GENERAL TRANSPORT SYSTEM FOUNDATION

Current transport systems are insufficient to support a long-term sustainable society.
Cars and public transportation are competing over new investment, but both are founded on technical concepts from the 19th and 20th century.
Thus, we need a new transport system, which is better than road and rail-traffic in the long-term and at the same time backwards compatible with such older systems.

Today, people are expected to adapt to the existing means of transport.
Instead, we need a general transport system – GTS – that is adapted to people's needs with future oriented technology. By doing so we can achieve a higher quality of life and profitability to individuals, organizations, businesses and society as a whole. We still have not finalized the design of this new transportation system. We think that it will resemble current "podcar" systems, but will be developed further to meet greater transportation demands.

We have established the foundation for a general transport system (the GTS Foundation). The stated purpose of the Foundation is to pursue scientific research, development, application, standardization, education and licensing relating to the GTS system.

We welcome any and all donations and contributions to the cause of the GTS foundation.

Uppland, Sweden, september 2010
Kjell Dahlström and Jan-Erik Nowacki,
founders

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A brief description of a general transport system[1]

1 The General Transport System – GTS

GTS looks like a PRT[2] system but has significantly more universal applicability in many respects – technically, functionally, socially and industrially. GTS handles the whole trip, whether it is local, regional or long-distance. The trip can be made individually or together with others. Transport of goods is also within the capability of the GTS. GTS competes with all known means of transport, except walking, biking, long-distance flights or sea traffic, and bulky goods transports.

GTS core technology includes magnetic carrying, propulsion, steering, switching and platooning[3]. The GTS is fully automated. A ”drive sled” hovers along inside an up side down U-beam.

GTS vehicles, in many different sizes and capacities can be connected under the drive sleds and then levitate above ground level. GTS vehicles will have standardized outside measurement, a door on the right side and standing height inside the vehicle. GTS vehicles can also be built as cars, for driving on standard roads (”dual mode”). The size of a “compact car” is considered to be optimal for handling the majority of all travel needs and goods transport.

2 GTS Technology, Development of Standards

The GTS technology will be designed to meet the GTS Foundation specifications. The foundation is considering forming a separate development company for this task. Development can also be performed by independent companies to the specifications of the foundation. The goal is to promulgate and implement an international GTS standard. This is considered the best way to generate industrial momentum, creating high quality at moderate prices (as has been done during the development of the car industry and mobile phones).

Picture: SIKA /Hans Kylberg

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1 The pictures illustrating the GTS are reproduced here by permission of SIKA, from the video ”Bubbles and Beams, a convenient future”, produced by Hans Kylberg. Mr. Kylberg also made the Google map on p.11, and the illustration of a bundle of beams set against a real background, p.5.
2 PRT, acronym for Personal Rapid Transit.
3 This concept will be explained later in the text.

3 The General Functionality

GTS blurs the difference between public and private transport systems. The beam network allows for a mixture of widely diverse passenger traffic and goods transports. GTS vehicles can run independently or be coupled together into trains (so called platooning). Coupling and uncoupling is done automatically and can be done on the fly. The platooning technique yields high capacity and low air resistance, contributing to low energy use. When the guideway network is expanded with regional and interregional lines, travel and transport can be made at any time, directly and seamlessly between local stops in all connected cities and regions.

4 The General Technology

GTS technology can be divided into three parts:
- Mechanical components;
- Control system including user interface;
- Stations, maintenance and auxiliary systems.

Mechanically the GTS system consists of beams, mostly supported by posts. Inside these beams runs a drive sled, which carries a suspended cabin or cargo module.

The beams consist of two parts, *the guideway*, where the drive sled runs, and *the horizontal supporting structure*, which has the task of carrying the guideway. Thanks to this division, different supportive structures can be used when appropriate. For spans up to 30 meters, a box beam could be suitable. A truss structure could be used to support spans up to 100 meters, and pylons and cable suspension for even greater spans. The guideway's size is minimized and the supportive structure can be architecturally adapted to the immediate surroundings.

Supporting posts for the beam can be T-shaped for two-way traffic or gallows-shaped for one-way traffic. Posts are designed to be safe from collisions by road traffic and to be easily adjusted if the ground settles. (Seismically active regions also demand shock-absorbing foundations). Additionally, supports and beams are designed to require minimal maintenance.

Drive sleds have at least four functions: Propulsion/braking, carrying, switching and platooning. Propulsion is executed with direct electricity, backed up by limited battery support for extreme situations. Carrying is designed to minimize friction forces and to ensure that the drive sled is safely supported. There are also two independent braking systems. Primarily, the drive sled brakes by returning electric energy to the electric grid. Secondarily, it has a brake directed towards the beam that activates if either the power or information supply fail, or the primary brake is insufficient.

The switching function is made bivalent, forcing the vehicle either to go left or right in a switch; thus it never can get stuck in an intermediate position. Finally, the platooning function is constructed to enable the vehicles to be coupled and uncoupled on the fly (platooning).

For the drive sleds picking up or delivering cabins, road vehicles or cargo carriers at ground level, there is also a built-in elevator mechanism. Such a mechanism enables stations at ground level to take up less space and volume, and also minimizes physical barriers.

GTS cabins are standardized, enabling them to connect and form trains. This feature provides large transport capacity and low air resistance. A standard GTS cabin/cargo carrier can fit eight people, a ton of goods or a small car. We are aware of current regulations prohibiting platooning on the fly. With technical and safety development however, this regulatory issue is not insurmountable.

Naturally, there are different cabins/cargo carriers for different tasks. Some of them are to be released and loaded onto other vehicles, or to drive on their own wheels the final stretch toward the target. The passenger cabins are made for high traffic safety. They are also equipped with alarms directing the cabin to the nearest station or other destination depending on the type of alarm. The cabins can be evacuated to the ground, e.g. during longer power or information failures.

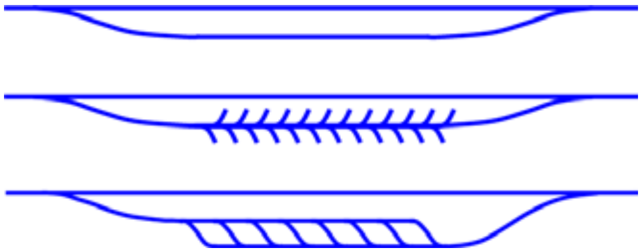
The control system has multiple levels. The lowest level is there to prevent, in a redundant way, vehicles from colliding with each other or their surroundings. Each vehicle continually reports its position and speed. The vehicles behind can read this and determine the speed required to keep a suitable distance. In parallel with this system there is an independent system measuring distance and relative speed to all objects ahead. If an unknown object would appear, the brake is activated. At a diverging switch, no control system guidance is needed as the vehicles themselves steer right or left. In merging switches, however, control system guidance is needed. Vehicles, together with the system, coordinate a time for passing through the merging switch. The merging point's computer then informs all involved vehicles of what velocity each must keep in order to pass through at the right time. The vehicles also coordinate with each other to avoid colliding in the merging point. Each vehicle has a map of the entire network and can independently select the route to their destination.

A higher level in the guidance system keeps track of traffic under all beams, in real-time and spreads this information to all vehicles in the network. If any section becomes overloaded, vehicles will automatically select other routes. The same applies to a blocked station – the vehicles are then automatically directed to the nearest station instead. At the same time, boarding for all trips to the blocked station is cancelled.

At the highest level, the guidance system keeps track of statistics e.g. decides where to deploy empty vehicles. A big stadium, which is to be emptied after an event, needs many empty cabins for example. The system also monitors and schedules maintenance of the vehicles and calls them in. It is also at this highest level where information to the public and traffic debiting is administered.

Maintenance is conducted automatically to the greatest extent possible. Vehicles run automatic-ally to maintenance and cleaning, every day. Through self-diagnosis it can also be decided whether vibrations or overheating demands repairs in excess of scheduled maintenance.

The stops are usually equipped with a single sidetrack for loading and unloading. At larger stations and terminals, vehicle bays could also be arranged into a ”fishbone pattern”, as a ”parallell station” or in other ways. See figure below.



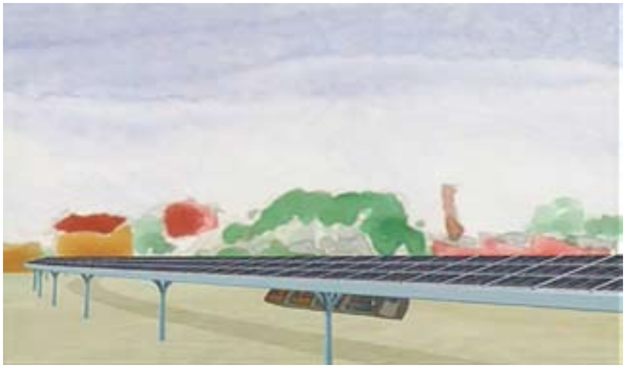
For GTS stations integrated with railroads, a sidetrack next to the railway-track will be filled with GTS cabins before the train arrives. The GTS vehicles start as they are occupied by different groups of travellers, each heading for a different destination.

All types of stops, stations and terminals will contain ordering and ticket machines. Some stations may be staffed with guards. All stops have camera surveillance.

5 GTS Environmental Aspects

GTS has crucial environmental advantages. The system is primarily driven by direct electricity. This will be twice as energy efficient as a system consisting of electric cars and batteries. Charging a battery is typically done at 70% efficiency and the discharge at about the same efficiency, combining for a total efficiency of 49%. However, operation by direct electricity usually renders 85% efficiency. Electro-voltaic panels may be placed on top of the beams to generate some of the electricity used by the GTS. Furthermore, the air and rolling resistance is much smaller for GTS-vehicles (especially when platoooned) than for corresponding electric cars.

Road-traffic currently consumes approximately 85 TWh of gas and diesel. The resulting by-product of this is 20 million metric tons of CO_2-emissions. The majority of these 85 TWh can be replaced by renewable electric energy.



Apart from the energy advantage, the noise level decreases and accident rates drop. At the same time we preserve the ground level for nature and people.

The most apparent disadvantage of the GTS is increased visual intrusion. However, guideways of this kind, which have been in existance for an extended time, often come to be loved by city dwellers. An example of this is Schwebebahn in Wuppertal, which has been in service for more than 100 years. The Eiffel Tower in Paris is another example of ”visual intrusion” that has become a cherished landmark.

Collection of many GTS beams into a bundle could decrease the visual impact of the GTS-net. When appropriate the GTS can be located underground, above the roofs or inside buildings. When GTS supplement more and more of road traffic, the total amount of traffic noise will also decrease. Light interference in the dark also decreases - GTS-vehicles can operate without headlights or lit up tracks.

6 GTS Yields Profitability in Public Finances

Public finance calculations can be made on the gains of GTS. It involves gains to society from less travel time, increased security, decreased environmental impact, less energy consumption and increased accessibility for all travellers and goods. Reduced investments in road and rail, decreased car and truck traffic, increased accessibility on rail for long distance heavy goods traffic, less air traffic on short distances, reduced traffic noise, reduced oil import, reduced subsidies for traditional public transport can be expected. GTS is not meant to be dependent on tax financing. Add to this increased biking, walking and resulting health improvement, as well as decreased costs for transportation services.

7 Practical and Safe Design

An elevator function is added to some the drive sleds. The elevator hardware weighs approximately 100 kg, which means that the vehicle’s carrying capacity decreases correspondingly. The elevator lowers and lifts the vehicle between the beam and ground level.

The vehicles' size and level entrance enables travellers to easily bring along bikes, strollers, walkers, shopping carts, manual and electric wheelchairs etc. In this way GTS-vehicles can increase accessibility for many people and decrease the need for specialized transportation services.

The combination bike/GTS is also interesting, probably leading to increased biking over all. An electric car, parked a large part of the journey on a car mover, will have its range radically increased. Even the batteries of today will suffice.

Suspending the vehicles under the beam provides many advantages. It enables tighter curve radii and since the vehicle can bank in the curves. Moreover, the beam can be made thinner and be raised about 2 m by using a suspended construction. This results in less visual intrusion in the street scene. Another important advantage from utilizing suspended vehicles is that the guideway becomes naturally weatherproof, since all sensitive technology can be located inside the beam. When snow and ice stops traffic on roads, railways, airports and at sea, GTS works normal.

8 Dual Mode, Public, Private/Special Travel

GTS vehicles, designed for driving on normal roads (dual mode), take the passengers from or to remote start and end points.

An alternative to dual mode is for "compact cars" to be transported on specially designed car transporters on the GTS guideway network. Public travel means sharing a cabin with others. This makes travel considerably less expensive and can be carried out with great personal safety since emergency service centres can be contacted in many different ways. During rush hours and on crowded lines, vehicles can platoon like trains. Passengers who accept intermediate stops are incentivized by lower costs. Public vehicles can be designated either as economy or comfort class; compare with second and first class on trains or "economy" and "business" class on airplanes.

Private travel for one or more persons can be reserved but of course at a higher cost than a trip with a public vehicle. Vehicles for long-distance travel can also be rented. They could be equipped with half-bathroom, kitchenette and sleeping accommodations. These vehicles can be privately owned, and also designed for driving on roads (dual mode). Vehicles could also be linked together (like a car and trailer). A GTS-ambulance could run directly to the emergency room without traffic jams and with priority on the GTS system. Patients can also be transported quickly within a hospital area or between hospitals. GTS-ambulances as well as police cars are normally designed for dual mode.

9 GTS Beam Network in Sweden

The GTS beam network will be integrated into the existing transport network structure. Starting with some smaller tracks in an area where the current infrastructure is insufficient. Such conditions exist in the most populous Swedish province, Uppland, comprising the north of Stockholm County and Uppsala county. This province contains good examples of possible local beam networks, regional and long-distance lines which can be compared to ordinary road and rail investments.

Long-distance lines capable of speeds up to 240 km/h, are preferably constructed above European highways and national roads. Pillars can be built to support “bundles” of beams made for different velocities. The long-distance lines connect the big terminals with regional and local beam networks without requiring the passenger to change modes of transportation.

Regional networks, capable of speeds up to 120 km/h, are built like spider webs in every county/region and are tied to the regional capitals. The regional networks are also connected to local guideways. The local tracks, capable of speeds up to 60 km/h, connect all local stops, often in one-way loops permitting narrower beam systems. The one-way design enables the beam to be lowered down to ground level, especially in cases where there is a barrier of some kind. Along larger streets such as highways, avenues and boulevards, two-way local beam passages can be built. Vehicles will operate at low speeds in sensitive areas to assure the vehicles’ motions aren't perceived as obtrusive, but contribute positively to the hustle and bustle of the city.

10 Stops, Stations and Terminals in Sweden

Local stops will be much utilized and are built in every neighbourhood and village, about one per 2000 residents/workplaces as an initial basis of calculation. They are automated and remotely monitored and within walking distance. Empty vehicles circulate automatically to places where needs are anticipated.

Privately owned vehicles can be ordered home or be parked by the system. This means vehicles are distributed effectively in the guideway network. When demand for vehicles is low, vehicles are sent to automatic compact parking in special storages.

These storage facilities house twice as many GTS vehicles as can be fitted in ordinary multi-level parking structures. To travel again, order a public-, or your own private vehicle to any stop you like. The order can be made through your mobile phone. The automatic parking can be used for privately owned vehicles as well.

For every 20 stops, a station is projected, approximately one per every 40,000 residents/workplaces (initial basis of calculation), providing daytime commercial services. Stations contain kiosks, boutiques and the possibility to park or drive your cars or dual-mode vehicles on or off the GTS-system.

For every 10 stations, one per every 350,000 residents/workplaces (initial basis of calculation), a big terminal is projected. This terminal provides full service around-the-clock including compact parking, a GTS depot with supervision, maintenance and repair of GTS vehicles, good access to road and rail networks and cargo terminal. Larger stores, restaurants, hotels and other services can be located here as well.

Based on this initial calculation, approximately 5000 stops, 250 stations and 35 terminals will be sufficient for a GTS network covering the entire country of Sweden.

Stops, stations and terminals will have a certain standard disposition making it easy for travellers to orient themselves even in unfamiliar locations. Of course, stops, stations and terminals must be adapted to local conditions, considering their nature and configuration. Stops do not require a lot of space but should generally be built above the ground, serviced by elevators and stairs. If space is available, stops also can be built at ground level.

11 Fast GTS Traffic in Northern Europe

A trip between the universities of Uppsala and Örebro takes less than an hour. A trip between any two stations in the greater Stockholm region takes 15 minutes on average. Arlanda airport will serve an area with 4 million inhabitants who within the hour can get between any workplace, or residential area, directly to or from their appropriate terminal at Arlanda.

Within the Scandinavian capital triangle, travel with GTS can be made from point to point, faster than by plane, a few meters above the ground at 240 km/h and without changing vehicles between origin and destination.

Due to the relatively light vehicle and guideway construction, wide bodies of water can be spanned cost-effectively. Examples of this are the lake Mälaren between Västerås and Eskilstuna, Öresund between Helsingborg and Helsingör, the Sea of Åland between Hargshamn and Nådendal as well as Norra Kvarken between Umeå and Vasa. The bridge over Öresund can be provided with GTS. If "Bypass Stockholm" is built, an adaptation of GTS could be utilized. With a practicable beam gradient of up to 10 percent, large mountain areas can be bridged without expensive tunnels, for example straight between Oslo and Vestlandet (Bergen-Stavanger) through Telemark. If a tunnel is still needed, the cross sections will be much smaller than road or rail tunnels.

From these examples it is apparent that GTS is a more efficient alternative to traditional high-speed rail traffic. The Nordic countries can often be connected without air-traffic. With GTS, travel time from Stockholm would be two hours to Gothenburg, Oslo and Helsinki, three hours to Copenhagen, four hours to St. Petersburg and five hours to Hamburg.

12 Words on the Way

The transport sector has been curiously free of trailblazing changes during the last decades. Transportation has consequently become a sanctuary for obsolete methods in a time where other technologies such as biomedicine and information technology have made enormous progress.

We are now making an attempt to provide the transport sector with the power to change by means of technological advancement, leaving old technology far behind.

Donations and Contributions

If you wish to support progress of the GTS Foundation, please feel free to contact us.

THE FOUNDERS, CV AND CONTACT DETAILS

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The founders trapped between traffic lights for trams and cars in Stockholm (Dahlström left, Nowacki right)