

# Intelligent transport system and mobility 3.0: definition, challenges and players

Like many segments of the economy, for over a decade the transport and mobility sector has experienced fundamental organizational changes due to a two-fold revolution in technology (digitalization) and usage (new forms of transportation, autonomous vehicles, etc.). This shift has profound consequences for citizens' relationships with mobility, as well as the economic model used by traditional players (equipment manufacturers, automobile manufacturers, etc.). Looking ahead, and as in other fields, activist consumers could disrupt traditional ways of thinking about mobility.

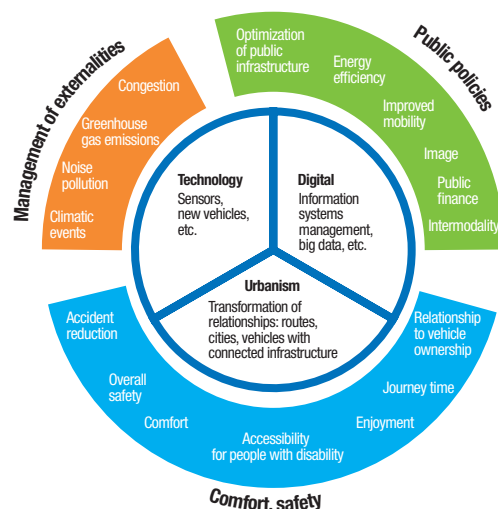
For the past several years, the transport and mobility sector has experienced profound revolutions, and must now systematically be understood by embracing urban, technological and human dynamics: value chain break-up, increased competition among automobile manufacturers, lower vehicle consumption and reduced greenhouse gas emissions (GHG); societal demand for environmental protection, decline of the accidentology, etc. and specific constraints (road congestion, city pollution, etc.). In this new context, the existing relationship between people, automobiles and its immediate environment (road infrastructure, urban design) is being reinvented with the concept of intelligent transport and intelligent transport systems (ITS). Two major paradigms are currently being reinvented.

First, vehicle ownership, which has stood for economic and social success since World War II, is now being challenged by a segment of the population, with the question now centered on the concept of use. Second, the driver tends to be gradually removed from the vehicle, becoming a mere passenger. The move toward autonomous vehicles has reached an intermediate phase with the connected vehicle, borne out of the convergence between the automotive industry and digital technologies (connectivity system<sup>1</sup>). Electric vehicles also have a role in these new mobility paradigms. The Boston Consulting Group affirmed in

April 2017, that by 2030, nearly 25% of kilometers could be driven in a shared, self-driving electric car<sup>2</sup>, resulting in savings of up to 60% of traditional travel costs.

Within this emerging ecosystem (Fig. 1), made up of new players and innovative technologies, the economic model used by traditional players in the transport and mobility sector is being challenged.

Fig. 1 – Intelligent transport systems



Source: IFPEN

[2] <https://www.bcg.com/pt-br/d/press/10april2017-future-autonomous-electric-vehicles-151076>

[1] A vehicle is connected when it incorporates wireless connectivity systems that gather information it can later use. G. Corde, <http://www.ifpenouvelles.fr/Espace-Decouverte/Tous-les-Zooms/Le-vehicule-connecte>

## Intelligent transport system and mobility 3.0: definition, challenges and players

### Intelligent transport system, mobility 2.0, mobility 3.0

The ATEC ITS France Association, which brings together stakeholders in the ground transport sector (see ITS box p. 5), defines ITS as follows: "ITS result from the combination of information and communication technologies with vehicles and networks which ensure the mobility for people and goods<sup>3</sup>".

ITS permit management of externalities related to mobility (noise, pollution, congestion), to improve comfort and safety for people and goods, and to optimize infrastructure management and public policies that relate to the transport system as a whole (Fig. 1). The literature is filled with new concepts to characterize the current revolution. The notion of mobility 2.0, used in reference to the Web 2.0, considers that the automobile is no longer a simple transport object, but rather a mobility tool interacting with its immediate environment, and a communication and information exchange system<sup>4</sup>. The idea of mobility 3.0 has emerged in recent years. Though still somewhat vague, it can be defined as an enhanced mobility 2.0. Resulting from a convergence of digital technologies and mobility issues, it opens the universe of possibilities for all citizens in its transportation modal choices. It suggests a range of mobility solutions in real time, and optimizes the stand-alone and overall systems. Finally, through the autonomous vehicle, mobility 3.0 offers a revolution for the individual, saving time for work or play. "Breaking barriers, optimization and freedom" characterizes mobility 3.0 and the revolution associated with it.

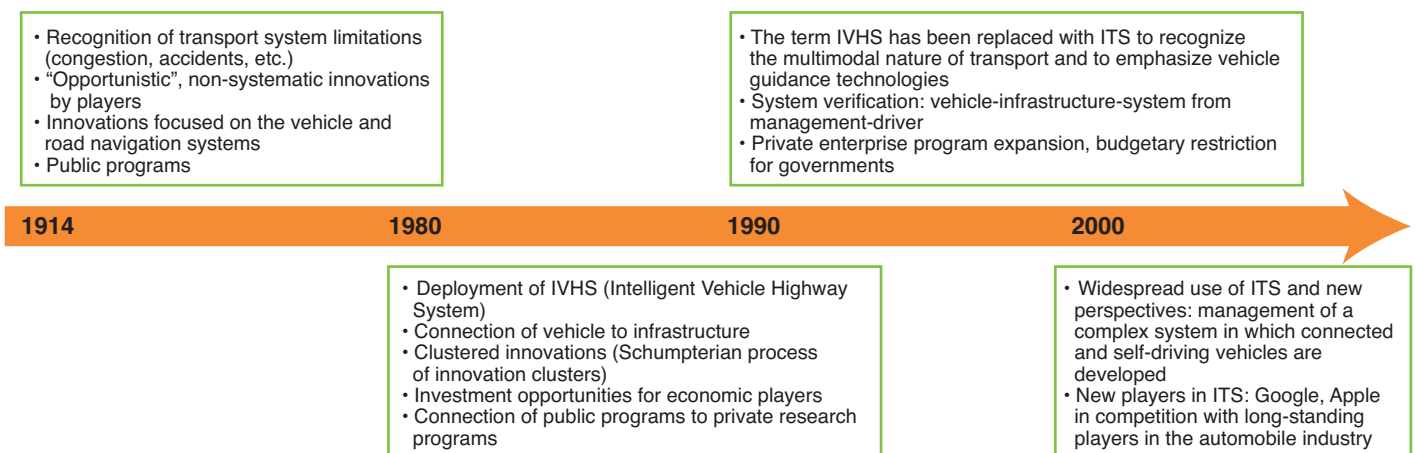
### How have intelligent transport systems (ITS) evolved throughout history?

ITS first appeared in the late 60s and early 70s with the CACS system (Comprehensive Automobile Traffic Control System) in Japan and the ERGS (Electronic Route Guidance System) in Germany and the United States.

Historically, ITS arose from government recognition of the limitations of transportation systems, with the increase in congestion and road traffic accidents. From the first use of three-color traffic lights in the United States (1914) and Europe (France in 1923), to the installation of the first parking meters (1935), the rationale behind initial transport management efforts involved the imposition of recent innovations onto road infrastructure. This approach to innovation gradually shifted toward the vehicle, with a focus on safety, a priority for public authorities with the growing number of vehicles<sup>5</sup> and implementation of new standards (widespread use of seatbelts, packed dashboards, standardized bumpers, etc.).

The first road navigation systems were launched during the late 60s and early 70s, with installation of the first speed sensors, traffic volume sensors and traffic occupancy sensors. The first electronic traffic signals entered widespread use (Dynamic Message Signs) along with the first positioning algorithms with representation on digital maps. All of these innovations were built upon with the creation of the first Traffic Management Centers (TMS), which integrate data on weather, vehicle speed, congestion and accidents. Collected data is distributed to travelers and the media (specially radio). At the time, traffic

Fig. 2 – Evolution of ITS since 1914



Sources: US Department of Transportation, IFPEN

[3] <http://www.atec-itsfrance.net/home.cfm>

[4] This definition comes from the work "The Automotive Revolution, Towards a New Electro-Mobility Paradigm", Danielle Attias (Ed.), Springer, p.10

[5] For example, in the United States, there were more than 75 million vehicles in the 1960s, compared with fewer than 33 million in 1946

## Intelligent transport system and mobility 3.0: definition, challenges and players

management centers were already functioning as a hub for roadway issues. The introduction and expansion of GPS (Global Positioning System) in the late 1970s, with the sharing of satellite capabilities between civil and military use, leading to improved TMS operations.

The 1980s saw a revolution in the transport sector with the launch of Intelligent Vehicle Highway Systems (IVHS). Innovations no longer focus solely on the vehicle, but rather on the ability to connect the vehicle to its infrastructure. With expanding mobility, the economic opportunities within the sector are growing and benefit from funding through public and private research programs. In this manner, specific research programs on automatic traffic control systems have been initiated, along with the first autonomous vehicle prototype programs through the DARPA<sup>6</sup> program in the United States (ALV - Autonomous Land Vehicle). In 1985, the first prototype could reach 3 km/hr along a straight route, for a distance of around 1 km. The ALV was preceded by the robotics laboratory Tsukuba in Japan which, starting in 1977, launched a driverless car that traveled at nearly 30 km/hr. In Europe, the Prometheus program (PROgramme for a European Traffic of Highest Efficiency and Unprecedented Safety) funded software to support driving by autonomous vehicles. Germany, through its universities (automatic recognition software) and manufacturers (particularly Daimler-Benz) also took the lead on these issues.

The concept of intelligent transport systems (ITS) emerged during the 1990s. The transition from IVHS to ITS reflects a shift in emphasis from the vehicle to the system, and a focus on the multimodal nature of transportation. ITS reflects the notion of a systematic feedback loop around four components: the vehicle, infrastructure, the management system and the driver. Technological innovations relate to improvements and standardization of transport management systems, integrated navigation systems for the driver (GPS, traffic management, dashboard) and electronic toll systems.

Since 2000, ITS have become widespread and are driven by the digitalization process observed across various sectors of the economy. The key changes have allowed improvements to driver assistance systems, but stakeholders' priorities have changed. While safety and congestion still drive technological development for ITS, economic (reducing vehicle consumption) and environmental challenges (lowering GHG emissions) also contribute to the convergence between digital technologies and traffic management. The 2007 launch of the iPhone and, more broadly, the widespread use of smartphones are increasing the momentum of ITS.

(6) An agency within the United States Department of Defense, the Defense Advanced Research Projects Agency in charge of R&D for technologies for military use.

### The Geco air application developed at IFPEN



Geco air is a free smartphone app, developed by IFPEN with the support of ADEME to raise awareness of pollutant emissions related to transport methods. It aims to help users reduce the day-to-day environmental impact of their journeys.

Through the smartphone GPS, Geco air analyses emissions related to the journeys undertaken, regardless of the transport method used (car, bicycle, walking, public transport). Geco air innovatively couples information technology with IFPEN's expertise in modelling vehicles, achieving highly reliable results. With all of this information, Geco air provides a mobility score each day, for each journey – a barometer for clean transport! The application also provides customized advice. It helps to change driving methods in order to reduce journey impact, and also promotes more eco-friendly methods of travel – such as the bicycle – for certain short, high-emission routes. Emissions of pollutants can be lowered by 50% by following Geco air's advice!

Source: <http://www.ifpenergiesnouvelles.fr/Espace-Decouverte/Tous-les-Zooms/Geco-air-l-appli-Smartphone-pour-une-mobilite-plus-propre>

These structural changes are driven by the convergence of stakeholders in the digital and transport sectors. Major GAFAM players (Google, Apple, Facebook, Amazon) have launched transport research programs. In 2005, Google initiated a R&D program focused on driverless cars, leading to the manufacture of a prototype in 2010.

### Classification of ITS-related applications

**Information for travelers:** information on trip preparation, information during travel for the driver, information during travel on public transport, roadway information, positioning, etc.

**Traffic management:** traffic control, accident management, flow management, infrastructure maintenance management, infrastructure planning, etc.

**Vehicle:** improvement of visual coverage, automated vehicle operation, collision avoidance (lateral and longitudinal), safety, vehicle maintenance, etc.

## Intelligent transport system and mobility 3.0: definition, challenges and players

**Commercial vehicle:** pre-clearance for utility vehicles, administrative procedures for utility vehicles, automatic road safety inspection, monitoring on-board safety for utility vehicles, automobile fleet management, automated diagnostic systems, etc.

**Public transport:** public transport management, management of flexible transport, management of shared transport, schedule management, positioning, etc.

**Emergency management:** emergency notification and personal safety for travelers, emergency vehicle management, management of hazardous materials transport and incident notification, etc.

**Electronic payment:** electronic financial transactions (tolls).

**Safety:** public safety for trips, improvement of user safety, intelligent junctions, etc.

However, the Google Car activity has now been incorporated into Waymo. Google no longer wishes to become a car manufacturer, but rather plans to specialize in software to support autonomous driving and car sharing services for driverless vehicles. For its part, Apple has launched the Titan project which unites the IT giant's ambitions with the electric and self-driving vehicle sectors. In May 2017, Amazon opened a software development center in France to focus on drone traffic management for its deliveries.

### Key players in France

In October 2015, the 22nd ITS World Congress<sup>7</sup> held in Bordeaux shattered every attendance record (more than 10,000 participants), demonstrating the growing enthusiasm about these issues<sup>8</sup>. During this Congress and with the approach of COP21, French participants have broadly contributed, alongside professionals, the media and their international partners, to tapping and incorporating ITS into a worldwide effort to fight for the environment and the climate (Ségolène Royal signed a manifesto along with 28 ministers and representatives from other countries<sup>9</sup>). However, while two years ago France hosted the largest congress on ITS, what actions are actually being taken in the country? Can France be considered as a major player in ITS?

[7] <http://2015.itsworldcongress.com/>

[8] Figures date from 2015 but trends since then have continued to move in this direction

[9] Report from the 22nd World Congress on ITS, *Mission des transports intelligents*, November 2015

### The challenges

Intelligent mobility significantly boosts employment, innovation and new business formation, especially start-up companies. According to the green paper drafted by the ATEC ITS France network<sup>10</sup>, this sector already represents annual sales of €4.5 billion within the country, counting more than 1,000 businesses and 45,000 direct jobs in the private sector. While these figures may seem somewhat optimistic, the sector also brings hundreds of thousands of indirect jobs in traditional sectors like construction, transport infrastructure operation, automobile manufacturing and logistics, which increasingly use intelligent mobility solutions.

In the face of new challenges linked to the rise of ITS, it is important to draw comparisons to the undeniable strengths of French stakeholders. France has many talented engineers, great technological know-how and industrial capability, along with renowned research and public education institutions. In view of this, it is possible to strengthen French intelligent mobility capabilities. This is essential and strategic in order to maintain sufficient innovation and prevent intelligent mobility products and services from being relocated outside of France.

### The specific case of intelligent infrastructure

Despite significant technological advances, the success of connected and autonomous vehicles is closely tied to improvement of infrastructure and the urban environment, which must also be fully connected, along with regulatory changes. With this in mind, many firms, including automobile equipment manufacturers, are working to design new technologies, as an integral part of ITS and intelligent cities projects worldwide. The market is still dominated by North America and is estimated to reach \$39 billion by 2020<sup>11</sup>. These innovations include cameras, sensors, software and positioning tools, installed both on the roadways and in vehicles to monitor, control and manage road traffic in real time while exchanging information with surrounding vehicles. Among the players operating in this sector, Flir, the global leader in thermal imaging systems, French automotive equipment suppliers Valeo and Faurecia are faced with international competition (Magna International, Continental AG, Robert Bosch GmbH).

### Strategy for France

France can rely on sustained European momentum that seeks to promote ITS research and better define interoperability challenges (H2020 program with a specific section

[10] *Mobility 3.0: Ensemble pour une mobilité plus intelligente*, Green paper, ATEC ITS France, September 2015

[11] *Mobilizing Intelligent Transport Systems (ITS)*, GSM Association, 2015

## Intelligent transport system and mobility 3.0: definition, challenges and players

dedicated to ITS as part of the Smart, Green and Integrated Transport challenge). In addition, the government has proposed a strong local policy with support for innovation. For example, these include Phase 2 of Nouvelle France Industrielle (NFI) which provides €1.9 billion in subsidies for innovative industrial projects, many of which relate to ITS.

In addition to public subsidies that mainly support development of ITS at the local level, French players in ITS rely on a dedicated network through the ATEC ITS France Association, which aims to bring together and encourage cooperation among these stakeholders.

Finally, on September 19, 2017, the new French government launched *Assises de la mobilité* (mobility roundtables). These roundtables are one of the key projects undertaken by the Minister for Transport, Élisabeth Borne, and the Minister for Ecological Transition, Nicolas Hulot. All private and public stakeholders have a seat at the table, where the future of ITS in France is discussed.

### ITS in territories in France

For the past several years, there has been a significant expansion of local initiatives (urban areas, transport catchment areas, regions) advocating for change in mobility patterns and ITS. Major projects are currently emerging, bringing together public and private stakeholders and promoting the formation of start-up companies. Major metropolitan areas can be seen as full-scale laboratories. Examples of planned or ongoing projects include:

Optimod’Lyon<sup>12</sup>: a three-year project to optimize sustainable mobility in central Lyon. Thanks to this projects, more than 70 wireless sensors have been installed below the asphalt in strategic locations. This provides more detailed traffic information to inform users and regulate traffic in real time. This project also includes three other aspects, including optimization of parking space availability and the creation of a multimodal urban GPS for the smartphone.

The Grenoble Alpes urban community has a centralized multimodal management center for transport. The project seeks to reduce the proportion of cars in the market in favor of alternative transport methods.

SCOOP@Breizh<sup>13</sup> Project: pre-deployment in Brittany of an innovative system that falls within the field of communicative cars. In 2016, nearly 3,000 vehicles were equipped with this system, which offers real-time information to drivers, improves driving safety and makes it easier to get around. ITS Bretagne manages the project for Breton local authorities.

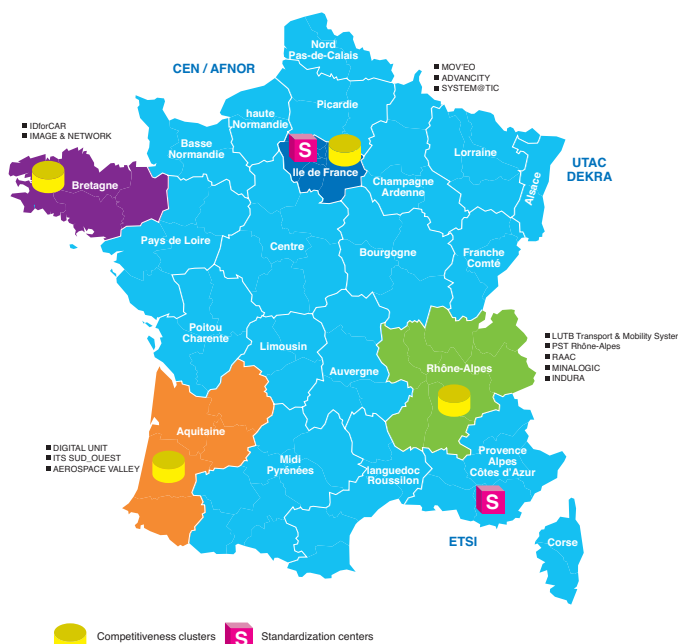
### The ATEC ITS France network

The ATC ITS France network brings together key players in the field of intelligent mobility. It was established in 1973. Today it has more than 130 complementary member organizations, including regional authorities, government services, research and educational institutions, as well as the principal companies and engineering firms within the transport sector.

ATC ITS France leads the ambitious national program Mobility 3.0 which provides structure for stakeholders within the ecosystem, providing a base for French leadership in the ITS field and promoting solutions development in France and abroad. Lastly, ATC ITS France represents all players involved in international bodies dedicated to development of ITS solutions. In November 2016, a mandate letter cosigned by DGITM (General Directorate for Infrastructures, Transport and the Sea) and DGE (Directorate General for Enterprise) assigned ATC ITS France to lead discussions aimed at producing a national road map.

At the national level, public action to develop ITS is focused within four highly active regions (Fig. 3). Stakeholders include academics, research institutions, competitiveness clusters, certification centers and other entities.

Fig. 3 – Map of the most active public players in ITS (September 2017)



Sources: ATEC ITS France, IFPEN

[12] [http://www.infra-transport-materiaux.cerema.fr/IMG/pdf/COLDEFY\\_J.pdf](http://www.infra-transport-materiaux.cerema.fr/IMG/pdf/COLDEFY_J.pdf)

[13] <http://www.itsbretagne.net/index.php/projets/projet-scoop>

## Intelligent transport system and mobility 3.0: definition, challenges and players

### Curbs on deployment<sup>14</sup>

Even if they meet growing demand from users and managers, intelligent transport services are faced with numerous obstacles to growth:

- the growing number of involved players add to the complexity, and therefore difficulty of ITS service production; governance challenges are particularly significant, especially to promote multimodality;
- integration of innovations (mainly from IT and telecommunications services) demands field testing within the transport system, which market players cannot always conduct without support from public authorities, especially infrastructure managers;
- access to data plays a key role in ITS development; it lies at the heart of specifications set forth in Directive 2010-140<sup>15</sup>; but the issue of charges for data access will likely require an additional reference framework;
- the expansion of services, systems and related equipment makes it difficult for public decision makers to set priorities when faced with growing budgetary restraints.

While multimodal practices expand (shared bicycles and automobiles, car pooling, electric vehicles, etc.), we are also faced with a paradox. Users are demanding greater fluidity in intermodal interfaces, information and payment, while the players involved (project managers, operating authorities, managers and service providers) are increasingly varied.

Transport operating authorities often find themselves at the center of the interplay among these stakeholders, especially at the regional and departmental levels, and have developed a range of initiatives, mainly focused on the concept of mobility centers that bring together various transport providers and handle services, information and payment.

However, these services do not cover the entire territory and, from the user's point of view, may appear inadequately standardized or multimodal. The lack of evaluation is also

hampers future deployments. All of this information suggests that ITS in France have reached a critical juncture in their development. In fact, the current environment, characterized by a proliferation of players and options, require implementation of a specific form of governance to streamline offerings from the various players to more effectively meet consumer demand. Better organized, ITS can serve as a genuine catalyst for growth for all stakeholders in the new urban mobility revolution.

### Conclusion

ITS are currently at a crossroads, faced with many challenges that largely exceed the scope of technological innovations or the driver-vehicle-infrastructure relationship. The ability to optimize mass data on movement of people, while minimizing accident risk and reducing the carbon footprint, require improvements in big data management. In addition, the main constraint will likely be systemic. In the coming years, ITS will manage a complex system that blends traditional vehicles, connected vehicles and driverless vehicles. It must also be optimized within economic (system costs), safety (accident reduction), energy (lower consumption), environmental (smaller carbon footprint) and practical (payment, accessibility, etc.) limitations.

Meanwhile, ITS serve as a new economic model for mobility-related services. There are numerous opportunities in technology and the scope of innovation is vast, including digitization, sensors, infrastructure and services. The other driver behind ITS is its connection to the masses (through Internet platforms, social networks and mobile applications). These are low capital intensity services that quickly change or optimize mobility patterns.

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[14] <http://www.wikiterritorial.cnfpt.fr/xwiki/wiki/econnaissances/view/Questions-Cles/Lessystemesdetransportintelligents>

[15] [http://transport-intelligent.net/IMG/pdf/Presentation\\_de\\_la\\_directive\\_J0.pdf](http://transport-intelligent.net/IMG/pdf/Presentation_de_la_directive_J0.pdf)