers and government bodies or on a collaborative basis in Finland. For this purpose “STU” Ltd. (the head developer of STU) and the Finnish party could establish in Finland a joint company with the distribution of shares as 49% : 51%, respectively. This company within the aforementioned time limits will undertake construction of an experimental-demonstrational STU route (a testing ground), its certification and parallel organization of the construction of the first STU line followed by the subsequent construction of other similar STU routes not only within the territory of Finland but also in other EU countries.

Experimental-industrial development of a high-speed STU with a gauge of 1.25 m will require the input of Finland in the amount of 35—40 million € and it will take 15—18 months. The low cost and reduced implementation time result from the fact that “STU” Ltd. has got the concepts of all necessary engineering solutions (that have been developed during 30 years of its previous activity), also it is proposed to provide the unibuses with the ready and the best components, aggregates and equipment, currently series-produced by the world automobile industry.

Construction of a experimental-demonstration STU route in Finland could re-pay the costs during the first year of its operation through the orders for the construction of various STU routes coming not only from Finland but also from other EU countries. Thus, it will be possible to develop sustainable large-scale business with a life cycle of not less than 100 years and profitability of more than 1 billion €/year.

General Director —
General Designer of “STU” Ltd. Anatoly Unitsky

Moscow, 04.11.2008



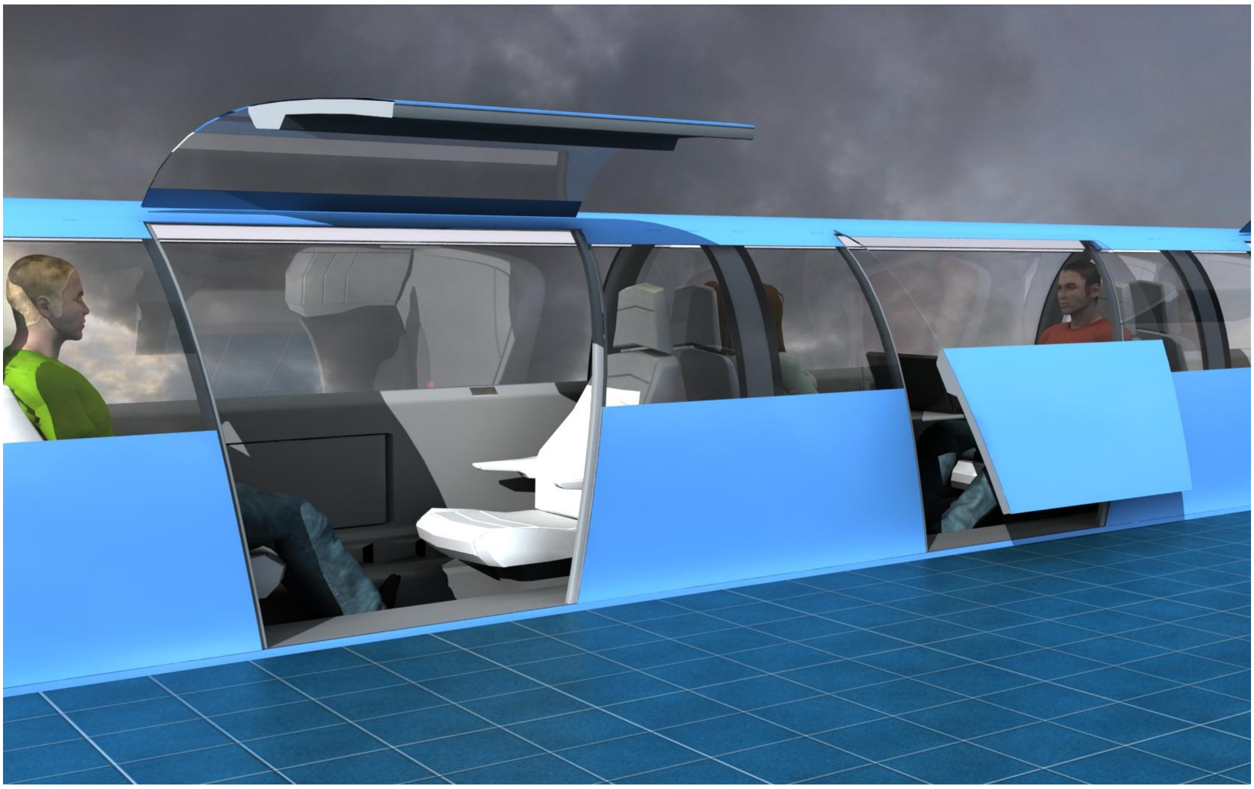


Fig. 1. High-speed unibus with a 0.75-meter gauge
Number of seats — 20

Fig. 2. High-speed way STU
Speed up to 360 km/h, gauge 0,75 m

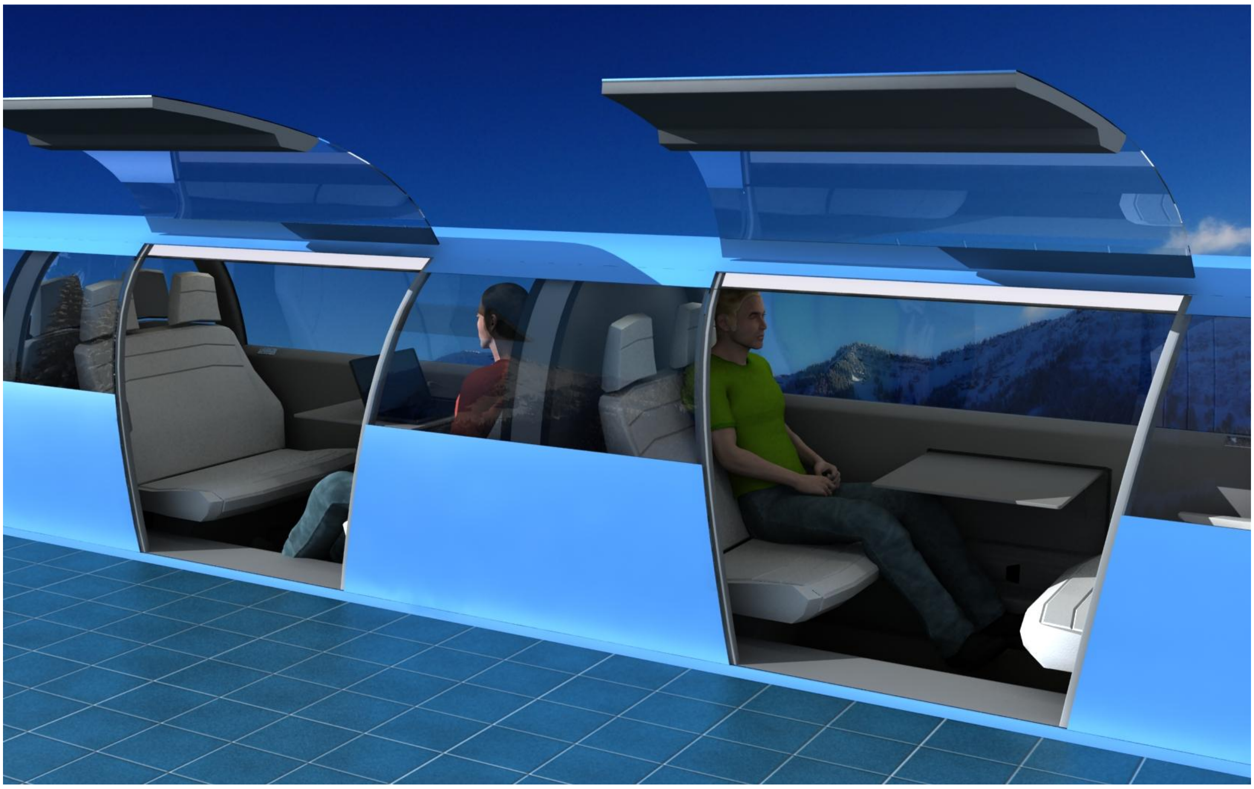
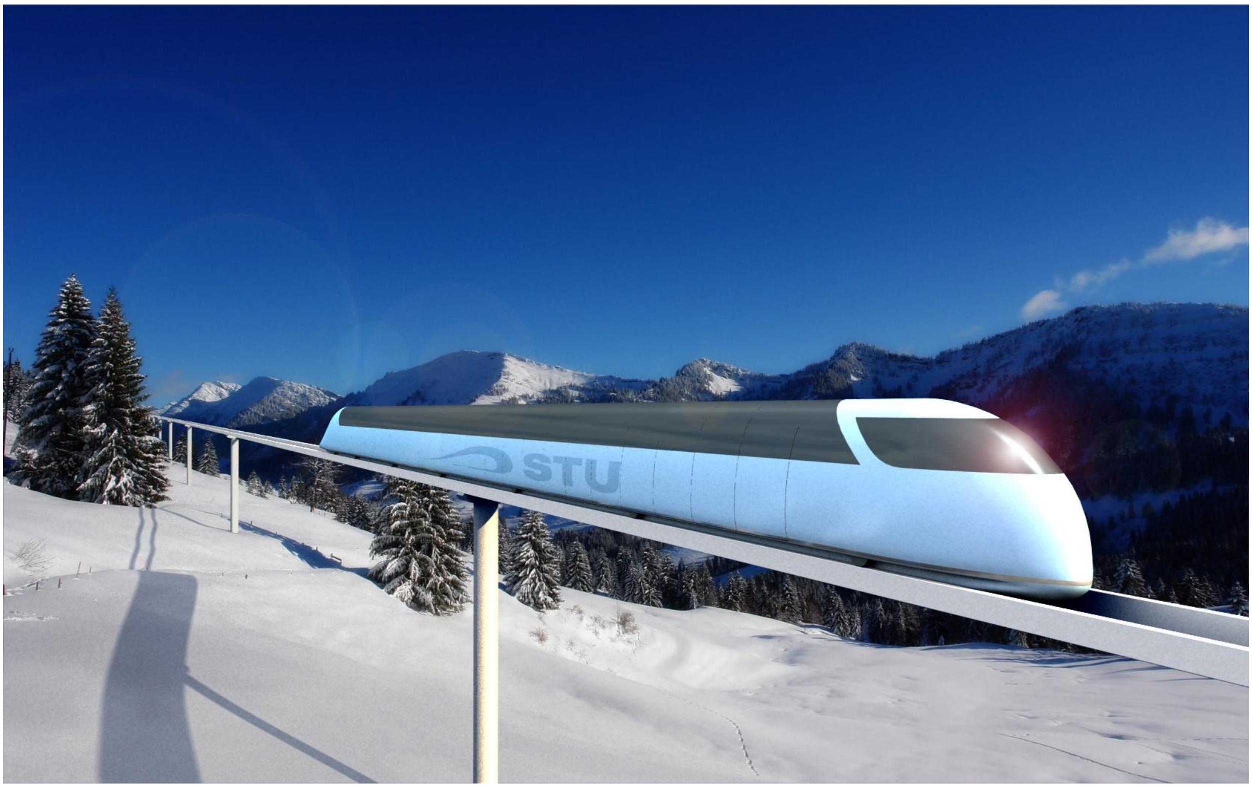


Fig. 3. High-speed unibus with a 1.25-meter gauge
Number of seats — 40



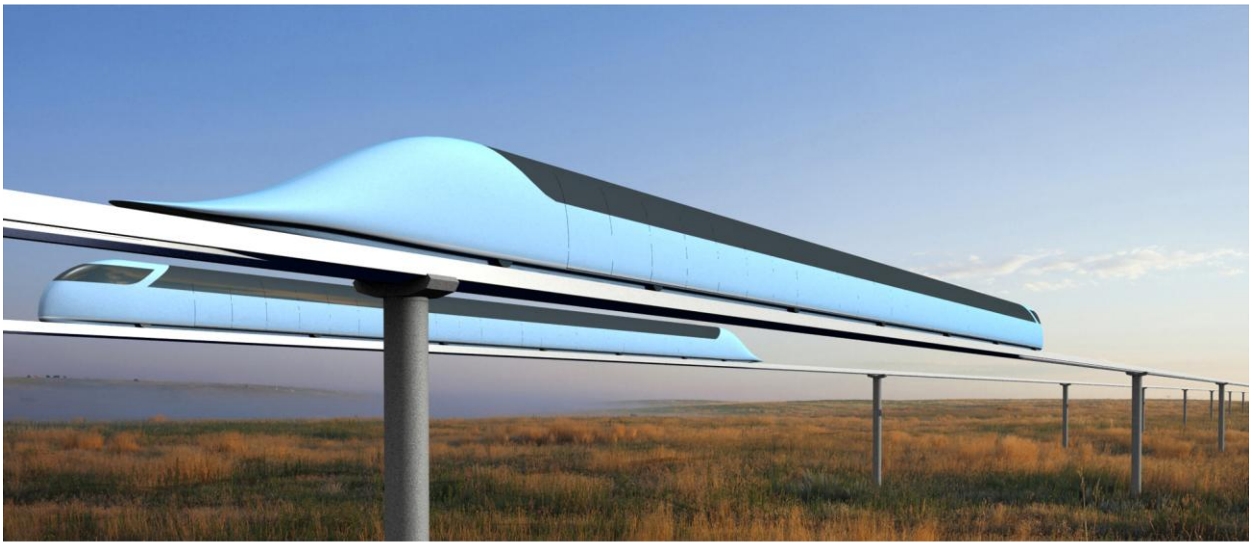


Fig. 4. High-speed way STU
Speed up to 360 km/h, gauge 1,25 m