Anatoly Yunitsky

Almanac about STS from 1997 to 2000

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String Transport System

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Moscow, 2000

Investment project «String transport systems»

Investment project «String transport systems» (STS) is the principally new high-speed transport system. Rail-strings are the basis of the STS, in which strings are stretched to the total strain of 100...500 tons and rigidly secured to anchored supports placed with the step of 0.5...5 km. The transport line, having two rails, is upheld in spans by intermediate supports with the step of 20...100 m, depending upon the relief. The STS route structure requires little materials. For example, the consumption of materials for the one-way route will be within the limits of 50...100 kg/m and this is equal to the quantity of material for a one rail of the common railway.

The consumption of the reinforced concrete is also low: 0.2...0.5 m^3/m. The STS is not critical to the terrain relief as since the height of supports can amount to 50...100 m, that allows to smooth the relief of the crossed area. Routs can pass through the area of mountains at an angle of 30^o and more to the skyline, and the length of spans without supports, for example over the canyon, can amount to 5 km.

Vehicles will easily achieve the speed of 300...500 km/h due to the high directness of the rail-string (it has no deflections and joints along its length) and its dynamic rigidity, that is ensured by both constructional decisions and technological techniques. Aerodynamics of vehicles has been analyzed and the body of the vehicle was designed having unique aerodynamic properties (there is no analogue to it in other kinds of high-speed transports) - the aerodynamic resistance factor C_x=0.075 was obtained during the blowing through in the wind tunnel. For this reason the electric motor with the output of 100 kW will provide the speed of 300...350 km/h for ten-seat vehicle; the output of 200 kW - 400 km/h; of 300 kW - 500 km/h.

The dynamics of route and vehicle vibrations was theoretically researched in the velocity range of 100...1000 km/h. Solutions were discovered, ensuring the movement along the route without resonance with relative amplitudes of its oscillation within 1/1,000...1/10,000. Thus, the STS route, requiring little materials, nevertheless will have higher operating characteristics than contemporary road-transport and railway bridges and overpasses that are characterized by big quantity of materials for their erection.

On sea areas the STS route can pass over at the height of 10...50 m above sea-level (the sea depth up to 50 m) or can be placed in the pipe 2.5...3 m in diameter with zero floating and situated at the depth of 10...100 m.

STS routes will be less expensive then common and high-speed railways, highways, one-rail roads and magnetic suspension trains due to their requiring of less materials, technological production and assembling, the use of traditional materials in structures of routes and supports. One kilometer of a double-route track in serial production will cost 1...2 million US$ - on land areas; 2...3 million US$ - on sea areas (the route is situated above sea-level) and 5...10 million US$ - the route is situated in the pipe.

The STS route will require small area of vacated land (less then 0.1 hectare/km, the same as for a walking path or a trail), at the same time it does not need embankments, tunnels, bridges or conduits, there is no need in felling of trees and demolition of buildings.

The cost for transportation of a passenger over land area of the STS route at a distance of 1,000 km will be: 20...25 US$ (at 20,000 passengers during 24 hours), 10...15 US$ (at 50,000 passengers during 24 hours), 5...10 US$ (at 100,000 passengers during 24 hours).

It follows from produced advantages of the STS that under other equal conditions (equal speed, carrying capacity, terrain relief, etc.), it will be the cheapest and ecologically safe transport from all existing and future (electric-cars, shield-flights, etc.) kinds of transport.

It is necessary to continue scientific-research and design works and to erect the pilot route with the aim to fulfill the STS project.

Needed volume of investments depends upon the range of scientific-research and design works, and the length of the pilot route (model part of the route) - from 0.5 to 10 million US$.

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Rec-503

Project of UN Centre for Human Settlements (Habitat) No FS-RUS-98-S01 “Sustainable Development of Human Settlements and Improvement of their Communication Infrastructure through the Use of a String Transport System”

Principally new

HIGH-SPEED STRING TRANSPORT OF YUNITSKY (STS)

passed the technical-science examination, patented in a number of countries, is offered.
It is a special electric car, wheels of which move along special current-carrying rail-strings.

Short description

String elements of the structure are tightened to the summary tensile stress of 200…500 t and toughly fixed on the anchor supports installed at 0,5…5 km intervals. Moreover, the intermediate piers located (depending on the ground features) at 20…100 m intervals support the route structure consisting of two rails.

The STS is characterized by little consumption of materials and accordingly low cost. Thus, for example, one-way route requires 75…100 kg/m metal consumption. And just a rail of modern railways requires the same material consumption.

The STS with its rail-string construction characterized by a high smoothness (rail-string has no drips or junction on its whole length) and dynamic hardness, which is provided both by constructive decisions and technological methods, makes it possible to gain the speeds 300…400 km/h and over.

The electric engine capacity of 100 kW makes it possible for a ten-passenger transport module to reach a speed of 300…350 km/h, 200 kW - 400 km/h, 300 kW - 500 km/h.

The STS is characterized by a high throughput capacity: about 500 thousand passengers a day and 1000 thousand freights a day.

The main advantages of a world-wide using the STS

1. Environment of the planet

1.1. Consumption of non-completed energy resources (oil, coal, gas), non-ore materials, ferrous and non-ferrous metals will decrease, as:
- the route structure and supports of the STS characterized by little material consumption;
- building of the route does not require embankments, depressions, viaducts, bridges and other constructions, which requires considerable amount of resources.

1.2. Pollution of the environment will decrease at the expense of:
- using the most environmentally-friendly type of energy – electrical;
- little specific consumption of energy resources (as compared with an automobile it is 5...6 times less);
- giving quarter development of vulnerable environmental systems (tundra, eternal frozen area, jungle, swampy area and others);
- possibility of the using alternative environmentally-friendly types of energy (wind, sun, etc.).

1.3. Fertile agricultural land requirements will decrease, as building of the route requires little land using (about 0,1 hectare/km, a feet-path requires the same land using), and also it is possible to make routes without building of tunnel, cutting down of forest and drift of buildings.

2. Economics

2.1. Requirements of financial resources for the long-term building will decrease at the expense of:
- low capital intensity of the STS (the route of the STS with infrastructure costs 1…2 million USD/km, but high-speed railways – 10…15 million USD/km);
- short payback period (3…5 years).

2.2. Cost price of the transport service will decrease (10…15 USD/1000 pass · km and 5…10 USD/1000tone · km), its accessibility and attraction for all people will increase with high quality of service (speed, comfort, safety).

2.3. Integration and cooperation in domestic and world economy will be accelerated and intensify.

2.4. Cost price of the route almost does not depend on the ground features, so through the use of the STS hard-to-reach places (desert, eternal frozen area, jungle, swampy area, taiga, tundra, mountains, and etc.) will be developed.

2.5. It will be not necessary to build separate electric power transmission lines and communication circuits including fiber optic, as they is easily matched with the routes of the STS.

2.6. It will be possible to make a global high-speed infrastructure of the STS in short period of time (10…15 years), and it make multiplier effect on the other branches of industry.

3. Social environment

3.1. Communication will intensify.

3.2. It will be possible:
- to have a far work-station not moving from the usual residence;
- to make sustainable habitation zones within pedestrian approach from routes of the STS;
- to build linear cities opened into the nature along routes of the STS;
- to do special medical aid;
- not to interfere in traditional habits of people in the transport service sphere (e.g. possibility of moving at a long distance using personal car at a normal price).

3.3. Moving will be more individual through the use of the STS' transport module as a personal transport at more convenient price than car.

3.4. The amount of crashes in the other types of transport will decrease at the expense of transferring part of passengers and freights flows to the STS (every year 900 thousand people in the world die at crashes on roads, and more then 5 million people become cripples).

3.5. Transport-energy and communication system will be more protective from disasters (floods, landslides, earth-quakes, tsunami) and terrorist action thanks to interactivity of the STS' control elements.

3.6. Transport will become:
- for any weather (it does not depend on fog, mist, snow, ice-crusted ground, wind, sand storm and other unfavorable weather condition);
- universal, as it will be used both on land and sea areas.

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The STS will make the perceptible contribution to the formation of the united correlative and more safety world.

The STS with its essence and scale might be compare with the Internet.

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THE INNOVATION PROGRAM
"YUNITSKY'S STRING TRANSPORT SYSTEM"(STS)

The STS is principally new communication system, which is two current-carrying rail-strings (isolated from each other and from supports), on which four-wheeled high-speed electric cars move at the height of 10…30 m and over. Due to the high directness of the rail-string and its dynamic rigidity, vehicles of the STS will achieve the speed 500…600 km/h in the long term (optimal speed – 250…350 km/h). The distinctive (from other high-speed systems) features of the STS are little consumption of materials required for building (for a two-way route: metal constructions – 200…300 kg/m, reinforced concrete – 0,2…0,3 m^3/m); low land requirements (0,01…0,02 hectare/km); low-level specific energy consumption for a high speed moving (0,02…0,04 kW·h/t·km and 0,025…0,05 kW·h/t·km); low cost price of passenger trips (10…15 USD/1000 pass·km) and freight trips 3…10 (USD/1000 pass·km); low-level cost (two-way route with infrastructure will cost 1,0…1,5 million USD/km – on land areas, 1,5…2,5 million USD/km – on mountainous areas, 1,5…2,5 million USD/km – on shelf, if a route is situated above the sea-level, and 5…8 million USD/km – if a route is situated in the pipe). Throughput capacity of a two-way route is 500 thousand passengers a day. The STS is easily matched with electric power transmission lines, wind and solar power station, communication circuits including fiber optic. The STS will make new types of settlements – linear cities, also in hard-to-reach for settlements places (mountains, shelf of ocean, jungle, and desert). Routes can be exploited with 100…200% efficiency (as a ratio of profit to costs of trips). The STS can be built as technological and specialized routes (waste exportation from megalopolises, ore supply from opencast to a preparation plant, coal transmission to a power station, supply of high-quality natural drinking water in big amount and food ice to world regions with dense population a 5…10 km way off, oil transportation from an oilfield to an oil-refining plant and etc.), and also as freight and passenger (including only tourists routes) and combined freight-passenger routes.

Few variants of the STS' Project implements

	Name of a project or STS' route	Cost, million USD	Fulfillment's period, years	Recoupment period, years
1.	Entertaining complex with slow-speed STS 1 km long (in recreation park, in Disneyland, as a bridge, and etc.)	2	2	1
2.	Island-beach connected with a bank by slow-speed STS (0,5 km)	6	2	1
3.	Test ground of the STS for program's industry tests (5 km)*	25*	3*	2
4.	"Sochi – Adler – Engelmanovy Polyany" (92 km)	150	4,5	4
5.	"St-Petersburg - Moscow – Sochi" (2300 km)	3000	5	4
6.	"London (Paris) – Moscow" (3200 km)	5000	5	3,5
7.	Circular (around Black Sea) route "Sochi – Sukhumi – Istanbul – Odessa – Crimea – Novorossysk – Sochi" (3300 km)	6000	6	4,5
8.	Circular (around Baltic Sea) route "Stockholm – Helsinki - St-Petersburg - Tallinn – Kalinningrad – Rostock – Copenhagen – Stockholm" (5400 km)	9500	6	5
9.	Freight route for big-amount supply of Baikal deep water and food ice to Europe "the Baikal – Moscow - London (Paris) – Lisbon" (9900 km)	15500	5	1
10.	"London (Paris) – Moscow - the Baikal – Ulan-Bator – Peking – Seoul – Tokyo" (12500 km)	23000	7	3
11.	"London (Paris) – Moscow - the Baikal – Yakutsk – Bering Strait - Calgary – New-York" (21000 km)	40500	10	5

* is included in all routes of the STS

Note: every of these STS' routes consists of shorter self-compensated routes, such as "St-Petersburg - Moscow", "Moscow – Minsk" and etc.

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Director of UN Centre (Habitat) Project № FS-RUS-98-S01 "Sustainable Development of Human Settlements and Improvement of their Communication Infrastructure through the Use of a String Transport System"

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CENTER OF INNOVATIONS
MALAYSIA

“STRING TRANSPORT SYSTEM"

Yunitsky’s String Transport System (STS) is a principally new communication system, which is two special current-carrying rail-strings (isolated from each other and from supports), on which four-wheeled high-speed electric cars move at the height of 10…30 m and over. Due to the high directness of the rail-string and its dynamic rigidity, vehicles will easily achieve the speed of 250…350 km/h (in the long term up to 500…600 km/h).

The distinctive features from other high-speed systems of the STS are:

- little consumption of materials required for building (for a two-way route: metal constructions approx. 200…300 kg/m, reinforced concrete – 0.2…0.3 m^3/m);
- small land requirements (0.01…0.02 hectare/km);
- low-level specific energy expenditure for a high-speed moving (0.02…0.04 kW*h/t*km for passenger trips and 0.025…0.05 kW*h/t*km for freight trips);
- low cost price based on European unit cost per passenger trip (10 to 15 USD/1000pass*km) and freight trip (3 to 10 USD/1000 t*km);
- low-level construction cost based on European unit cost (one kilometer of a two-way route with an infrastructure will cost 1 to 1,5 million USD – on plane, 2 to 3 million USD – on mountains areas and above the sea-level (on shelf), 5 to 10 million USD for an underwater or tunnel route.

The standard capacity of a two-way route could be designed to transport 500 000 passengers and 1 million tonnes of freight per day. In addition to this use the STS could easily be used and utilized for electric power transmission lines, wind and solar power stations, communication circuits including fiber optic lines etc. The STS will make new types of settlements, like linear cities, also in places, which are hard-to-reach for a settlement (mountains, shelf of ocean, jungle, desert) possible and viable. The STS can also be built as technological and specialized route for waste exportation from megalopolises, ore supply from opencast to a preparation plant, coal transportation to heat power plants and transportation of oil from an oilfield to an oil-refining plant, etc., and also as freight, passenger (including only tourists routes) and combined freight-passenger routes and system.

The essence of the technical design of the STS is a steel wheel moving along the special rail which was studied with a great degree of detail in the theory and which utilizes all the practical experience from high-speed railway roads in Japan, France, Spain and other countries and also the results from test grounds at running speeds 300…500 km/h. However, the distinctive feature of the STS is associated with its more optimal technical - ecological and economic indices.

Thus, for example, the string road structure located on the thin graceful piers makes it unnecessary to use embankments, depressions, bridges and viaducts, and makes it possible to make routes without demolition of buildings and cutting down of forest. This results in the reduced construction costs by 3 to 5 times and in the minimization of the negative environmental impact in the course of construction of a high-speed transportation infrastructure.

STS structure is in fact a variation of an aerial bridge with a very small deflection (a few centimeters) located inside a hollow rail, which is stiffening girder. The rich technical and industrial experience gained in the construction of bridges has been included into the design of STS.

These and other experience and know-how as well complemented by worldwide accepted engineering experience will be used by the implementation of STS. However, the development work requires an optimization of construction, technological and operation indices which will be conducted and carried out in both the laboratory stand and polygon testing site. Each individual element of the STS like piers, infrastructure, energy supply and control system including the various types of modules will be tested separately, than in section and as a system, thus creating new quality, technical and engineering standards.

Taking into account specific features of the STS which distinguish it from other transportation systems a detailed mathematics model was applied for a transportation module moving along the string road with the speeds ranging from 100 to 500 km/h and more using various structural and technological characteristics of the system. Specialist representing the mathematical schools of Russia, Byelorussia and Ukraine were involved in the work and they would be joined by local specialist thus receiving a rare opportunity for a cooperation.

Quite all systems consists of transportation module which is the main source of environmental pollution as it is responsible for either noise pollution or land vibration, pollution or emissions of the fuel combustion products. That is why the STS module was thoroughly tested in a aeronautical wind tunnel; the tests produced unique results in terms of the module configuration having till today no analogues in the world practice: the lift-drug ratio of the module was reduced to $C_x = 0{,}075$ against the ordinary car which had the lift-drug ratio amounting to $C_x = 0{,}2…0{,}3$.

These experimental data make it possible to forecast that the STS will become the most environmentally pure, cheap and least energy wasteful type of the ground high-speed transportation system. For example, to gain the speed of 350 km/h for 10-seat module it is enough for its electric motor to have the power as small as 80 kWt. Therefore, the STS module will be able to gain the transformation speeds close to those of an aircraft while having a motor similar to that of a middle-class car; at the same time its negative environmental impact will be at the level of an urban trolley-bus.

All the necessary know-how and system designs for an implementation of rail-string and support (maintaining, braking, anchor) construction, route structure, top construction of the supports, anchor attachments construction, basic elements of infrastructure, transport modules (passenger, freight and freight-passenger) in different geographic and climatic conditions are available. At this moment this information is to be seen and considered as know-how representing a significant financial value to be up dated by respected international experts.

The current know how is in a need for a verification and possibly a modification in order to assure the most efficient, economical and ecological use of local Malaysian geographic, climatic, manufacturing, scientific and social-economic pecularities and resources. This process could be completed within 12 to 18 month from the date of begin of the practical cooperation and it is certainly a subject of availability of information needed.

Main Stages of Scientific Research and Development to be carried out in Malaysia are:

1. Designing and stand building for full-scale tests of wheel motion on a rail-string and full-scale tests of a rail-string.
2. Designing of experimental samples of freight and passenger transport module.
3. Designing of experimental route.
4. Manufacturing of experimental samples of freight and passenger transport module.
5. Building of the experimental route of the STS to be agreed by all parties involved.
6. Complex of bench tests and tests at the experimental route.
7. Creation of padding nominal workstations throw all stages of Scientific Research and Development.

Other work including lodging of application for patents and licenses, documentation, business and investment planning etc. to be specified and agreed at a later stage.

After experimental-manufacturing and evaluation of test and operation of the STS it would be possible to start designing and building principally new type of high-speed routes not only in Malaysia and South-East Asia but also in other regions. The STS with its great export potential has therefore a significant strategic and political potential. According to data available about 100 billion USD are estimated to be spent for the development and construction of new transport systems within the first quarter of the XXI century by developed countries. Taking in account the need for viable and economical transcontinental high-speed routes, in which any country is interested without any doubt, the value of the niche in the world economy for the STS program as an export article could be estimated in the region of many hundreds of billion USD equivalent.

According to its technical and economic indices available, STS can become leading type of transport in the XXI century. So its influencing on economics and human life on the planet may be not less then railway-road influencing in XIX century and car influencing in XX century. This potential has been recognized by the UN Habitat program which has been supporting the project development till now. Consideration will continue and be completed in due course to accommodate partners from other countries recognizing the values of STS. A series production of STS will become very similar (on scales) to a railway branch, motor industry, aircraft and other transport sectors..

Beside the construction, manufacturing (of modules, solar energy products, control systems etc.) new "workstations" will be made in science, training and teaching as the preparing of new specialists on new specialties is indispensable in this type of work and engagement and significant number of work opportunities in industry, building, service, power engineering, extracting and refining branches and others will be created.

The major STS summarized benefits are:

- the most currently available economical, ecological and efficient transport system in the world for passengers, cargo and modern communications;
- significant commercial value as an export product in both, the construction and design of STS system and subsystems and as a scientific, educational and patent / license attractor;
- provider of a significant number of new local manufacturing and production industries in the composite, IT, energy and other sectors;
- provider of a significant support for already existing and local Malaysian construction, steel and other industries;
- competitive advantage in the field of high technologies, engineering, R&D and transfer of know how at operation level;
- significant political advantage at least within the ASEAN, Asia and Pacific region for reasons which are self explanatory;
- a real potential to include Malaysia into UN Habitat program and establish an intergovernmental (Russia, Byelarus, Malaysia and XYZ) program, project and cooperation;
- to embark on a transport system implementation for a pilot route with symbolic character, like KL-Putrajaya (-KLIA) with a contribution of approx. 10 RYM per inhabitant of Malaysia, to be collected by a special STS to be established fund and deductable from taxes by a special government decree in order to make STS a really national issue identified and initiated by PM and a national and not only a government or party related project…

STS program would be implemented within a joint PD structure to be established as soon as a decission in principle has been reached and which also would be eligible for MSC status.

The current representatives of STS program are:

- Yunitsky Anatoly Eduardowitch (YAE), the Inventor of STS and patent holder, CEO for STS development;
- Dr. Campbell Jan (JC), collaborator of YAE and COO for STS development outside CIS countries;
- Dr. Ristina Majid and Dr. Rahim Said, local partners of JC in KL.

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Few words about myself, Anatoly E. Yunitsky.

I was born in 1949 in Kryuki village, Braginsky district, Gomel region, Republic of Byelarus. Today it is evicted and the most radioactive contaminated area of Byelarus, as it is situated within 10 km from Chernobyl nuclear power station.

In 1966 I finished secondary school in Jezkazgan (Kazakhstan), then I entered Tyumen Industrial Institute in 1967, and graduated Byelarus Polytechnical Institute in 1973.

Communication Engineer. I worked at construction trust (leading engineer), project institute, design bureau (leading designer), scientific-research institute (patent-license department manager).

In 1988 I left state job, then created (and was at the head) Research Center “Stars’ World” (Gomel) for implement of my inventions by the solicitation of the Cosmic Federation of the USSR. Since that I created different organization structure in order to provide my scientific research with finance. So since 1998 I have been the President of Regional public Foundation to assist in the promotion of Linear Transport System (Moscow).

I’m the author of over 80 inventions (certificates of the USSR) and 15 patents given in 8 countries. 22 inventions have been used in machine-building, construction, electronics, and transportation. I’m the author of over 100 scientific and popular-science publication including scientific monograph.

I’m the author of non-rocket cosmos development (since 1986 I’ve been the member of the Cosmic Federation of the USSR) and Yunitsky’s String Transport (STS). In 1994 I applied for the principal scheme of the STS to Geneva, from where it has been patented in over 20 countries of the world.

Key results on the STS was reported and discussed at the Byelarus Congress on theoretical and applied mechanics “Mechanics-95”; at the International practice-science conference “resource- and energy-saving technologies in transport and construction (1995); at the scientific Counsel of industry union “Transtechnics” (1995); at the scientific Counsel of the Ministry of transport and communications of Byelarus” (1996); at the scientific Counsel of Petersburg state communication university (1996); at the experts scientific Counsel attached to President of Byelarus (1997); at the Committees on environment and north areas’ problems of the State Duma of Russia (1997); at the International conference on transport corridor “Paris – Berlin – Warsaw – Minsk – Moscow” (1997); and also at other specialized conferences and organizations.

The model of the STS’ transport module (in scale 1:5) was investigated in the aerodynamic pipe of the central scientific-research institute named after academician Krylov (St-Petersburg, 1996). It was exhibited (as the acting model in scale 1:5) at two Leipzig Fairs (1995) and Hannover industrial Fair (1996), and also at the Achievements exhibition of Science Academy of Byelarus (1995, 1996 and 1997) and at the exhibitions taken place at the State Duma of Russia (1997 and 1998). The STS was awarded by the first-degree diploma at the International fair-exhibition “Innovations-98” and by gold medal at the All-Russian Exhibition Center (1998). Mathematical dynamic model of the STS has been created. Groups of mathematicians from the Byelarus State University, the Petersburg State University of Transport, the Voronezsh polytechnic academy, the Science Academies of Byelarus and Ukraine were attracted for its investigation. Key results of the investigation are in science monograph “String transport systems: on the Earth and in cosmos”.

Since 1998 I’ve provided the STS’ programs with finance. According to experts’ conclusion intangible assets worked out during this period (patents, know-how, engineering and designing and other knowledge) value over 10 billions USD.

In 1998 United Nations supported the STS. And since January 1999 UN Centre for human settlements has financed the project N FS-RUS-98-S01 “Sustainable development Development of Human Settlements and Improvement of their Communication Infrastructure through the Use of a String Transport System”. A.E. Yunitsky was appointed as a Manager of the Project.

I’m a member of Academy of New Thought (Moscow) and Russian Academy (Moscow), and I has been invited to members of New-York Academy of Science.

A.E. Yunitsky

THE INNOVATION PROGRAM
"STRING TRANSPORT IN KOREA"

Yunitsky's String Transport System (STS) is a principally new communication system, which is two current-carrying rail-strings (isolated from each other and from supports), on which four-wheeled high-speed electric cars move at the height of 10-30 m and over. Due to the high directness of the rail-string and its dynamic rigidity, vehicles will easily achieve the speed of 250-350 km/h (in the long term – to 500-600 km/h).

The distinctive (from other high-speed systems) features of the STS are:

- little consumption of materials required for building (for a two-way route: metal constructions – 200-300 kg/m, reinforced concrete – 0.2-0.3 m^3/m);
- little ground using (0.01-0.02 hectare/km);
- low-level specific energy expenditure for a high-speed moving (0.02-0.04 kW*h/tonn*km for passenger trips and 0.025-0.05 kW*h/tonn*km for freight trips);
- low cost price of passenger trips (10-15 USD/1000pass*km) and freight trips (3-10 USD/1000 tonn*km);
- low-level cost (one kilometer of a two-way route with an infrastructure will cost 1-1.5 million USD – on land areas, 2-3 million USD – on mountains areas, if a route is situated above the sea-level (on shelf), and 5-10 million USD – if route is situated in the pipe).

Throughput capacity of a two-way route is 500000 passengers a day. The STS is easily mated with electric power transmission lines, wind and solar power stations, communication circuits including fiber optic. The STS will make new types of settlements – linear cities, also in places, which are hard-to-reach for a settlement (mountains, shelf of ocean, jungle, desert). The STS can be built as technological and specialized routes (waste exportation from megalopolises, ore supply from opencast to a preparation plant, coal transportation from an oilfield to an oil-refining plant, etc.), and also as freight, passenger (including only tourists routes) and combined freight-passenger routes.

The essence of the technical design of the STS is a steel wheel moving along the special rail which was studied with a great degree of detail at the high-speed railway roads in Japan, France, Spain and other countries, and also at the test grounds at running speeds 300-500 km/h. However, the distinctive feature of the STS is associated with its more optimal technical and economic indices. Thus, for example, the string road structure located on the thin graceful piers makes it unnecessary the use of embankments, depressions, bridges and viaducts, and makes it possible to make routes without drift of buildings and cutting down of forest, and therefore results in the reduced construction costs by 3-5 times and minimization of the negative environmental impact in the course of construction of a high-speed transportation infrastructure. Communication STS structure is in fact a variety of an aerial bridge with a very small deflection (a few centimeters) located inside the hollow rail, which is stiffening girder. The rich technical and industrial experience gained in the bridge construction was used to design this STS.

These and other outcomes as well as the world experience will be used to the full scale to implement the STS, however, they require optimization of construction, technological and operation indices to be carried out both through the laboratory stand and polygon testing of the individual elements of the communication structure, piers, infrastructure and transportation modules and through the testing of certain sections of the road as a whole.

Taking into account specific features of the STS which distinguish it from other transportation systems a detailed mathematics model was applied for a transportation module moving along the string road with the speeds ranging from 100 to 500 km/h and more using various structural and technological characteristics of the system. Specialist representing the mathematical schools of Russia, Byelorussia, and Ukraine were involved in the work.

In all systems the transportation module constitutes the main source of environmental pollution as it is responsible for either noise pollution or land vibration pollution or emissions of the fuel combustion products. That is why the STS module was thoroughly tested in the large wind tunnel and the tests produced the unique results in terms of the module configuration which had no analogues in the world practice: the lift-drug ratio of the module was reduced to C_x=0.075 against the ordinary car which had the lift-drug ratio amounting to C_x=0.2…0.3.

These experimental data make it possible to forecast that the STS will become the most environmentally pure, cheap and least energy wasteful type of the ground high-speed transportation as, for example, to gain the speed of 350 km/h for 10-seat module it is enough for its electric motor to have the power as small as 80 kWt. Therefore, the STS module will be able to gain the transformation speeds close to those of an aircraft while having a motor similar to that of a middle-class car and its negative environmental impact will be at the level of the urban trolley-bus.

Rail-string construction, support (maintaining, braking, anchor) construction, route structure, top construction of the supports, anchor attachments construction, basic elements of infrastructure, transport modules (passenger, freight and freight-passenger), the know-how of manufacturing, building and mounting have been designed. Standards (track width, geometrical parameters of the rail-head and wheel's reference part, etc.) have been determined and justified with reference to different geographic and climatic conditions. For this moment this information is as know-hows, which are estimated in 14.8 billion USD by independent experts.

It's necessary to complete and optimize know-hows', designer, technological, operational and other parameters of the STS with reference to geographic, climatic, manufacturing, scientific and social-economic features and capabilities of Korea. It will be realized at the test grounds within 36 months. Common costs will be 24 million USD.

Main Stages of Scientific Research and Development:

1. Designing and stand building for full-scale tests of wheel motion on a rail-string and full-scale tests of a rail-string. The costs are 1.5 million USD. Fulfillment's period is 12 months.
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7. Creation of padding nominal workstations* throw all stages of Scientific Research and Development. The costs are 3 million USD. Fulfillment's period is 36 months.
8. Other costs and random costs throw all stages are 5 million USD.

The General Designer of the STS (Yunitsky A.) with a group of specialists (12 men – assistants and helpers of the General Designer) will organize activities in Korea. Basic specialist indispensable for organizing activities and preparing production in Korea (20-25 men – managers, designers, scientists) will be hired directly in Korea.

After experimental-manufacturing improvement of the STS at the test grounds it will be possible to start designing and building principally new type of high-speed routes not only in Korea and South-East Asia but also in other continents. The STS program has high export potential. For example, bookings amount in such countries as Russia, China, India, USA, Australia, Canada, Brazil, might be about 100 billion USD for the first quarter of the XXI century. If to take in account need for transcontinental high-speed routes, any country is interested in which one, the niche in the world economy for the STS program might be about 1000 billion USD.

According to its technical and economic indices, the STS can become leading type of transport in the XXI century. So its influencing on economics and human life on the planet may be not less then railway-road influencing in XIX century and car influencing in XX century. At series production the STS will become the same (on scales), as railway branch, motor industry, aircraft. Thus, in 20-25 years millions new workstations will be made in the world economy. For the same period, about 100 thousands highly-paid workstations will be made in a country, which will be an exporter of the principally new high technologic industrial program. New workstations will be made in science, teaching (the preparing of new specialists on new specialties is indispensable), in industry, building, service, power engineering, extracting and refining branches and others.

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THE INNOVATION PROGRAM
"STRING TRANSPORT IN ITALY"

Yunitsky's String Transport System (STS) is a principally new communication system, which is two current-carrying rail-strings (isolated from each other and from supports), on which four-wheeled high-speed electric cars move at the height of 10-30 m and over. Due to the high directness of the rail-string and its dynamic rigidity, vehicles will easily achieve the speed of 250-350 km/h (in the long term – to 500-600 km/h).

The distinctive (from other high-speed systems) features of the STS are:

- little consumption of materials required for building (for a two-way route: metal constructions – 200-300 kg/m, reinforced concrete – 0.2-0.3 m^3/m);
- little ground using (0.01-0.02 hectare/km);
- low-level specific energy expenditure for a high-speed moving (0.02-0.04 kW*h/tonn*km for passenger trips and 0.025-0.05 kW*h/tonn*km for freight trips);
- low cost price of passenger trips (10-15 USD/1000pass*km) and freight trips (3-10 USD/1000 tonn*km);
- low-level cost (one kilometer of a two-way route with an infrastructure will cost 1-1.5 million USD – on land areas, 2-3 million USD – on mountains areas, if a route is situated above the sea-level (on shelf), and 5-10 million USD – if route is situated in the pipe).

Throughput capacity of a two-way route is 500000 passengers a day. The STS is easily mated with electric power transmission lines, wind and solar power stations, communication circuits including fiber optic. The STS will make new types of settlements – linear cities, also in places, which are hard-to-reach for a settlement (mountains, shelf of ocean, jungle, desert). The STS can be built as technological and specialized routes (waste exportation from megalopolises, ore supply from opencast to a preparation plant, coal transportation from an oilfield to an oil-refining plant, etc.), and also as freight, passenger (including only tourists routes) and combined freight-passenger routes.

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String transportation system – possible alternative to the mass-scale automobilisation of cities in the 21th century

Streets and crossroads, squares and parking, bridges and viaducts, garages and gas stations and others in modern cities are built just for cars. Cars subordinate cities more than people who have been building them and who need (as biological creatures) other living conditions.

Cars in the city are a main source of air (to 80%) and noise (to 90%) pollution. Adjoining areas are polluted with fuel combustion products, tire and road friction products, de-icing salts, road dust and others. Gas stations, washing stations, car repaired shops and other elements of transport infrastructure also pollute. The land covered by roads does not breathe and change its natural modes of surface and groundwater moving. The land is excepted from biosphere system of oxygen generation and air cleaning by green plants exactly in places where people live.

Every day millions of people sit at wheel and is in self-contained space of the small size in stress condition for hours, and breathe polluted air with fuel and lubricant steam, fuel combustion products and fumes of heated asphalt.

Every day cars kill thousands of people all over the world, make tens thousand of people cripples and invalids. Billions of people are exposed to negative effect.

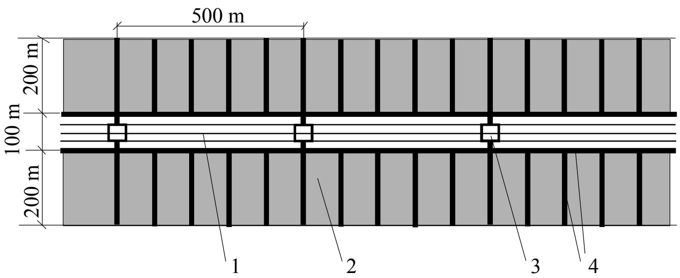
This planet is covered by oil wells, oil pipelines, oil refining and concrete and other plants which work for urban cars and which also pollute.

The main reason of formation of cities, megalopolises and mass concentrating of people is guaranteeing of transportation accessibility. Accessibility of work-stations and educational and sanitation and cultural centers and entertainment places, guaranteeing of possibility of physical communication of people with each other – all of these gather thousands and then millions of people. Cities arose just so. Appearance of these cities has been formed during centuries first by pedestrians, then – by horses that move transportation means, and in 20 century – by rail-road (including trams and underground) and cars (including buses and trolleys). Historically just they have form appearance of modern cities and megalopolises, their structure.

Only because of the need to provide transportation accessibility in modern cities there is such dense building which save nothing from nature. It can lead to collapse, social burst, “black hole” which can absorb peoples gathered to different points. Civilization is already approaching to the dangerous 50 % level of urban people.

But if the role of the transport in future will be so big, why don’t we form future cities’ appearance based on new transportation technologies and cities-building conceptions?

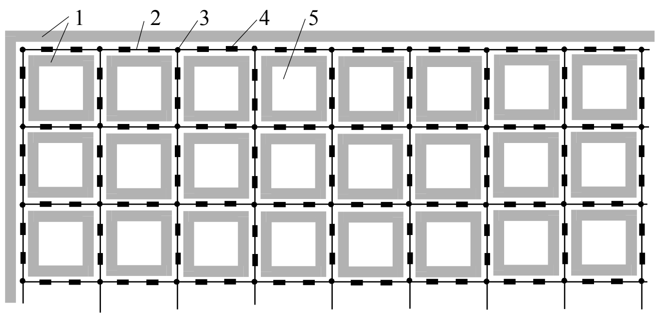
Imagine a chessboard where checks are nature, but lines dividing into checks are linear cities width 500 m, mainly with cottage building (picture 1).



Picture 1. Linear city:
1 – many-way high-speed “green” routes (through, reverse, sidetracks);
2 - cottage building area;
3 – offices, industrial buildings, cultural and trade and sanitation and other centers;
4 – paths.

Along the middle line of such city, along green line width 100 m, above trees at the height 20…30 m and over there are high-speed “green” transportation communications. “Green” means that they are secure, they don’t threaten to people lives and health (environmentally-friendly, noiseless, high-speed moving safety, etc.), they don’t break the harmony of environment including landscape. If such city is 100 km long and the speed of moving is 250 km/h, it will take a person 25…30 minutes to get from one corner to another as a maximum, but as an average – 15…20 minutes. Offices and industrial and other buildings with mass concentrating of people will be also located in middle green area of a city, and everybody will be able to walk towards them. If they are located at 100…500-m distance, it will take a pedestrian not more than 3…5 minutes to get there. At the same time in every building there will be transport station located on roofs or top floors.

With the population density 500 m^2/person in such city there will be 100 thousand people, and in “chess” green megalopolis (picture 2) including 100 such crossing linear cities (50 at the each side, or 2 km from each other) 10 million people will be able to live with comfort.

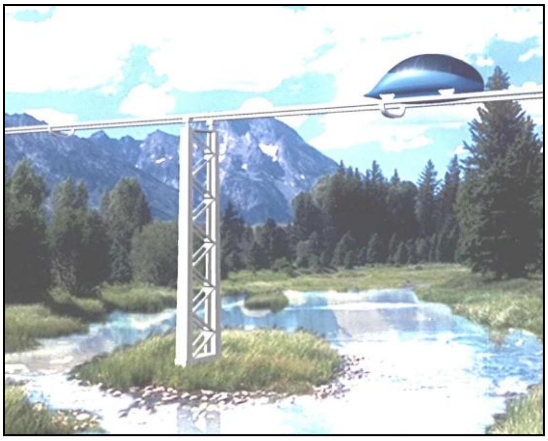


Picture 2. Green (chess) megalopolis:
1 – linear city building area;
2 – “green” high-speed transportation communications;
3 – change stations;
4 – entraining stations;
5 – park.

You will be able to get from any point of such megalopolis to any another one just with one changing. Maximal time in the way (from one corner to another) is 50 minutes; average time is 20…25 minutes. Maximum throughput capacity of a transportation line is 500 thousand passengers a day and 500 thousand tones freight a day. It provides in rush hours with moving in the megalopolis over 10 million people (for the whole communication net).

People concentration in such city-village will be considerably less then in modern cities. The megalopolis will be really green, because it won't be covered asphalt and it will be just for pedestrians. And people will wake up in the mornings not because of car noise but because of birds' songs.

For realizing this conception principally new transport of 21 century is necessary. The String Transportation System (STS) of Yunitsky could become such transport.



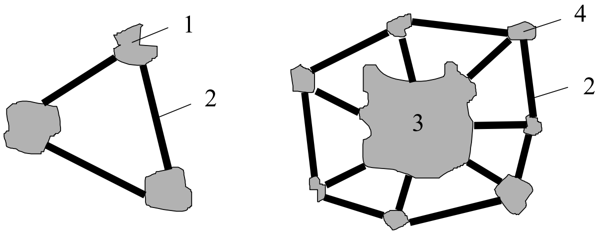
Picture 3. One-way route of the STS

The STS is two current-carrying rail-strings (isolated from each other and from supports), on which four-wheeled high-speed electric cars. When an electric car is supplied from the autonomous power source the STS track structure will be switched off the current supply system. The speed is 200-250 km/h (in the long term – to 400-500 km/h). Little materials consumption requirement of route structure (for one-way route – to 150 kg/m), little vertical loads on supports (to 50 t in 100 m interval), arbitrary length of intervals (20…1000 m and over) and arbitrary height of supports (5…100 and over) provide introduction of the STS into urban environment, not affecting buildings and communications which has already been built. Little land requirements for supports (about 0,05 hectare/km) keep more area for green plants.

High energy efficiency of an electric gear (over 90%) and minimum mechanic and aerodynamic losses (aerodynamic drug coefficient C_x=0,08) provide high-speed and comfortable passengers and freights trips with less energy consumption (5.10 times less than a car). Compact stations will be combine with upper floors and roofs of buildings and won't require additional land using.

Small cross sectional dimensions of a rail-string with energy and information service lines inside it (100 x 200 mm) except other non-traditional pollution: routes will not shadow and do visual intrusion. Low power (to 50 kW for a vehicle by capacity 20 passengers and carrying capacity of 5 tons), low-level electric tension (about 1000 V) and absence of sliding electric contacts make the STS more faint source of electromagnetic pollution, than trolley-bus. Injury to the Nature during the whole living cycle of the STS will be minimal – during building and exploitation stages and dismantling.

Linear cities are easy entered into real cities' system (picture 4).



Picture 4. Linear city in the cities' system:
1 – real city;
2 – linear city;
3 – real megalopolis;
4 – city-satellite (airport).

For example, linear cities can concern little and middle cities located at the distance 50…150 km. Concerning cities-satellites and airports with each other and with the megalopolis will be also effective. Having such communication system a passenger from the megalopolis center can get to any city-satellite or airport within 20…25 minutes. It will cost him 0,5…1,5 USD.

So the STS provides new conception of urban building in the 21 century. It will be environmentally sound linear cities, in which dwelling, industrial, office, cultural and other buildings and constructions will be situated within the limits of pedestrian accessibility to high-speed environmentally-friendly and secure string routes. Them will be in harmony with the Nature in all its variety: on fields, on shelf of the ocean, in mountains, in taiga, desert, jungle and any other places which God gave us.

General Designer of the STS,
Director of UN Centre (Habitat) Project № FS-RUS-98-S01
"Sustainable Development of Human Settlements and
Improvement of their Communication Infrastructure
through the Use of a String Transport System"

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Enclosure to order for getting the credit

The abstract of Business Plan
of the project of String route "Sochi - Adler - Krasnaya Polyana - Engelmanovy Polyany"

Technical-economic ground (Business Plan) is worked out by Institute of independent consultant's investigation of investment and credit projects (Minsk city, Byeloruss) together with its initiator - Mr. Yunitsky A. E. - the President of "Yunitran" Foundation (Moscow) and the specialists of Sochy city administration, with the usage of computer Model UNIDO (United Nation Organization of the Industrial Development), COMFAR 2.1 with further correction in accordance with the conditions of credit line.

In Business Plan is given the estimation of basic technical-technological, marketing and financial-economic aspects of erecting high-speed String Transport System of Yunitsky (STS) on the district "Sochi - Adler - Krasnaya Polyana - Engelmanovy Polyany". The creation of such route will allow to solve the problem of combining mass, high-speed transportation of passengers and cargoes in the complicated geographical conditions (mountains, sea) in a complex way, ensuring the preservation of unique mountainous-climatic and resort-recreation characteristics of the localities, where mass cargo-passengers transportation will be carried out.

Technical-economic ground consists of 4 main issues:

1. History and main idea of project.
2. Investigation of transportation market.
3. Engineering projection and technology.
4. Economical estimation and financial analysis

In given abstract are considered only economic aspects and made financial estimation of project, which results are put in the attached table.

For route is accepted the maximum speed for carriage moving with - 200 km/hr.

There are 4 stations, 7 intermediate stations, 3 cargo terminals, depot and controller station.

The adopted structure of the ticket fare for passengers and its value on different parts of route is based on accepted:

- the purchasing power of population,
- the competitive preference of STS fare in comparison with automobile transport in the route "Sochi - Adler"
- the route extension,
- the accessibility of populated areas on the mountain district.

The route has the total extension - 92 km., and consists of 3 characteristic parts: sea one (26 km), mountain (43 km), high mountain (23 km), which are differ from each other by specific cost of transport line and infrastructure, the transportation cost and seasons depending. The calculated capacity of transportation: passengers - 890 mln pass. · km/year, cargo - 83 mln tons · km/year, with the middle arm of transportation 30,8 and 31,5 km, accordingly. The mean value of transport service: 0,059 USD/pass. · km and 0,11 USD/tons · km. The mentioned characteristics STS route will have on the 7-th year since the beginning of project financing, for this the year volume of realization will be 61,2 mln USD, among them 52,5 mln USD at the expense of passengers and 8,7 mln USD - cargo transportation.

THE COMMON CONCLUSIONS

The STS is represented by itself the highly low expenditure system with low exploitation expenses and can be, with success, used in those world regions, where the road nets are not developed, complicated ecological situation, high density of population.

Taking into account the important national economic effect of this project realization, (it is already included in the Russian federal program of Sochy resort city development on the period till 2010 year), the favorable terms will be given to the company, which will realize this project under the guarantee of Russian Government, the Krasnodar Region Administration and city Sochy authorities in particular: the reducing allocations to the Federal and local Budgets and gratuitous transference of land plots for route and infrastructure. By their favorable terms the State will "come into" the income part of project that will improve to a marked degree its technical-economical indexes in comparison with the mentioned above.

Enclosure. Project characteristics - 1 sheet.

Yunitsky A.E.
The President of "Yunitran" Foundation