

## The Importance of Telematics in the Transport System

T. Neumann

*Gdynia Maritime University, Gdynia, Poland*

**ABSTRACT:** Security mechanisms of a telematics system are exceedingly intersecting as they could pretend the ordinary influence of the vehicle and perhaps terminate in accidents. This paper includes a new look at automotive and telematics transportation systems, also refers to methods in modelling, facility location, data processing and assessment of risk in telematics networks.

### 1 INTRODUCTION

Telematics in the essential way improves safety and reliability of transport systems, enables optimizing cargo motion routes and reduces the costs. Telematics is currently the important parts of transportation infrastructure. The key question in transportation system safety and reliability is its ability to gain the output products (information), generated by the participating in transportation process, and then integration for quantity and quality evaluation, and processing to output products useful in the decision process. Telematics, using techniques such as informatics, optoelectronics, automatics and telecommunications, helps to reduce costs of transportation potential management, improves the security and reliability of the transportation service and the decision process automation. Modern telematics methods offer a huge application potential in teleservicing, having impact on most engineering disciplines. (Szpytko et al., 2006; Weintrit and Neumann, 2015)

Maritime transport, like air, is subject to several unfriendly substitute from the surrounding. These conclude, among other, period varying hydro-

meteorological circumstances. Thus, it is decisive to negative or to disappoint these negative constituent. Considering the fluid freight like oil, gas, chemicals, etc., the question of transportation via marine is more complex. Due to the obscure depth of tankers, not every intention can be expanse. Thus, the common stretch in the attention of baggage show its valid relationship to the determination and optimization hypothesis. (Guze et al., 2017; Neumann, 2018)

### 2 TELEMATICS

#### 2.1 Definition of telematics

The development of the intelligent transport system (ITS) resulted in the integration of mobile communications, data transmission, and positioning systems. ITSs have been applied to managing and controlling road and transportation systems, with ITS applications becoming a traffic improvement trend among developed countries. Telematics combines the systems of wireless communications, information management, and in-vehicle computing to allow car owners to use wireless communication functions to

exchange and convey information as well as provide drivers and passengers with personalized information services. In recent years, telematics has been a crucial development in ITS fields. "Telematics" is a portmanteau of the words "telecommunications" and "informatics" (Cho et al., 2006). Telematics resulted from the rapid development of wireless communication technology, global positioning systems, and e-commerce. Through the application of onboard units in vehicles, telematics systems facilitate in-vehicle communication and information services. The most crucial features of telematics systems are that they assist people in driving, integrate services, and are service-oriented. Telematics system services are provided by various vendors, such as content providers, content coordinators, software developers, hardware vendors, telecommunication service providers, telematics service providers, and telematics system coordinators. Through the collaboration of these vendors, telematics systems can be used to provide services to satisfy user needs. Fig. 1 presents the conceptual framework of a telematics system.

### 2.2 Future and trends of telematics development

In response to the saturation of the global vehicle market, vehicle manufacturers have explored new markets and developed new products to expand their business scope. In seeking high-value-added products, vehicle manufacturers have transformed vehicles into diversified service platforms. Therefore, vehicles are not only used for transportation but also for providing drivers with additional features to promote driver and vehicle safety as well as mobile communication. Because customers expect vehicles to be equipped with telematics systems, many vehicle manufacturers provide telematics services. As wireless communication technology and information and communication technology have evolved, telematics technology has been developed. In addition to some TSPs, which cooperate with vehicle manufacturers, independent TSP vendors also provide telematics services. The cooperation of both types of TSPs as well as telematics technology innovations is the key factor influencing the development of telematics-related industries. This cooperation and innovation drives healthy competition among TSPs and telematics-related industries to develop innovative user-oriented telematics services. The global telematics market continues to expand and is projected to have a compound annual growth rate of approximately 23% for 2014 – 2020. Currently, the market penetration is 15%. The global telematics market is focused on many countries in North America (e.g., Canada and the United States), Europe (e.g., the United Kingdom, France, Germany, and Italy), and Asia – Oceania (e.g., Japan, Korea, and Australia). Moreover, North America leads the global telematics market, but growth in the telematics market in Europe and Asia-Oceania has been substantial. Therefore, the global telematics market possesses high growth potential. Telematics systems combine technology from many industries. Therefore, developing telematics systems requires applying and integrating technology from many industries. Because end consumers primarily use telematics systems while driving, these systems should be designed to provide consumers with

needed information in a safe and practical manner. Therefore, the key technologies used to develop telematics systems are ICTs, in-vehicle computing technology, human – machine interfaces, and software platforms. Particularly, the rapid evolution of ICTs has produced diverse applications of telematics technology in recent years. (Chang and Fan, 2016) For example, although wireless networking environments are highly developed, a new generation of onboard computers was designed, thus connecting driver and passenger smartphones and tablet computers by using wired or wireless high-speed connection interfaces. Therefore, these onboard devices allow drivers and passengers to access the Internet and operate vehicles, thereby providing additional navigational, media, and networking services.

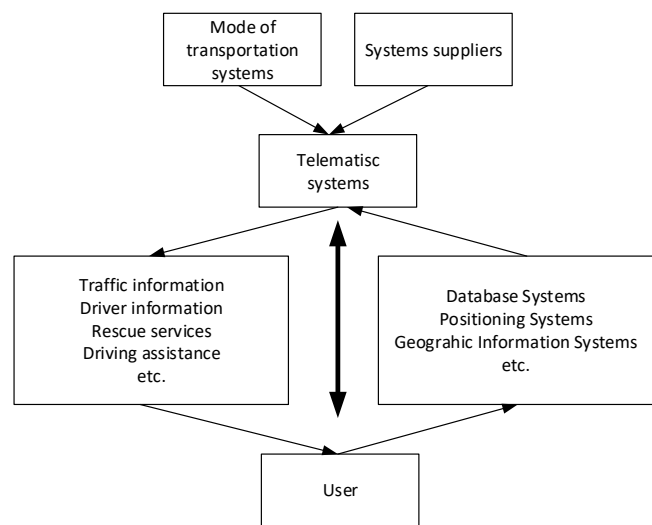


Figure 1. Telematics system.

### 2.3 The advantages of telematics in the context of the development of transportation systems

Contemporary telematics of transportation is one of the key instruments of the improvement and growth of the effectiveness of transportation systems (Bekiaris and Nakanishi, 2004; Wydro, 2008). These instruments may be used in the processes of transportation management and transportation system operation as:

- structural solutions, wherein the electronic information acquisition and processing and the electronic communications are an integral element of the transportation systems and are designed relevantly to their needs,
- technological solutions utilising universal and at the same time integrated telecommunication and IT systems (Wydro, 2005).

This allows the development of the transportation systems to a degree allowing some of the systems to be branded as modern and intelligent. (Janecki et al., 2010)

With the above context, one may pose a question: what does modern transportation telematics dedicate to the transportation systems?

In a general approach to this issue one may state that the tools provided by the transportation telematics allow the following:

- the integration of all the endogenous elements of a specific transportation system, i.e. all the branches and kinds of transportation, means of transportation, transportation infrastructure, the subjects of the supply side of the transportation services market, the management processes and the system operation,
- ensuring the collaboration and interoperability with the near and far environment of the transportation systems, including the influencing of the relationships with the subjects of the demand side of the transportation services market (Stimson et al., 2009)

### 3 TELEMATIC SYSTEM ARCHITECTURE

In this section, we present the proposed global architecture of the telematics system as shown in Fig. 2. There are ranges of wireless technologies for vehicle telematics that are described by Finnegan and Sirota (2004) where its viability will depend on the different target applications they were optimized for. Some examples are Bluetooth, ZigBee, UWB, and Wi-fi. On the other hand, InternetCar as cited by Chen et al. (Chen et al., 2004) proposed architecture to connect car to the Internet. (Gerardo and Lee, 2009)

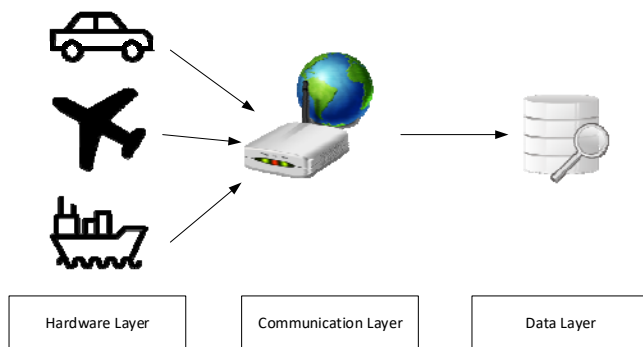


Figure 2. Global architecture for data aggregation in a telematics system

Some other workable communication medium to transmit data from a mobile vehicle is described in the primer on real-time traffic system (Helm et al., 2006), which includes cellular technologies such as GSM, CDMA, GPRS, EDGE, WCDMA, TDMA, iDEN, and WiDEN. These cellular technologies are more suitable for real-time data delivery due to its availability and the types of network it can support.

Hence, in this framework we chose CDMA as a medium for data delivery of real-time in vehicle information because of its suitability to the geographical implementation of the system. Data collection methods can be done through on board sensors, acoustic, embedded, radar and video sensors. Moreover, floating car data (FDC) cited in Chen et al. (2003) and ABI Research can be used for more accurate recording of vehicle data. FDC refers to a set of protocols, services and data formats by which cars transmit information to a server. The use of FDC can be traced back to the mid-80's using programs like Ali

and Euroscout from Siemens and Socrates from Philips. In this program, vehicles are equipped with GPS and cellular modems to transmit speed and position data to remote data centers.

### 4 THE AUTOMOTIVE TELEMATICS

Telematics has three fundamental capabilities:

- two-way communications capabilities;
- situation technology (geographic attitude);
- computing model for system rule and interface to self-propelling electronics systems.

The other telematics technologies are two-way communications and situation technology, such as a planetary attitude system recipient, which are confederated with an information processing system hardware and software sketch to composed a telematics system. Depending on the telematics performance, this system is interfaced and incorporated with the machine's electronics systems. Telematics technology will also have a huge strike on many other self-propelling electronic systems such as self-propelling restraint systems, mallet relieve systems (also called Intelligent Transportation Systems) and ITS. ITS will grow in adulteration over the next decennium and will increasingly need telematics capabilities in automobiles that can take benefit of ITS applications. The telematics assiduity is shape on these three telematics technologies and has several separate traffic section. The biggest telematics traffic section is the telematics systems that are in state by self-propelling manufacturers.(Neumann, 2017)

In order to be able to speak about a system it is necessary to describe it minimally as a final automat defined by mapping the system inputs with respect to internal state plus mapping the inputs and internal state with respect to the system outputs. A subsystem must be describable through an identical methodology like a system; in its substance a subsystem is a system to be described at a more detailed distinguishing level. (Neumann, 2018)

A system shows both a structure and architecture while the structure is usually much more detailed than the architecture. The architecture defines the basic arrangement of subsystems and functional blocks in the space. Functional block is used if it is not possible to define the given block as a system or a subsystem. The architecture is more global and its objective is to be arranged and intelligible as clear as possible. The structure goes up to systems elements, and it is more complex and more complete but less clearly arranged. For that reason architecture approach is used within our Intelligent Transport Systems (ITS) studies. A process reflects the chained events within a system. An event may mean a change of a system state brought about by an initiation on inputs (transfer of input values) or initiation of internal system state or "only" in the course of the external time. A set of all activated processes at possible environmental conditions defines the system behavior.(Zelinka and Svitek, 2008)

#### 4.1 Technical valuation

Transportation standard are also usefulness in technology assessment. Indeed, the technological elaboration in transit is often costly, which cause a safe economical appraisal of its result and bazaar intersecting. The absorption is therefore separate here from that in the antecedent pilcrow: instead of revolve the performance of removal policies at a participation-wide even, the strike of movement told techniques is now revolve from the moment of judgment of specific actors (productions, implementation organizers) within the connection. The areas of transit technique disturbed by these considerations broadly fall in the succeeding categories.(Toint, 1993)

- Infrastructural project. Probably the firstborn extent of request for conveyance standard is that of advance and updating of transportation infrastructures. Measuring the strike on bargain of mesh modifications, both in personal and general transport, is indeed a very usual request. The variety of situations is nevertheless very huge: motorways and polite roads, trains, coach, automobile, cyclists, ordinary passing, universal infrastructure sustenance and all combinations thereof supply an extended authority of research.
- Technological elevate in vehicles. A many of applications have been made in description with today's technological elevate in automobile technology. Started many years ago with the navigate" features, the innovations gift the automobile some intellect and more sharp apprehension of its surrounding have outrushed. Gap discovery and cautioning, machinelike expedition arrangement, synchronized impelling all have their result on the common trade, not to numerate the uncompounded melioration in carriage performances.
- Technological elevate in communications. Possibly the top question in today's standard proceed from the coming of progressive intelligence systems for conveyance users. These developments are supported on the premise that instruct conveyance users chance their behavior. The behavioral modification, at the user's steady, is then enumerate to source important turn in the planetary conveyance spectacle at city-wide even. Of course, the proposition is then to induce these planetary turn from the sometimes rather elaborate wisdom of the intelligence diversified. Questions of interest are then narrated to the broadness of intelligence arrangement, its precision, constancy, opportuneness and process of transmission. The posture of users with venerate to this notice is also a much learned theme.
- Regulations in the transportation cirque. Finally, the confirmation of modern regulations traffic with conveyance also elevate the topic of their strike on bargain. One instantly expect of parking policies, catalogue of commodity rescue in metropolis centers, highway cost or speed restriction constraint on motorways.

#### 4.2 Assessment of risk in telematics networks

The assessment of exposure in the choice of passing in a meshwork along which to transportation uncertain materials, engage into contemplation the duration of time in conveyance, the likeliness of a conflict and the exposure of population exposure in the result of an casual. There are a diversity of theories, perspectives, advances and algorithms that have been put agreement to explain multi-objective problems for bound the most passing to transportation adventurous substances.

While it is unmingled to inclination efficacious substitute that can control passing decisions such as population compactness, expertness stamp, essential to be reward, and exposure, the censure is to appropriate these substitute into limited temperate criteria to appropriate to limited grounds in a meshwork and then evolve algorithms which can use the calculate to recognize the most passing.

Risk is characterized by two aspects:

- Occurrence likeliness of an adventure; and,
- Consequences of an appear adventure.

Quantification of exposure is crabbed for probabilities for bargain accidents are low and those surround hazardous things are even lower, but the consequences of the latter can be huge.

The strength conception is to divide the optical even and the computation even. This constitute our standard more inconstant: it is calm to innovate the input data to manifest. The input data thus could be either those from simulations, or those from naturalistic on the pressing bargain meshwork which are detention from on situation cameras, if it is practicable. Moreover, this divorce also termination the consequence of preserver expedition on the visualisation: we could counterfeit with a colossal multitude of agents with a little dilatory acceleration, but the inference are then show as those of immovable acceleration for the parade is now uncontrolled from the computation. This standard has six cardinal action as follows (see Fig. 3.)

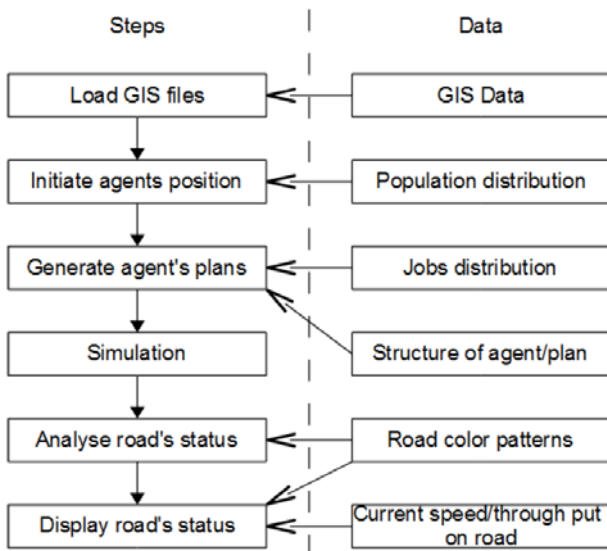


Figure 3. Steps and procedure data in the standard

## 5 GRAPH THEORY AS AN APPLICATION IN ROUTE PLANNING

In many applications such as transportation, routing, communications, economical, and so on, graphs emerge naturally as a mathematical model of the observed real world system. (Neumann, 2016a) Fuzzy logic is a form of many-valued logic or probabilistic logic; it deals with reasoning that is approximate rather than fixed and exact. Compared to traditional binary sets (where variables may take on true or false values) fuzzy logic variables may have a truth value that ranges in degree between 0 and 1. Fuzzy logic has been extended to handle the concept of partial truth, where the truth value may range between completely true and completely false. Dijkstra's algorithm (named after its discover, E.W. Dijkstra) solves the problem of finding the shortest path from a point in a graph (the source) to a destination. It turns out that one can find the shortest paths from a given source to all points in a graph in the same time, hence this problem is sometimes called the single-source shortest paths problem. Dijkstra's algorithm keeps two sets of vertices:

- S: The set of vertices whose shortest paths from the source have already been determined and
- V:-S the remaining vertices.

In finding the shortest path under uncertain environment, an appropriate modelling approach is to make use of fuzzy numbers. One of the most used methods to solve the shortest path problem is the Dijkstra algorithm. In the case of crisp number to model arc lengths, the Dijkstra algorithm can be easily to implemented. However, due to the reason that many optimization methods for crisp numbers cannot be applied directly to fuzzy numbers, some modifications are needed before using the classical methods.(Boominathan and Kanchan, 2014)

Routing problems in networks are the problem in the context of sequencing and in recent times, they have to receive progressive note. Congruous issues usually take places in the zones of transportation and communications. A schedule problem engages

identifying a route from the one point to the other because there are many of optional tracks in miscellaneous halting place of the passage. The cost, time, safety or cost of travel are different for each routes. Theoretically, the method comprises determining the cost of all prospective tracks and the find with minimal expense. In fact, however, the amount of such options are too large to be tested one after another. A traveling salesman problem is a routing problem associated with preferably strong restrictions. Different routing problem emerges when it can to go from one point to another point or a few points, and choose the best track with the at the lowest estimate length, period or cost of many options to reach the desired point. Such acyclic route network problem easily can be solved by job sequencing. A network is defined as a series of points or nodes that are interconnected by links. One way to go from one node to another is called a path. The problem of sequencing may have put some restrictions on it, such as time for each job on each machine, the availability of resources (people, equipment, materials and space), etc. in sequencing problem, the efficiency with respect to a minimum be measured costs, maximize profits, and the elapsed time is minimized. The graph image and the example of costs of borders are given in the figure 1. In this hypothetical idea the tract network is illustrated by a graph. Presented graph is given with an ordered pair  $G = (V, E)$  comprising a set  $V$  of vertices or nodes together with a set  $E$  of edges (paths), which connect two nodes. The task is to reach the  $N1$  node from  $N3$  node in the graph at smallest cost.(Neumann, 2016b)

## 6 PATH FINDING ALGORITHMS

A path finding algorithm for transit network is proposed to handle the special characteristics of transit networks such as city emergency handling and drive guiding system, in where the optimal paths have to be found. As the traffic condition among a city changes from time to time and there are usually a huge amounts of requests occur at any moment, it needs to quickly find the best path. Therefore, the efficiency of the algorithm is very important . The algorithm takes into account the overall level of services and service schedule on a route to determine the shortest path and transfer points. There are several methods for pathfinding: In Dijkstra's algorithm the input of the algorithm consists of a weighted directed graph  $G$  and a source vertexes in Graph. Let's denote the set of all vertices in the graph  $G$  as  $V$ . Each edge of the graph is an ordered pair of vertices  $(u, v)$  representing a connection from vertex  $u$  to vertex  $v$ . The set of all edges is denoted  $E$ . Weights of edges are given by a weight function  $w: E \rightarrow [0, \infty]$ ; therefore  $w(u, v)$  is the non-negative cost of moving from vertex  $u$  to vertex  $v$ . The cost of an edge can be thought of as the distance between those two vertices. The cost of a path between two vertices is the sum of costs of the edges in that path. For a given pair of vertices  $s$  and  $t$  in  $V$ , the algorithm finds the path from  $s$  to  $t$  with lowest cost (i.e. the shortest path). It can also be used for finding costs of shortest paths from a single vertex  $s$  to all other vertices in the graph (Boominathan and Kanchan, 2014).

An ordered pair of sets  $G = (V, E)$  where  $V$  is a nonempty finite set and  $E$  consisting of 2-element subsets of elements of  $V$  is called a graph. It is denoted by  $G = (V, E)$ .  $V$  is called vertex and edge set respectively. The elements in  $V$  and  $E$  are called vertices and edges respectively. If elements of  $E$  are ordered pairs, then  $G$  is called a directed graph or digraph. The vertices between which an edge exists are called endpoints of the edge. An edge whose endpoints are the same is called a loop. A graph without loops is called a simple graph.

For a given source vertex (node) in the graph, the algorithm finds the path with lowest cost (ie the shortest path) between that vertex and every other vertex. It can also be used for finding the shortest cost path from one vertex to a destination vertex by stopping the algorithm is determined by the shortest path to the destination node. For example, if the vertices of the graph represent the city and are the costs of running paths edge distances between pairs of cities connected directly to the road, Dijkstra's algorithm can be used to find the shortest route between one city and all other cities. As a result, the shortest path algorithm is widely used routing protocols in a network, in particular the IS - IS and Open Shortest Path First. (Neumann, 2014)

Short characteristic of Dijkstra algorithm (Neumann, 2016a).

- The input of the algorithm consists of a weighted directed graph  $G$  and a source vertex  $s$  in  $G$
- Denote  $V$  as the set of all vertices in the graph  $G$ .
- Each edge of the graph is an ordered pair of vertices  $(u,v)$
- This representing a connection from vertex  $u$  to vertex  $v$
- The set of all edges is denoted  $E$
- Weights of edges are given by a weight function  $w: E \rightarrow [0, \infty)$
- Therefore  $w(u,v)$  is the cost of moving directly from vertex  $u$  to vertex  $v$
- The cost of an edge can be thought of as (a generalization of) the distance between those two vertices
- The cost of a path between two vertices is the sum of costs of the edges in that path
- For a given pair of vertices  $s$  and  $t$  in  $V$ , the algorithm finds the path from  $s$  to  $t$  with lowest cost (i.e. the shortest path)
- It can also be used for finding costs of shortest paths from a single vertex  $s$  to all other vertices in the graph.

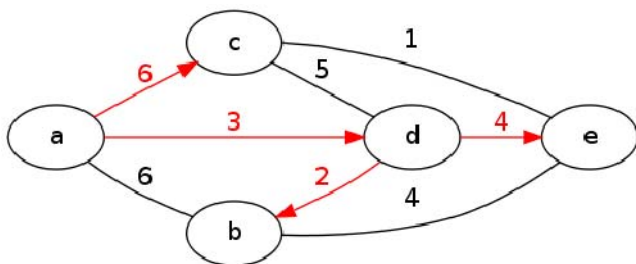


Figure 4. Dijkstras algorithm on tree graph

The Dempster-Shafer and Dijkstra algorithms are well known. The Dijksta algorithm was first published almost a half a century ago. To this day, finding connections between vertices is used. But not

always the shortest path is the best. It is to consider various criteria. This paper is an introduction to further research.

In this study was developed a model of the ship routing network that solves problems optimal path using a modified version of Dijkstra's shortest path algorithm and the basic function of the reaction vessel. Was established fidelity models by testing. As you can see, the model avoids the adverse weather conditions and solves the path of least time to your destination. It calculates the useful time, distance, fuel consumption and metrics to quantify routing decisions. All calculations was made by intervals. (Neumann, 2015)

## 7 CONCLUSIONS

The proliferation of modern electronics systems is already exaction the duration for user input and superintendence systems. Telematics will be requisite to stay the development multitude of user-selectable input attendant and points within the vehicle. As carriage come more complicated they will increasingly confide on telematics and driver notice systems that will come the user interface to both on-board and off board enlightenment. Government commission and homogenous actions are already composed necessarily for telematics systems. Hands-free mobile phone commission are growth fast due to driver furiousness egress. It is probable that low-end telematics with a harangue user interface and radio system integration will come the elect solutions. ITS will enlarge in adulteration over the next decennary and will increasingly need telematics capabilities. As huge as the self-propelled telematics hardware and benefit opportunities may be, the circuitous benefits effectual from the worth of telematics data may be alike essential. The circuitous telematics benefits soften the locomotive assurance diligence, healthcare providers, general safeness agencies and many other industries. The price savings, price annulment and amended functional efficiencies external the telematics assiduity will be graduated in 15 to 20 years. (Juliussen, 2003)

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