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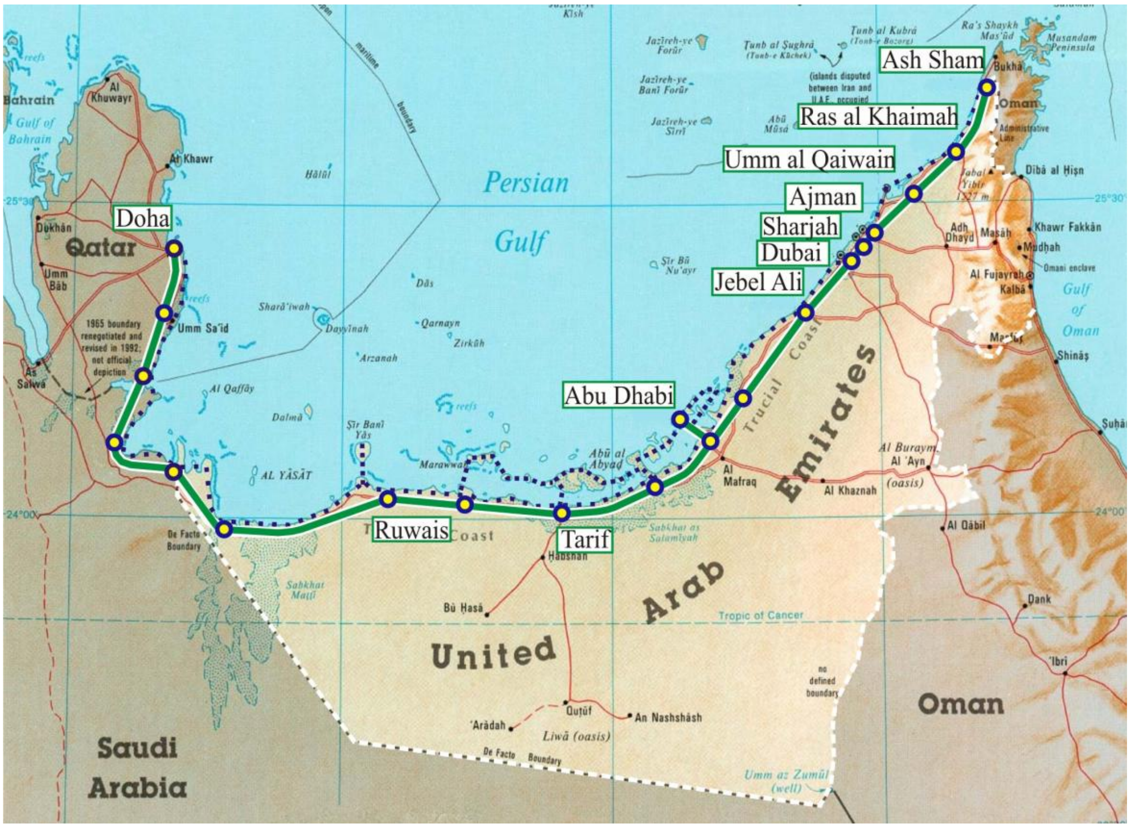
Project proposal
to open up and develop the coastal area
of United Arab Emirates

on the basis of "String Transport Unitsky" transportation technologies

"PEARL NECKLACE OF EMIRATES"



Moscow 2007

List of the key executives of STU Ltd.

Chief Executive, General Director, General Designer	Anatoly Unitsky
Executive Director	Denis Unitsky
Deputy-General Director on the Rolling Stock, Chief Designer	Vladimir Zharkevich
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Chief Engineer	Anatoly Parkhomenko
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Contents

Resume

The project "Pearl necklace of Emirates" is focused on the development of the whole coast of UAE including the neighbouring islands of Persian Gulf through the use of a principally new mode of transportation — String Transport Unitsky (STU). The total length of the coast proposed for the development is 750 km stretching from the city of Doha (Qatar) via the capitals of Arab Emirates (including Abu Dhabi, Dubai, Sharjah) to Oman.

The project includes two principally different STU alternatives: a double-rail double-track super high-speed STU (travel speed up to 450 km/hour) passing at the height of 5—10 m and a single-rail double-track high-speed STU (with hanging transportation modules gaining the speed up to 120 km/hour) passing at the height of 100—150 m.

Super high-speed double-track STU route called "Green arrow" is an inter-city and international route that will make it possible with the travel speed of 450 km/hour to link the capitals of Arab Emirates with each other and with the airports and new distant resort centres located on the coast of Persian Gulf. In this case the travel time from the centre of Dubai to the centre of Abu Dhabi will be 30—35 minutes. The total length of the route is 748 km including 20 terminals (stations). With the average length of a passenger trip amounting to 100—150 km the "Green arrow" transportation system will be able to carry in both directions up to 5—7 million passengers per 24 hours or up to 1.8—2.5 billion passengers per year. At the average cost of travel amounting to 10 USD/pass. and the average future volume of transportation amounting to 400—500 million trips per year (i.e. approximately 20% of the total carrying capacity of the transportation system) the system will give the annual income in the amount of 4—5 billion USD.

The cost of the "Green arrow" system including construction of a 748 km double-track route, 20 stations and more than 1,000 super high-speed transportation modules (unibuses) each with the carrying capacity of 20—25 passengers is estimated at 6.1 billion USD. For comparison: in January 2007 a high-speed railway was put into operation in Taiwan. It was designed on the basis of the Japanese technologies and has the following characteristics: the length — 345 km, the average travel speed of trains — 300 km/hour, the cost of the system not including the cost of the high-speed trains — 15 billion USD.

However, the "Green arrow" system as it is could not be highly profitable without the provision of the required high volume of passenger flows. For this purpose it is necessary to develop along the route new recreation zones and new settlements where simultaneously not less than 1 million people could live and rest. Therefore it will be necessary to build from 200—300 to 800—900 high-rise buildings to be located along the UAE coast and islands at the average 2 km distance from each other. At the first stage these buildings will be grouped around the "Green arrow" stations and then as the number of high-rises will be increased they could be grouped to form a unified linear city with the total length of about 750 km located along the UAE coast. Such city should have its own high-speed transportation system that in terms of its characteristics is similar to a traditional metro. This function will be performed by a single-rail double-track monoSTU called in the project the “Sky flow”. The “Sky flow” route linking high-rise buildings with each other is designed as an “aerial metro” that with its higher travel speed (up to 150 km/hour) will be approximately 20 times cheaper than a traditional underground metro and approximately 10 times cheaper than the elevated mini-metro: the cost of 1 km of monoSTU including a double-track elevated track structure, high-rise terminals-stations located at the height of 100—150 m and the high-speed rolling stock is estimated at 5.1 million USD. “Sky flow” will perform the functions of a high-speed city route in the proposed linear city with its stops located in each building at the distance of 2 km from each other. At the average trip length of 16—20 km (8—10 stops with the average travel time of 15—20 min.) the whole “Sky flow” system of “aerial metro” in UAE will be able to carry up to 5—6 million passengers per day, i.e. each resident of a linear city in UAE will be able to travel along the route 2—3 times per day (to and from work, to the beach, shops, etc.). For example, today a similar volume of transportation is carried by Moscow metro with its total length of 200 km and 200 underground stations — every day it serves up to 8—10 million passengers.

With the future volume of transportation handled by the “Sky flow” amounting to 3—4 million trips per 24 hours (or 1—1.5 billion trips per year) and the ticket cost of 2 USD/pass. a monoSTU will give the annual income of about 2—3 billion USD.

Moreover, it will be possible to build along the UAE coast additional 20 large residential, shopping, commercial and entertainment centres (within the walking distance of the “Green arrow” stations) and to put into operation several hundreds of high-rise multi-functional buildings (residential, office, hotel, shopping, etc.) with the total floor area of 20—30 million sq. m and more. (In this case the summary volume of investments into the real estate will amount to about 20—30 billion USD; after construction this property could be sold but in this case its cost will be 40—60 billion USD). Within the walking distance of each high-rise building it is possible to build, if necessary, low-rise buildings (offices, hotels, shops, houses, etc.) that could bring additional high profit to investors.

On the whole, it will be possible to develop in UAE a unique strategic transportation system of the “second level” that will be highly profitable, environmentally friendly and safe having no analogues in the world to raise the economy of UAE, at least its tourist component, to a new level bringing additional income to the national budget in the amount of not less than 10 billion USD annually. In future this communication system could be extended to other countries of Arabian Peninsula (Saudi Arab, Oman, Kuwait, Yemen) as well as to Asia and Africa. In this case UAE with the established modern production capacities for the construction of principally new type of transportation communications (including the rolling stock designed on the analogue of automobile industry) and ultra-modern infrastructure of a principally new type (including high-rise buildings combined to linear cities) could become an industrial leader among other Arabian countries.

Introduction

This Project proposal investigates a possibility to implement a project: "Pearl necklace of Emirates" aimed at the development of the coast and neighbouring islands of Persian Gulf with the total length of 720 km stretching from the town of Doha (Qatar) through the capitals of United Arab Emirates (including Abu Dhabi, Dubai and Sharjah) to Oman.

Extension and development of new recreation areas and economic zones within the Arabian coast of Persian Gulf envisaged by the project is based on the construction of a strategic transportation system with its influence zone to be used for the distribution of newly-formed settlements and their subsequent consolidation by this transportation system to form a unified coastal "linear city" including already existing cities and settlements.

Development of a strategic transportation system envisages the use of innovative transportation technologies of "String Transport Unitsky" ("STU") that in combination with other applied technologies make it possible to create a universal communication system which in addition to the unique high-speed and super high-speed transport systems of the "second level" will include information and engineering life-supporting systems of existing and newly-formed settlements.

This Project Proposals takes into account the following factors:

- the economic strategy adopted by United Arab Emirates with its focus on the development of the large-scale national tourist complex in combination with the expansion of special tax-free economic development zones;
- availability of highly positive investment climate in UAE that is unique for developing countries;
- actual achievements of United Arab Emirates in the field of the attraction of foreign investments channeled to the development of tourist business, housing and production sector;
- availability of large undeveloped coastal areas in United Arab Emirates that have a great tourist and recreation potential;
- exclusive opportunities opened up by the STU transportation technologies for the development of unpopulated areas with their further integration into other existing systems of human settlements and cities.

The aim of this Project Proposal is to bring to the attention of the Federal Government of United Arab Emirates and the relevant authorities of the Emirates and financial-investment institutions and leaders of international development the ideology of the project: "Pearl necklace of Emirates" and to show practically unlimited opportunities opened up as a result of the Project implementation for the general socio-economic development of UAE and initiation of international investment business.

Implementation of a strategic infrastructure project "Pearl necklace of Emirates" could become the main programme of socio-economic development of United Arab Emirates for the nearest 20—30 years.

1. Project technologies

Development of a new transportation system envisages the use of “String Transport Unitsky — STU” transportation technologies having the world novelty and international patent protection. Relatively low investment cost of STU technologies makes it possible to create transportation systems of high carrying capacity comparable to that of the underground (up to 70 million pass./year and more) and high running speed (up to 350 km/hour and more). At the same time STU transport systems differ from the traditional transportation systems by their low energy consumption, insufficient labour costs and minimal environmental impact.

STU makes it possible to mobilize hidden resources and to leave behind an automobile, bus, trolley-bus and tram in terms of its safety, economic efficiency and comfort and railway and metro in terms of its speed and investment indices.

Safety is characterized first of all by a 100-fold strength factor of dual-rail micro-, mini- or macroSTU and 10-fold strength factor of single-rail light, medium and heavy monoSTU.

STU is the all-weather operational transport. The travel schedule of STU rolling stock is not subject to the impact of hot weather, rain, hurricane wind, flood, tsunami or earthquake.

Traditional modes of urban public transportation represented mainly by the large-sized heavy and powerful buses, trolley-buses and trams are the major source of noise in the cities whereas noise takes the first place among other hazards in terms of its hazardous impact on human health.

In contrast to other modes of transportation STU does not generate soil vibration with its hazardous impact on people and buildings, or radio interferences and electric magnet pollution of urban environment. It is characterized by lower air pollution with combustion products and by lower electric energy consumption.

STU routes could pass through the built-up areas, squares, parks and other urban lands unsuitable for the construction of tram or trolley-bus lines. If necessary, they could pass through the residential and office buildings, shopping centres and other urban facilities.

In terms of the travel tariffs the cost of STU tickets is at the level of existing urban and international transportation.

STU as the “second level” transport (its track structure is elevated above the ground on the supports) contributes to the considerably reduced land allocations in the course of roads construction.

Construction of STU routes in the city does not require bridges, overpasses, underground or overhead pedestrian crossings and multi-level traffic exchanges which construction costs in the traditional urban roads considerably exceed the cost of the roads themselves.

Circulation of STU is facilitated without intersections and traffic lights that are mostly responsible for excessive consumption of fuel by existing urban transport, air pollution and smog and are the major source of traffic jams and noise in the city streets.

STU structure enables location of communication lines and nodes and various types and means of urban infrastructure.

STU has a number of other advantages over the traditional modes of transportation.

2. Project implementation

Project implementation is a multi-stage process with the total duration of 20—30 years. It could be subdivided into a number of independent and self-sufficient stages that could be implemented within the relatively short time periods of 5—7 years to enable the full-scale operation.

Stage-by-stage construction alternative of a super high-speed dual-track elevated double-rail transportation system of miniSTU route — “Green Arrow”

Super high-speed double-rail elevated miniSTU transportation system — “Green Arrow” is intended for the high-speed passenger traffic and transportation of freights between the Emirates with the travel speed up to 450 km/hour.

Stage 1. Section Abu Dhabi — Ajman — 138 km with the cost of 1,118 million USD.
Stage 2. Section Ajman — Northern Emirates — 110 km with the cost of 891 million USD.
Stage 3. Section Abu Dhabi — Doha (Qatar) — 500 km with the cost of 4,051 million USD.

Construction of a super high-speed “Green Arrow” route will make it possible to provide the transportation access to all coastal areas which will contribute to the accelerated integration of individual Emirates economies into the federal state economy of UAE.

The coastal UAE territories united by a modern transportation infrastructure will open up new opportunities for the construction of hotel and residential complexes to enable the attraction of unlimited volumes of international investments.

With the total annual volume of investments to the UAE economy that in the nearest years will amount to 80—100 billion USD the volume of annual investments to the construction of “Green Arrow” transportation route during 6 years will amount to not more than 1 billion USD which will not exceed 1% of the total volume of investments.

Low operation costs of a new transport system will make it possible to pay back the initial investments during a short period of time and to ensure the high profit to its future owners. With the total volume of investments amounting to 6 billion USD the annual profit gained from the transportation services provided by the "Green Arrow" during the first five years of its operation could reach 0.5 billion USD envisaging the future gradual increase of the annual profit to 1 billion USD. The full-value pay back of investments to the construction of a super high-speed transportation system could be facilitated within 8—10 years.

Stage-by-stage construction alternative of a high-rise double-track high-speed single-rail transportation system of a monoSTU route — "Sky flow"

A high-speed single-rail high-rise monoSTU transportation system — "Sky flow" is intended for the provision of local transportation service of cities and opening up of new developing areas including natural and filled-in islands with the travel speed up to 120 km/hour. It is proposed to integrate "Sky flow" with a super high-speed "Green arrow" transportation system through the combination of their terminals (stations) in one building located in the intersection points of these routes to provide passengers with comfortable exchange services.

A monoSTU "Sky flow" transportation system will be developed on a stage-by-stage basis as the new areas are developed. First of all it is expected that its intensive construction could be facilitated within the already-developed territories that at the present time are in need of the development of transportation infrastructure.

The following projects could be considered as the first stages of a "Sky flow" development:

Project 1. Abu Dhabi STU "Sky flow" — 136 km with the cost of 693.6 million USD.
Project 2. Dubai STU "Sky flow" — 126 km with the cost of 642.6 million USD.

Development plan of a monoSTU "Sky flow" route should take into account the need in the construction of high-rise buildings-stations with the height of about 150 m and the useful floor area of about 40,000 sq. m each. These newly-built floor areas could be used for the distribution of hotels, offices and housing.

In the course of the development of new areas these buildings-stations of a monoSTU "Sky flow" transportation system will act as the city-generating dominants around which the new built-up neighbourhoods will be formed.

A monoSTU "Sky flow" transportation system used as a leader in the course of the development of new territories will contribute to the integration of newly-developed areas into the general UAE infrastructure and in this case it is envisaged that at the first stages it could be developed locally in separate territories and in the future it could be linked with a proposed super high-speed "Green arrow" route.

“Sky flow” being a highly environmentally friendly, low-cost and comfortable transportation system is free of the development limitations typical to the traditional modes of transportation. It is possible to assume that as a result of its active use to develop new coastal areas and solve the transportation problems of already built-up cities the total length of the transportation system could reach 1,000—1,500 km within 10—15 years including construction of 650—820 buildings-stations with the total useful floor area of 26—32 million sq. m. It is necessary to note that these buildings-stations as well as the new neighbourhoods built within the walking access zone will be integrated into the general transportation system of UAE.

The total cost of the future monoSTU transportation system could amount to 5—8 billion USD. Investment efficiency of the “Sky flow” project is very high which will attract additional investments to the development of new territories of UAE.

3. Project investments

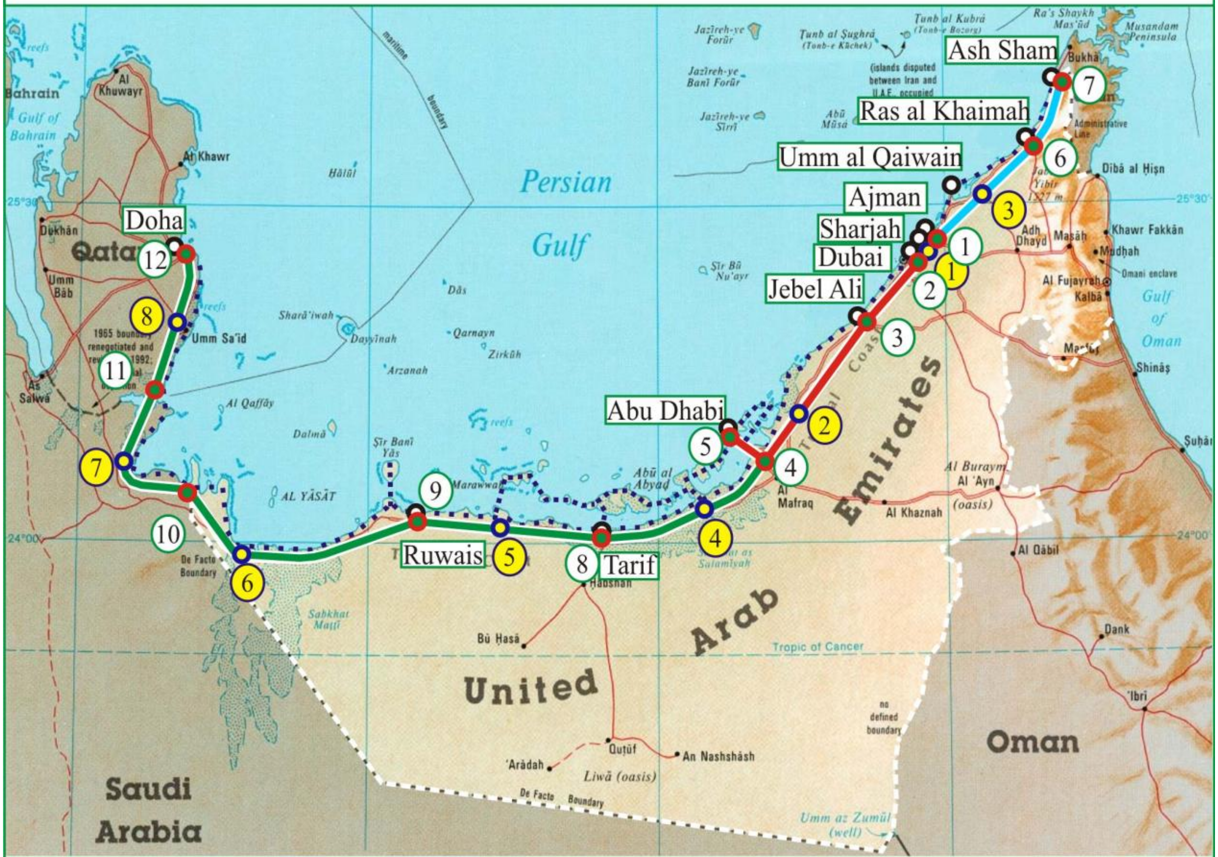
The key technical and investment indices of the "Pearl necklace of Emirates" project are given in Table.

Name of indices	Measure of indices
Elevated super high-speed miniSTU transportation system "Green arrow"	
General data	
Total length, km	748
Number of terminals (stations), units	20
Maximal speed, km/hour	450
Average speed, km/hour	360
Carrying capacity, million passengers (million tons) per year	121 (31)
Cost of miniSTU	
Specific cost of a track structure, million USD/km	5,5
Total cost of a track structure, million USD	4114
Specific cost of the rolling stock, million USD/km	1,8
Total cost of the rolling stock, million USD	1346
Specific cost of terminals (stations) equipment, million USD/unit	30
Total cost of terminals (stations) equipment, million USD	600
Total cost of miniSTU transportation system, million USD	**6060**
High-rise high-speed monoSTU transportation system "Sky flow"	
General data	
Maximal speed, km/hour	120
Average speed, km/hour	56
Carrying capacity, million passengers (million tons) per year	60 (6)
Cost of monoSTU	
Cost of 1 km of a track structure, million USD	3,1
Cost of the rolling stock per 1 km of the route, million USD	1,5
Cost of equipment of 1 terminal-station, million USD/unit	1,5
Total cost of 1 km of monoSTU, million USD	**5,1**

Appendix 1

Project illustrations

Examples of the implementation of the high-rise buildings-stations of monoSTU — “Sky flow” combined with office, residential or hotel complex.
Buildings-stations of monoSTU — “Sky flow” could be located on the coast, or on the filled-in or natural islands



Examples of miniSTU route — “Green arrow” passing through the natural landscape of United Arab Emirates

Fig. 1. Layout alternative of a strategic STU transportation system in UAE

Legend:

Super high-speed double-track miniSTU transportation system — “Green arrow” (speed up to 450 km/hour):

1st stage of construction — 2nd stage of construction — 3rd stage of construction

High-speed high-rise double-track single-rail monoSTU transportation system — “Sky flow”

Boundary of United Arab Emirates — Cities

15 Terminals of a super high-speed miniSTU route combined with the exchange stations to transfer to monoSTU routes

2 MiniSTU stations

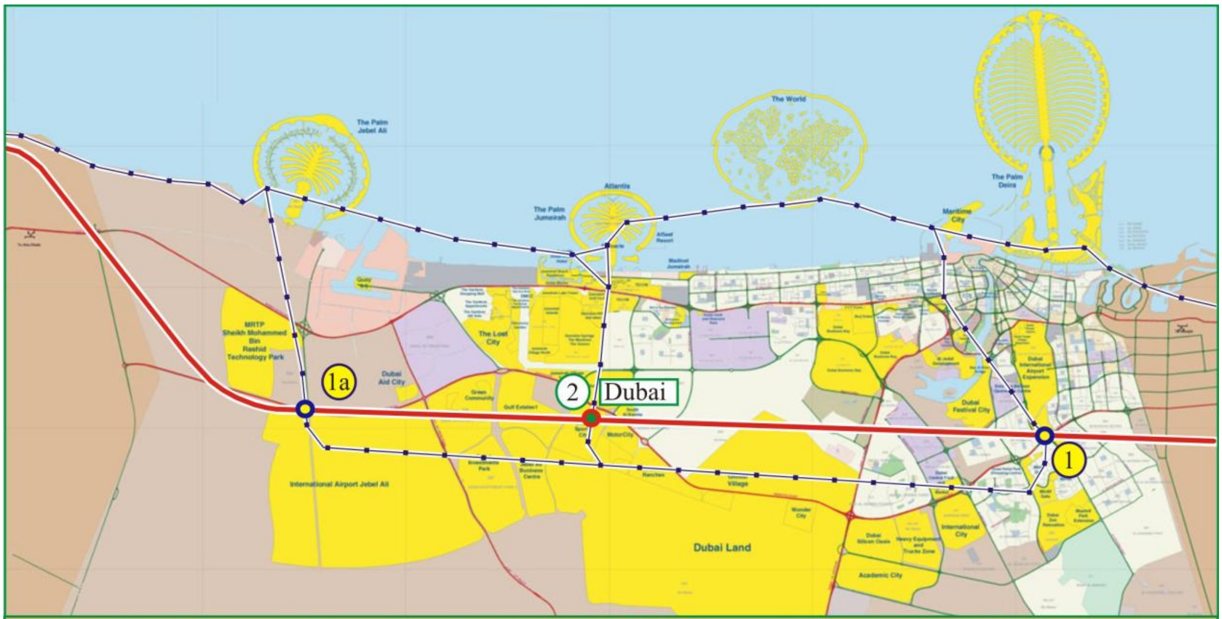


Fig. 2. Layout alternative of a strategic STU transportation system in UAE (within the region of Dubai city)

Legend:

- High-speed high-rise double-track single-rail monoSTU transportation system — “Sky flow” (speed up to 120 km/hour)
- Super high-speed double-track double-rail miniSTU transportation system — “Green arrow” (speed up to 450 km/hour)
- City terminal of miniSTU in Dubai combined with a monoSTU station
- City exchange stations to transfer from monoSTU to miniSTU and from miniSTU to monoSTU

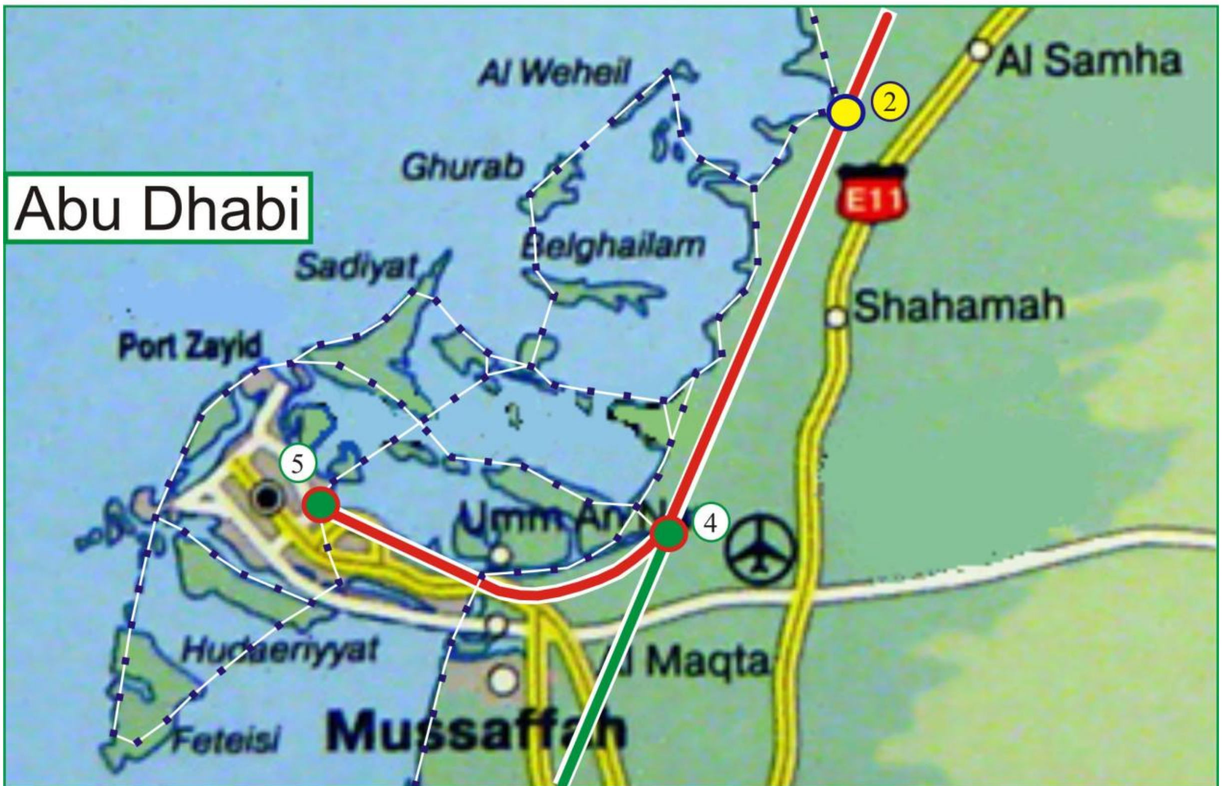


Fig. 3. Layout alternative of a strategic STU transportation system in UAE (within the region of Abu Dhabi city)

Legend:

- High-speed high-rise double-track single-rail monoSTU transportation system — “Sky flow”
- Super high-speed double-track double-rail miniSTU transportation system — “Green arrow”
- 5 Terminals of a super high-speed miniSTU route combined with exchange station to transfer to monoSTU routes
- 2 MiniSTU station

Fig. 4. Single-track section of a double-track super high-speed miniSTU route — "Green arrow" in the city

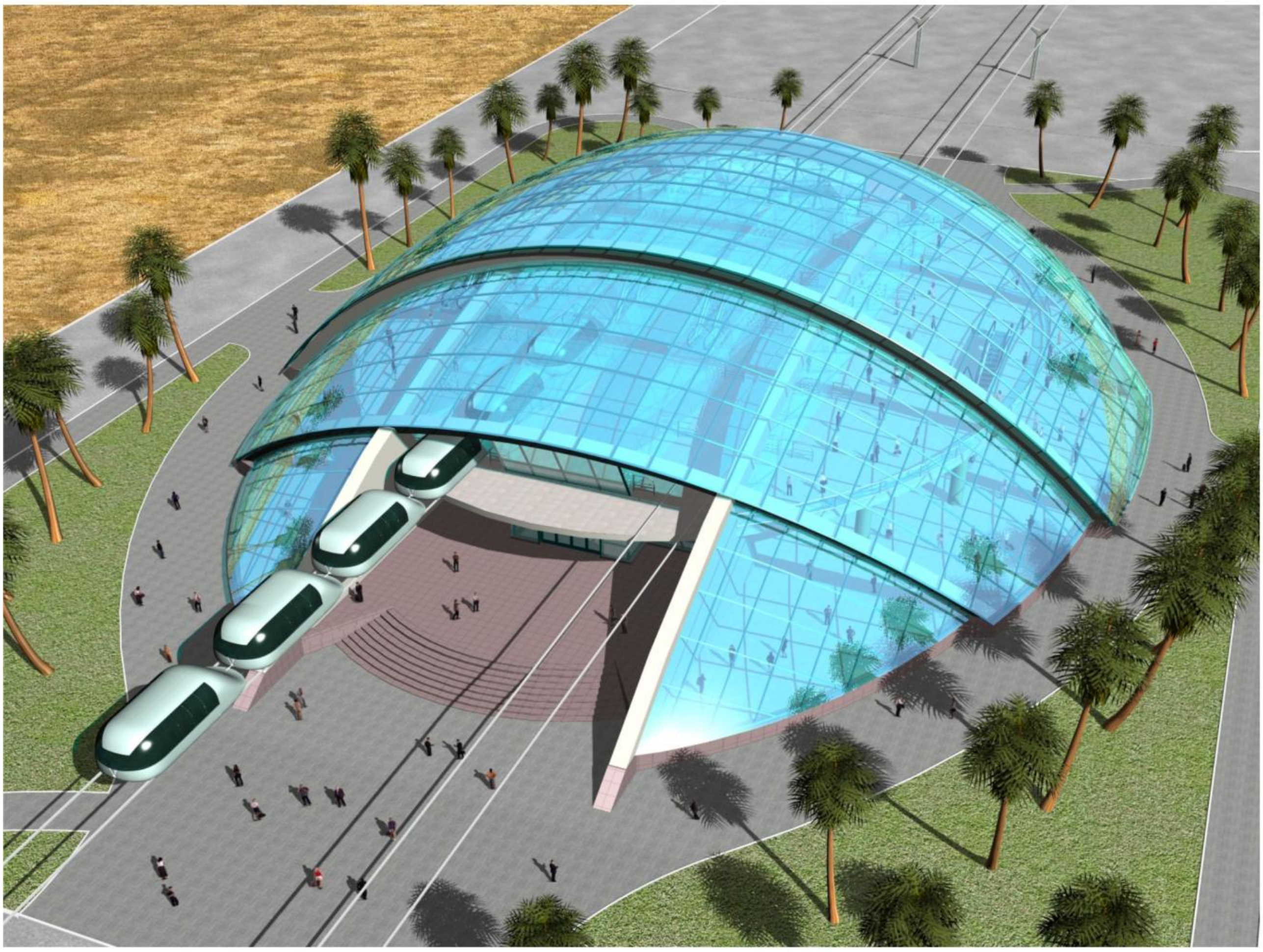


Fig. 5. Station of a super high-speed double-track miniSTU route — "Green arrow"

Fig. 6. Schematic view of a strategic STU transportation system in UAE (within the region of Dubai city)

Legend:

1. High-speed high-rise double-track single-rail monoSTU transportation system — ”Sky flow” (speed up to 120 km/hour)
2. Super high-speed double-track double-rail miniSTU transportation system — ”Green arrow” (speed up to 450 km/hour)
3. City exchange terminal to transfer from monoSTU to miniSTU and from miniSTU to monoSTU
4. Exchange stations on monoSTU routes

Fig. 7. High-rise double-track monoSTU route — ”Sky flow” with high-rise buildings-stations on the coast

Fig. 8. High-rise building-station of monoSTU — "Sky flow" in the city

Fig. 9. Layout alternative of a section of a double-track high-rise monoSTU route — "Sky flow" in the city centre of Sharjah

Fig. 10. Layout alternative of a section of a double-track high-rise monoSTU route — ”Sky flow” in the city centre of Sharjah

Fig. 11. Conceptual architectural solutions of high-rise buildings-stations of a high-rise monoSTU route — "Sky flow"

Appendix 2

1. Definition of STU

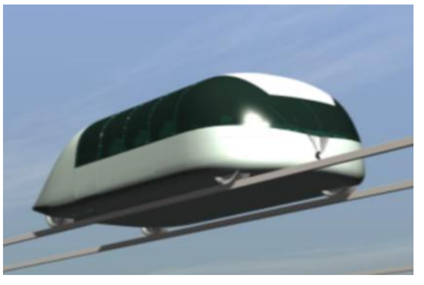
String Transport Unitsky (STU) is the newest transportation system of the “second level” having the worldwide novelty and international patent protection. It is designed as an original string-rail track structure and a special rolling stock consisting of single self-propelled wheeled-rail vehicles (unibuses).

STU is represented by two principally different transportation systems.

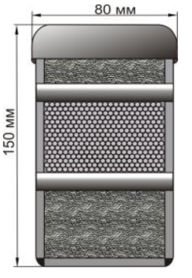
1.1. STU Light Rail Transportation System

Its track structure is designed as two string-rails stretched with the total stress of 300—500 tons between the anchor supports located at a distance of 3—5 km between each other and based on the intermediate supporting legs having the spans of 20—50 m. The rolling stock consists of single self-propelled rail cars moving at the top of the rail-strings on the steel wheels with the speed up to 500 km/hour.

STU Light Rail route in a city



High-speed unibus

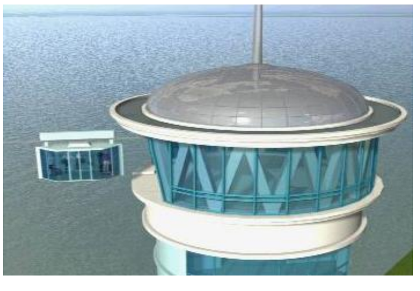


String-rail

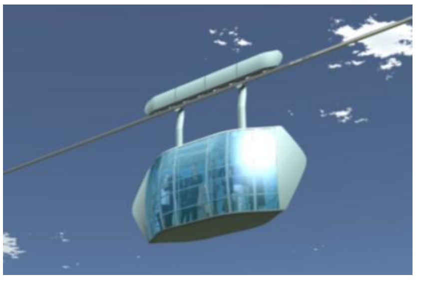
1.2. STU Monorail Transportation System

Its track structure is designed as one string-rail stretched with a stress of 75—150 tons between two anchor supports (buildings) without intermediate supporting legs. Supports could be installed at the distances ranging from 100 to 3,000 m between them.

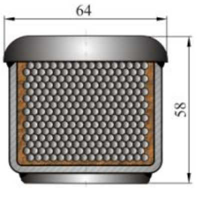
The rolling stock includes single self-propelled rail cars hanged on the steel wheels below a string-rail that are moving with a speed up to 150 km/hour.



Building-station of STU Monorail



Mono-unibus



String-monorail

Note.
1. Anchor supports (buildings) of a track structure located one after another in the necessary direction make it possible to build STU routes of unlimited length provided with necessary turns. Changes in the track direction are made on the anchor supports also suitable for the location of passenger stations and freight terminals.
2. Self-propelled rail cars (STU unibuses) could be used as passenger, freight and universal dual-mode (passenger-freight) vehicles of various carrying capacity and comfort level and they could have different operational speed regimes.

2. Key novelty characteristics of STU

2.1. Design novelty of STU

It refers to the original design of a string-rail track structure which makes it possible to create a practically ideally smooth track without a railway road bed with a sleeper grid and a gravel prism (ground alternative) or a rigid load-bearing beam installed on the supports (elevated alternative) that is obligatory in all traditional modes of rail transport.

2.2. Engineering novelty of STU

It refers to the use of the light wheeled vehicles that do not require complicated spring and amortization devices and considerable stabilization masses to absorb the shocks caused by the track unevenness which is typical for the traditional rail transport. Light STU vehicles are provided with a derailment system to make them stable on a super-smooth string-rail track even at the travel speeds that are considered super-high for the ground transport. In terms of their rigidity, evenness, strength and durability the STU string-rail span structures meet the standard requirements imposed on the elevated monorail roads, high-speed railways and trains on a magnet suspension.

2.3. Organizational novelty of STU

It is associated with a refusal of a traditional echelon vehicles circulating according to a strict schedule which became possible as a result of the low energy consumption of the light STU vehicles which creates a real possibility for each vehicle to operate as a self-propelled vehicle. As a result the total carrying capacity of STU routes is retained or even increased as compared with the traditional modes of transportation with long trains of cars and powerful locomotives. The use of the modern systems of traffic control makes it possible to eliminate the manual operation of STU vehicles and fully transfer to the operation according to the principle of a “horizontal lift” when the choice of the trip destinations and origins is made by passengers themselves. The speed regime of vehicles, provided that the design running parameters and safety requirements were met, is controlled by the automatically operated central post of STU transportation system.

Note.
Availability of a fully original transportation technology opens up a real possibility to refuse the outdated standards and rules applied for the development and operation of traditional transportation systems that fail to cope with the modern requirements and hinder the transportation infrastructure improvement. Also conditions are created for the successful application of all advanced scientific and technical achievements in the field of transportation and allied sciences and technologies.

3. Key STU advantages

The key advantages of STU over the traditional modes of transportation are the result of the innovative technologies and engineering solutions applied to its design. They could be subdivided into the following directions.

3.1. Reduced material-consumption in the course of construction

Availability of a super-smooth string-rail track to reach the high travel speeds eliminates the need in the complicated spring and amortization devices and artificial increase in the weight of vehicles to ensure their required stability.

The use of an original string-rail track structure of STU eliminates the need in the traditional material- and cost-consuming earth embankments, road beds or longitudinal load-bearing beams on the supports.

Refusal of the echelon circulation of vehicles opens up additional opportunities to reduce the weight of a string-rail track with the necessary smoothness and rigidity of a string-rail track being preserved. No need in the accumulation of passengers to load the trains makes it possible to considerably reduce the area of terminals and stations and to maintain the high carrying capacity and a high level of comfort.

3.2. Increased service life of a track structure and the rolling stock

Cardinal reduction in the shock loads on a super-smooth jointless string-rail track contributes to a considerable increase in the service life of a string-rail.

The lack of a complicated suspension considerably simplifies the design of STU vehicles and increases their operation time.

Automatic control of STU vehicles makes them operational within the limits of the recommended loads which in the absence of collisions and other ordinary accidents considerably increases their service life.

3.3. Reduced energy consumption in the course of operation

A super-smooth string-rail STU track enables to considerably reduce the energy consumption to overcome the rolling friction of steel wheels.

Acceleration of the light highly aerodynamic STU rail cars to reach the high cruising speeds requires considerably lower energy costs per 1 unit of the transportation service.

The absence of the echelon circulation of vehicles in accordance with a strict schedule makes it possible to enable more efficient operation of the rolling stock, to considerably increase the efficiency of vehicles and to reduce the share of empty running which also results in the considerable reduction in the energy consumption per 1 unit of transportation service.

4. Investment advantages of STU

The main advantages of STU attributed to its major design and technological novelty characteristics create a foundation for the identification of its investment advantages that, in their turn, are the subject of consideration in the course of the decision-making to promote the application of STU as a basic modern transportation technology to address the most of the transportation problems.

4.1. Consumer qualities

High accessibility of transportation services (no barriers for the construction of STU routes), all-weather operation and high stability to the extreme natural phenomena, minimal waiting time (vehicles coming on call rather than according to a schedule), high comfort of travel along the super-smooth string-rail track at higher speeds and without unnecessary stops and, finally, the low net cost of transportation services makes it much easier for STU to gain a large share in the market of transportation services.

4.2. Investment cost

Lower material consumption of a string-rail track structure and the rolling stock, a simplified design of vehicles and reduced area of STU stations considerably reduce investment costs for the construction of STU routes as compared with the traditional transportation systems.

4.3. Operation costs

Low level of energy consumption and maintenance costs for a track structure and servicing personnel to operate a fully-automated transportation system with a higher durability of its routes contribute to a considerable reduction in the net cost of transportation services of STU as compared with that in the traditional modes of transportation which, in its turn, considerably reduces the payback period of the transportation projects implying the use of STU technologies.

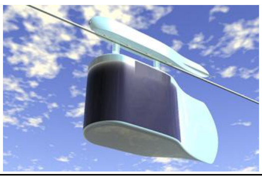
4.4. Environmental impact

No need in the long stripes of land and the large-scale earth works to lay down a road bed, no need in the demolition of urban built-up areas, a possibility of laying STU routes in a rugged terrain or through a forest, low energy consumption for a power drive, minimal noise and other environmental impacts create the necessary conditions for the reduction of ecological costs to integrate STU technologies in any transportation project.

Appendix 3

Key technical and cost data of various types of STU for construction in Gulf Countries

(for long routes in desert with the length of more than 10 km built beyond the city built-up environment*)

Types of STU	Key technical characteristics of a dual mode (passenger/freight) STU (for a double-track route)	Cost of a double-track STU (million USD/km) depending on the speed regimes used for the system operation				
		STU component	up to 100 km/hour	up to 200 km/hour	up to 350 km/hour	up to 500 km/hour
MicroSTU 	Width of a gauge, m 1.5 Capacity of a module: • number of passengers up to 6 • freights, ton up to 1 Volume of transportation: • thous. pass./24 hours up to 50 • thous. ton/24 hours up to 10	Track structure Infrastructure Rolling stock **Total:**	1.4—1.6 0.7—0.9 0.4—0.6 **2.5—3.1**	1.9—2.5 1.5—1.8 1.1—1.5 **4.5—5.8**	2.6—3.1 2.2—2.7 1.9—2.2 **6.7—8.0**	3.2—3.8 2.9—3.5 2.5—3.0 **8.6—10.3**
MiniSTU 	Width of a gauge, m 2.0 Capacity of a module: • number of passengers 7—20 • freights, ton 2—3 Volume of transportation: • thous. pass./24 hours up to 200 • thous. ton/24 hours up to 20	Track structure Infrastructure Rolling stock **Total:**	2.4—2.7 1.2—1.5 0.9—1.2 **4.5—5.4**	3.5—3.9 2.8—3.1 1.6—2.1 **7.9—9.1**	4.3—4.9 3.6—4.2 2.5—3.1 **10.4—12.2**	5.1—5.7 4.4—4.9 3.2—3.7 **12.7—14.3**
MacroSTU 	Width of a gauge, m 2.5 Capacity of a module: • number of passengers 21—60 • freights, ton 4—6 Volume of transportation: • thous. pass./24 hours up to 500 • thous. ton/24 hours up to 50	Track structure Infrastructure Rolling stock **Total:**	3.5—3.9 1.7—2.1 1.5—1.8 **6.7—7.8**	4.5—5.2 2.7—3.5 2.5—2.9 **9.7—11.6**	6.5—7.5 4.5—5.5 3.4—4.0 **14.4—17.0**	7.7—8.2 5.6—6.1 4.2—4.8 **17.5—19.1**
MegaSTU 	Width of a gauge, m 1.5; 2.0; 2.5 Capacity of a train: • number of passengers up to 500 • freights, ton up to 500 Volume of transportation: • thous. pass./24 hours up to 500 • thous. ton/24 hours up to 200	Track structure Infrastructure Rolling stock **Total:**	2.4—3.0 1.2—1.8 1.5—2.1 **5.1—6.9**	3.5—4.1 2.6—3.4 2.8—3.6 **8.9—11.1**	— — — **—**	— — — **—**
Light monoSTU 	Length of a span, m up to 2,000 Capacity of a module: • number of passengers up to 10 • freights, ton up to 1 Volume of transportation: • thous. pass./24 hours up to 100 • thous. ton/24 hours up to 10	Track structure Infrastructure Rolling stock **Total:**	0.9—1.2 1.2—1.8 0.3—0.6 **2.4—3.6**	1.4—1.7 2.0—2.5 0.8—1.2 **4.2—5.4**	— — — **—**	— — — **—**
Medium-size monoSTU 	Length of a span, m up to 2,500 Capacity of a module: • number of passengers 11—20 • freights, ton up to 2 Volume of transportation: • thous. pass./24 hours up to 150 • thous. ton/24 hours up to 15	Track structure Infrastructure Rolling stock **Total:**	1.5—2.4 1.5—2.1 0.6—1.2 **3.6—5.7**	2.6—3.5 2.2—2.8 1.4—2.1 **6.2—8.4**	— — — **—**	— — — **—**
Heavy monoSTU 	Length of a span, m up to 3,000 Capacity of a module: • number of passengers 21—50 • freights, ton up to 5 Volume of transportation: • thous. pass./24 hours up to 300 • thous. ton/24 hours up to 30	Track structure Infrastructure Rolling stock **Total:**	2.7—3.9 1.8—3.0 1.2—2.4 **5.7—9.3**	4.1—5.3 3.2—4.5 2.6—3.8 **9.9—13.6**	— — — **—**	— — — **—**

* under conditions of cross-country and urban built-up environment the cost of STU will be by 30—50% higher