Chapter 16
Intelligent Transportation Systems:
The State of the Art in Railways

Sundaravalli Narayanaswami
Indian Institute of Management, India

ABSTRACT

"Intelligent Transportation systems" is what everyone wants to know about, and about which very little is available as know-how. ITS technologies and monitoring systems are quite popular and reasonably well deployed in developed countries, particularly the roadways and airways. ITS holds a greater promise than ever before, as both availability of niche technologies and demand for more efficient transportation systems have increased multi-fold in recent years. Of late, there are huge railway projects all over the world that spans through several techniques, such as light / heavy rails, monorails etc. Apart from the social benefits that can be envisaged, these projects are genuine examples of public-private partnerships along with global business operations. Many of these projects demonstrate a classy trend of moving towards automation of operations of very large scales. Few agent architectures are discussed in brief in this chapter.

ITS: AN INTRODUCTION

It has become increasingly clear that the issue of efficiently moving people and goods is far more complex than previously imagined. The problem is not just confined to surface transportation, that is, vehicles and roadways; it affects trains, passenger planes, air cargo, ferries, ships, pipelines and all available and currently utilized transportation modes. This realization had helped foster the broader notion of intelligent transportation system (ITS). Clearly, to synthesize a genuine and realistic ITS system, one must adopt a holistic approach that takes into consideration complex and asynchronous interdependencies between the many transportation modes and guided by a fundamental goal, namely, minimize the transit time for all travelers and merchandise in transit, subject to fair distribution of the available resources (Chowdhary and Sadek, 2003). In the not-too-distant future, one might envisage a routine space travel to

DOI: 10.4018/978-1-5225-0084-1.ch016

the moon and other artificial satellites and planets in our solar system, which need to be accommodated within the ITS system. It is hoped that ITS caters to our futuristic demands (Konstadinos G. Goulias, 2007); hence the unique attributes of space travel and the likes should be taken into consideration today, while planning out the fundamentals of the ITS architecture for a seamless future integration. The motivation and rationality behind ITS, presumably rests on two key scientific and engineering advances. The first is from computational advances - the increased availability of computing power in the form of powerful desktop workstations and mobile laptops, palmtops, and handheld personal digital assistants (PDAs). The second is from communication advances - the increasing availability of networking, both wire-line and wireless control. However, there are more to ITS developments than mere availability of computing power and communications network. For instance, US rail industry reports that locomotives sit idle as much as 40% due to bottlenecks in the rail corridors due to poor information, coordination, and control. With huge average fuel expenditures of many railroad operators (Ganti et al., 2010), the extent of fuel wastage is staggering with idle running locomotive engines. By any standards, such inefficiency is not sustainable. Additionally to hardware technologies, the key to successful solutions to complex transportation problems lies in comprehensive understanding of the control and coordination algorithms. While abstract, these algorithms serve to unify the computing and networking resources in a synergistic, nontangible manner.

ITS is an evolving scientific and engineering discipline. The primary goals of ITS are:

1. To minimize the travel time of all travelers,
2. To provide safe, secure and reliable merchandising for service providers and end users,
3. To enable optimal utilization of available resources, especially under the scenario of increasing travel speeds and large number of travelers, and
4. To offer a precise and timely information to travelers.

To achieve this goal, it is absolutely essential for a seamless integration of the different transportation modes, including vehicular traffic, trains, cargo air transport, passenger air transport, marine ferries, and others through asynchronous distributed control and coordination algorithms, subject to societal norms, policies, and guidelines. Such an integration will enable a traveler to:

1. Gain access to accurate information of any transportation mode from any location in the system at all times,
2. Deduce the most efficient route or reroute across all different transportation modes using personalized decision support systems, and
3. Book or cancel reservations, dynamically on any transportation system.

Therefore, ITS encompasses:

1. All subareas of transportation management covering both surface and non-surface transport management,
2. Traffic signaling,
3. Travel management, such as multimodal traveler information,
4. Public transportation and transit management,
5. Safety management, which subsumes incidents, railroad grade crossings,

Related Content