Final Report Summary - 3IBS (The Intelligent, Innovative, Integrated Bus Systems)

Executive Summary:
The 3iBS project is founded on the consideration that buses still remain the most universal solution for a sustainable urban development, effectively taking into account the economic, environmental and social perspectives. Following the outcomes of previous research initiatives on bus systems, in particular the European Bus System of the Future (EBSF), 9 partners together with about 30 associated members have been actively working - since October 2012 - to give a new identity to urban and suburban bus systems. As the ultimate objective, the 3iBS project is committed to make the bus a competitive mode of transport for both passengers and operators.

Operational and infrastructural bus solutions have been addressed in the study cases analysis in order to assess how innovative concepts can be implemented in the real experience of urban mobility. The findings of this analysis, together with the review of research results on bus systems or specific bus system elements (coming from, e.g. ZeEUS, Civitas CAPITAL, NODES, ITxPT, OPTICITES), have produced a set of guidelines for the implementation of such good practices across European cities. The recommendations will support PT stakeholders from outside the project, who are interested to introduce them within their bus networks. Moreover, priority actions for further research, development and regulation have been identified and consolidated in the Innovative Bus Systems Roadmap (iBS).

3iBS has worked not only through case studies. The Survey on European Bus System Strategies presents a snapshot of the bus fleets in operation in urban areas across Europe and helps understanding the role of bus systems in local mobility policies for the coming years, a step towards a stronger competitiveness of the bus in the urban environment.

The 3iBS consortium and the associated working groups are widely representative of the European Public Transport sector. The joint collaboration of industries, PT operators, PT authorities, suppliers and research institutes all along the project life has allowed providing a significant overview of the current status of bus systems in European cities and identifying, as an overall final result, the common challenges and related research priorities for the further development of such systems. The results achieved within 3iBS shall encourage European PT stakeholders to set up a dedicated implementation entity based on the vision of the Innovative Bus System Roadmap.

Project Context and Objectives:
Towns and cities across Europe are facing growing mobility challenges due to a constant increase of passengers’ flows in/out and within densely populated areas. Urban sprawl and new mobility habits have resulted in chronic congestion throughout cities, with the consequences that this entails in terms of air pollution, accidents rates and accessibility problems. Climate change, environmental safeguard and integrated strategies to fight congestion phenomena in urban areas have become more and more mainstream issues on political agendas in Europe. Thus far results have been promising but private cars are still the dominant option (83.3%) in the modal split across Europe (Eurostat 2013) and the public tolerance for congestion is still high, as the average delay in minutes for one-hour journey driven by car in peak periods is 29 minutes (TomTom International 2013). At the same time, emissions due to transport are a largely acknowledged yet unsolved problem: in 2011, fuel combustion in transport still accounted for 20.2% of the greenhouse gas emissions in the European Union (EU) 28
Member States, since “transport was the only source that presented an increase between 1990 and 2011 (+19 %)” (Eurostat 2013:147), and for what concerns specifically CO2 emissions, more than 70% of them are due to road transport (European Commission 2014).

As a matter of fact, bus systems are in the front line in competing with private motorised transport for any travel across urban areas. Bus systems are the primary form of public transport both in Europe, where 56% of all passengers' journeys made by local public transport are undertaken via urban and suburban buses (UITP, 2014), and worldwide, where the bus market share is estimated at 80%. Buses are more environmental friendly than cars (in terms of energy efficiency, emissions and space occupancy), are a public transport mode tailored to the needs of end-customers in terms of network coverage and capacity and they do not require heavy infrastructure to be put in service. Nevertheless, bus is still perceived as a less attractive option among public transport modes, because of its low performance mainly in terms of regularity, speed, comfort and design.

Undoubtedly, bus systems offer a huge potential to make significant qualitative improvements and promote a low-carbon and resource-efficient mobility. Customers expect the same kind of lifestyle services and connectivity from PT vehicles and terminals as they already have in their own living space. Such services build on basic requirements like comfort, security, cleanliness as well as operational excellence, which calls for enhanced frequency, punctuality and reliability of the services thanks to optimised network design and service performances. Likewise, smart ticketing and integrated travel information contribute to making buses user-friendly while facilitating accessibility for all citizens.

Looking at the bus system as a whole including vehicle, infrastructure and operations, 3iBS identified 7 key research areas with high potential in generally perfecting bus infrastructures and operations, namely:

- Ensuring accessibility and safety measures to bus infrastructures and vehicles;
- Adapting accessibility and optimising operations to special events;
- Identifying new energy strategies while reinforcing the existing and successful policies;
- Adjusting internal and external modularity to the operational scenario;
- Intermodality with private and public transport modes;
- Restoring the service level and developing innovative solutions to prioritise the bus system;
- Standardising the IT platform for bus systems previously developed by the EBSF.

For all of the above domains, 3iBS was committed to exploit research and stimulate the deployment of key solutions in bus networks by promoting exchanges of knowledge and experience on a global scale. All in all, the exploitation of results and further development of the innovation areas are expected to promote a new generation of bus systems, more attractive for passengers, more efficient and economic to operate and more environmentally friendly, reinforcing at the same time the position of the European bus industry.

Project Results:
The overall methodological approach developed to achieve the project objectives is based on four core activities:

1. Validate innovative solutions through the analysis of Study Cases
2. Define a work-plan to move from research to innovation
3. Develop a Roadmap for European Advanced Bus Systems
4. Disseminate the 3iBS message

The work performed and the results achieved all along the life the Project are summarised in the following by core activity.

1. Validate innovative solutions through the analysis of Study Cases

Aiming at assessing how innovative bus systems concepts or solutions, as defined in EBSF and other research initiatives, have been successfully implemented in the real experience of urban mobility, the analysis of Study Cases focused on a set of good practices selected thanks to the experience of PT operators. More than 30 operational or infrastructural solutions tested in
France, Germany, Italy, the Netherlands, Spain, United Kingdom, Turkey, South Africa and Brazil have been analysed and guidelines for the implementation of such good practices across European cities have been produced to support other PT stakeholders interested in items to realize within their network. Moreover priority actions for further research and standardisation have been identified.

Since the 7 key research areas deal with very different aspects of bus systems, specific methodologies have been developed for the analysis of the relative study cases.

Accessibility is the degree to which a product, device, service, or environment is available to as many people as possible. A public transport system is accessible to people who are able to use it. There are many factors that may prevent a person to such access including a non-accessible design of bus stops and stations, vehicles, ticketing system and information as well as a feeling of insecurity when travelling. Approximately 39 million people in Europe are estimated to have some kind of disability, and as the demography of Europe is changing so is the proportion of older people and hence also people with different disabilities (EuroAccess, 2008a; NDA, 2005). EUROSTAT predictions show that the share of people aged 65 years or over in the total population is projected to increase from 17.5% (2011) to 29.5% (EUROSTAT, 2011). Similarly, the number of people aged 80 years or over is expected to grow from 4.8% in 2011 to 12% in 2060.

An inventory of user requirements for an accessible and safe bus system was performed, more specifically for the design of bus stops, vehicles, information and ticketing systems. Two study cases, Nantes and Rome, were analysed and assessed in terms of their respective potential contributions, with a focus on the elderly population and travellers with special needs. The Rome study case is more limited to its character since it focuses only on one part of a bus system: the vehicle. The measures implemented include several features: doors, dedicated areas for travellers using a wheelchair, information onboard, etc...; the study case could be described as modifications of a sub-system within the larger bus system. The Nantes study case differs from the ‘standard’ project in that it describes quite radical changes and conscious design of several features of a bus system: time table changes, dedicated bus lanes, speed restrictions, areas with restricted access for private cars, redesign of bus stops including the surrounding areas, pedestrian crossings, as well as traveller information. It does not include changes to the buses, the vehicles, though. Together the two cases cover a major part of a bus system – with the exception of ticketing.

In addition a selected set of EU-projects (among the others: PLUSBUS, EURO-ACCESS, PTACCESS, UNIACCESS, MEDIATE, SAVE ME, NICHES+) were investigated in order to identify innovative ideas and concepts for accessible and safe public transport vehicles, services and infrastructures. The inventory shows that a large number of projects has addressed and is addressing accessibility, in particular the accessibility for travellers with disabilities. Less focus seems to have been given to safety (and security) in public transport. Interventions include accessibility related to vehicles, bus stops and stations, and information systems whereas less emphasis appears to have been placed on ticketing. The outcomes of these and other projects constitute a comprehensive and valuable set of guidelines, recommendations and best practice examples in the fields of safety and accessibility, but the knowledge and the examples are far from being applied as consolidated practice across Europe. Policy work lies far ahead from implementation processes and in addition the level of implementation varies from country to country and place to place. Significant research and implementation efforts are still needed in order to address accessibility and safety for all travellers.

The recommended approach to accessibility and safety can be described as ‘inclusion’ rather than ‘integration’ or a “design for all thinking "versus introducing special solutions targeting special groups of travellers. The mindset is supposed to influence the processes and ways of working. In a similar way an understanding of accessibility as primarily physical accessibility to infrastructure and vehicles leads to certain visions whereas accessibility understood as creating access to public services leads to other visions.

Finding new and innovative ideas for accessible and safe vehicles, infrastructure (bus stops), information system, and ticketing is important. It is however fundamental to stress that no single feature or scheme will make a journey accessible. An
Investment in low floor buses may be of no value to the individual traveller if the access to the bus platform is made impossible by, for instance stairs or roadworks. In many municipalities the links between the chains are the responsibility of different authorities and/or private businesses which makes it difficult to ensure that the links are joined. This means that further efforts are needed to accomplish better coordination between different modes of transport (seamless journey, seamless information, seamless ticketing) and between different authorities and businesses. Information technology and an exchange of information between co-producing actors (transport authorities, operators, service providers, etc.) will be a prerequisite for multimodal and co-modal integration.

Assessing accessibility and safety solutions most often means to assess them in an objective way according to certain criteria. However, travellers’ behaviour is primarily based on what they believe to public transport to be, not what it is. It is therefore essential to develop further knowledge on the (possible) differences between ‘actual’ and ‘perceived’ accessibility and safety of PT systems. Moreover, the assumption that older travellers and travellers with disabilities cannot be treated as one category of travellers has been challenged in several projects but nevertheless most policies as well as design recommendations still treat these groups of travellers as one. In order to find solutions, further knowledge is required about older persons needs to travel, travel patterns, and choice of travel modes as well as on possible conflicts between the needs and requirements of older travellers and other groups of travellers including travellers with disabilities.

There is, finally, a need for improved method and tools to support the evaluation of different solutions from an accessibility and safety perspective. For instance, more useable public transport accessibility and safety indicators or improved cost-benefit methods to help assess the benefits (also in terms of independence and quality of life) of different measures, making it easier to prioritise between measures and help decision makers to implement them.

Cities are the theatre of a growing number of Special Event: sport competitions, concerts, cultural festivals and religious pilgrimages, but also strikes and underground disruptions that cause an unexpected temporary growth of surface transport demand. It is a core requirement for cities and PT companies to have the organisational and traffic management capacity to deal with the wide range of activities and special events that take place, whether they are planned or unplanned. A special event is an event that causes an exceptional movement of people within a host city (or a specific area of the city) and/or perturbs the regular operational status and management of the Public Transport system.

Special events go beyond the normal mobility demand, impact significantly on the transportation services in at least one part of the city and require a specific logistical response. Bus services are usually a significant part of such logistical response, covering both city buses and those from outside the city bringing people to and from the event. Experience shows that special events critically rely on the ability of the public transport system of the host city to get large amounts of extra travellers to the right places at the right time. In addition, the challenge of special events management is not only to merely guarantee the transport service to the venue of the event but also to guarantee regular PT services for the normal users, not interested in the event, with a specific attention on users with special needs and users’ security.

Overall, 9 different special events (hosted in Cape Town, Curitiba, Madrid, Milan, Rome) have been analyzed to provide a comprehensive overview of existing procedures and actions undertaken by European and Worldwide transport operator and municipalities for the management and provision of bus services during special events. For each study case the analysis focused on the requirements to meet and measures implemented in terms of information to passengers, bus service modifications, ticketing, services for passengers with special needs, parking policies, security, coordination and reactivity of the system, intermodality.

Focusing on the variable “time”, the study cases have been grouped in:
• Unforeseen events; PT stakeholders have to adjust quickly their offer in order to provide an efficient bus service (e.g. the Death of Pope John Paul II, Rome 2005).
• Planned events; PT stakeholders have the time to design and schedule all the needed activities (e.g. the World Youth Day, Madrid, 2011),
• Periodic events, PT stakeholders have the time to design and schedule the needed activities based also on the previous editions (e.g. sports events and concerts in Milan).

Independently from the technical solutions adopted and services implemented, information to passengers and coordination
and reactivity of the system (real time event’s management) appear to be as the key priorities for special event management. Efficient and timely information to passenger allow the users to successfully find their way among the different PT solutions offered. This remains valid both for the events’ users, who can be foreigners and not be aware of the city and its transport system, but also for regular users, inhabitant of the host city, who can found themselves in a transport system scenario different from the one they are used to (e.g. temporary deviations of routes and changes in schedules). In such circumstances social networks and Short Message Service (SMS) on mobile communication systems, perform the leader roles, permitting to reach a wide group of users in a very short time. The availability of trained staff and volunteers on strategic network nodes is also crucial according to the inventory of special events. The analysis shows that an effective real time event’s management can be reached by implementing a Control Management Centre and collecting information through staff monitoring the transport service and the event evolution. If an unpredicted situation occurs, it is of utmost importance the availability of a high level decision person, for the entire duration of the event, to quickly activate modifications to the agreed plan and re-arrange the system. In those cities where several operators manage the PT systems it is also important to have a solid cooperation and information exchange between all of them. A single authority or operator assuming the leading role appears to be a successful solution.

3iBS identified also a range of potential enhancements for managing bus services during special events. Suggested enhancements are based on post-event review of both the planning and execution phase. Some are the results of a deeper understanding of what could have been done better and how new technologies could have been utilised, while others are the results of addressing identified problems and process weaknesses. Mostly they can be implemented immediately with the available frameworks, know-how and technologies. However, there are some areas that require further research, development or harmonisation. These are mostly activities that go beyond a single city or even a single country, and are proposed as the further research recommendations, among them:

• A unified ticketing and validation system: a common European technology to speed up the operation of ticket validation and bus entrance authorisation.
• An interoperable European IT platform to exchange updated and reliable PT service information among stakeholders, users, operators.
• Further research about the design of PT infrastructures and their equipment considering the specific requirements for special events.

Based on the classification of “points of connection” produced in the EBSF project (i.e. long distance interchanges, metropolitan interchanges, intermodal areas and connecting points) and on the results and methodological approach developed in other past and ongoing projects (as PIRATE, NICHEs+, NODES, etc.) a set of selected best practices on intermodality have been analysed within 3iBS. The selected solutions are in operation in Umbria Region (Italy), Istanbul (Turkey), Osnabrück (Germany) and Madrid (Spain).

The main requirements for intermodality, conceived as the needs of bus services when combining with other public modes and complementary modes (walking, bike, car pooling, car sharing, etc...) have been investigated. To enable a wider approach towards intermodality, the analysis focused not only on interchange infrastructures but also on intermodal systems (e.g. integrated ticketing systems) and other intermodality management aspects. The study cases show that overcoming barriers to passenger intermodality requires three major next steps: further development of physical infrastructure (especially interchange points), improvement and enhancement of technological aspects, and expanded policy and legal frameworks to facilitate intermodal cooperation.

Identifying quality and design standards for interchange points is considered of utmost importance to help cities, operators and authorities implementing these infrastructures more easily, with minimum common standards to achieve. Without effective physical connectors, smooth and seamless services are impossible. The energy and environmental impacts of the interchange points should be considered as well in the design process. In the future, an interchange should take up the role of the energy producer, not only of an energy user. Terminals should offer options for rapid and slow charging of other electric vehicles such as electric buses or e-cars, e-bikes, e-taxis and help extending fully-electric solutions to a wider part of the urban road transport network. In order to find energy efficient solutions, further knowledge is required about interchange and landscape design (climate change adaptation), carbon neutral design,
energy management of the building (during construction and operation), water and waste management, renewable energy use (material/resources).

Concerning technological aspects, information systems that include all major modes of passenger transportation can greatly facilitate intermodal connections. These systems are a necessary prerequisite to achieving the vision of one-stop, seamless, door-to-door passenger service. Significant advances have been made in the development of door-to-door intermodal journey planner and inclusive computer reservations systems in certain modes but similar advancements need to be achieved also at urban-metropolitan scale. Further efforts (also considering the legal framework) are needed in establishing open data standards and supporting the introduction of a common European system for electronic ticketing (e.g. smart card system), while keeping open the possibilities for lower-cost options.

Regarding policy aspects, cooperation within and between the private and public sectors remains the key aspect in making intermodality a reality. Private sector progress will occur only as far as the industry can create profitable services. As more passenger intermodal initiatives are implemented over time, a longer track record of performance can be assessed to determine the successfulness of these innovations, which should result in an expansion of intermodal services. Mutually beneficial cooperation between private sector companies will make this happen. But cooperation must also include the public sector in the provision of physical infrastructure, information systems, and the policies that will facilitate implementing intermodal initiatives.

Selected bus system solutions in operation in Barcelona (Spain), Cagliari (Italy), London (United Kingdom), Paris and Nantes (France) have been analysed according to their level of service taking into account environmental, economical and comfort aspects.

To do so, a first differentiation between Level of Service (LoS) and Quality of Service (QoS) has been made. According to the definition provided by the COST Action TU 603 -Buses with a High Level of Service, the Level of Service “measures the quantity of the service as it is planned (frequency, capacity, operating span, etc.).” Buses with high level of service needs to offer a high quality”, but this doesn’t mean LoS being equal to quality of service, since the later measures the gaps observed between the planned service and the service really provided (regularity or punctuality, reliability, comfort, accessibility, etc.), according to the EU standard EN 13816. It could be said that service levels are one of the determinants of the quality of public transport services, but not the same thing. In other words, the quality of service involves the passenger’s point of view, whilst the concept of level of service is used to quantify quality of service, since it refers to the quantity of services offered, such as, typically, frequency, vehicle capacity, vehicle commercial speed, but also service span, comfort, safety, accessibility, connection to the network and other modes, related services (CERTU, 2005).

The selected study cases cover a wide range of bus system solutions, from bus with high level of service that operates on fully-dedicated infrastructures in order to combine the flexibility of buses with the efficiency of rail, to local lines, low capacity and low frequent services featured by standard buses with very limited ITS solutions. They have all been assessed in terms of performance and efficiency through a set of indicators which takes into account the vehicle, the infrastructure and operational concepts. More in details, the evaluation of the level of service was mainly based on age of the fleet, passenger load factors, dedicated lanes, Intermodal Transport Control System (ITCS), priority at traffic lights, commercial speed and peak headway. On the contrary, the quality of service of the different bus solutions has been characterized by indicators that measure the factors that influence passengers’ perception of the journeys’ quality.

All the study cases show good performance in terms of LoS, mostly in terms of age of the fleet, Intermodal Transport Control System, priority and commercial speed. Critical appear to be in all the investigated bus systems mainly the availability of dedicated lanes and the passenger load factor. Regarding QoS, it is noticeable the good performance of indicators as info to passengers, level of safety and ride quality, while quality of docking, image of the bus system (i.e. branding and specific design of buses and stations), marketing campaign and ticketing services appeared to be less advanced in several sites.

The analysis shows that cities redesigning their bus networks have experienced a great level of customers’ satisfaction while improving performance and cost of operations. There is also a trend to establish a clear hierarchy of lines (high frequency trunk routes, lower frequency local routes), well perceived by customers and generating ridership gains. The new network
design has to reduce the need to travel on an existing radial network, by means of new orbital lines that link directly attraction poles both existing and newly planned outside the city centre. It is based on few lines with few transfers, high frequencies and few stops, and is in line with the hierarchical organization of the bus network, which has to be different in each site depending on local characteristics and objectives to be achieved.

Improvement of average bus commercial speeds is a priority achievable via technical solutions (optimisation of traffic light control for enhanced crossroads performance and bus priority; wear-resistant materials for bus lanes - especially if guided-, rutting -lane grooves, etc...), constructive (e.g. kerb stone, saw-tooth bays) and layout solutions (e.g. bus lane management/guidance like introduced in Chinese BRT systems) and improvement of the interfaces between operators and authorities.

Modularly designed bus concepts are a relatively new strategy to save operational costs while keeping the same capacity or provide additional services for passengers without increasing the operators’ cost. The term modularity describes different bus concepts with a variable capacity. The overall objective of modular bus concepts is the adaptation of the bus capacity to the actual passenger demand. The passenger demand can vary in different ways: during a day (peak and off-peak traffic), during a week (working days vs. weekends), during a year (e.g. lower demand throughout the holiday season). Furthermore the passenger demand varies along each line, with the highest demand normally occurring in the city centres and near important destinations. Each variation of passenger demand can be met with different modularity concepts.

In general there are three different modularity categories:

- **Modular manufacturing of buses** means the use of modular assembly groups for different sizes of buses in order to reduce production cost.
- **Internal modularity** provides the possibility to vary the bus capacity with folding or sliding seats.
- **External modularity** describes concepts that offer a variable capacity by coupling and uncoupling single buses or trailers to buses. Hereby the coupling and uncoupling can take place at the bus depot and/or during operation.

The knowledge about the potentials of modular bus concepts and the necessary prerequisites for their introduction has been significantly enlarged within 3iBS, exclusively in terms of internal and external modularity. Modular manufacturing was not within the scope of project.

Seven study cases from six European cities (Rome, Taranto, Padua and Vicenza in Italy, Paris and Chambéry in France) have been analysed and provide a clear and facts-based list of the cost advantages due to the introduction of modularly designed bus concepts by replacing conventional buses on selected lines. The analyses, in conjunction with the results of EBSF, underline the feasibility of modular bus concepts. However, the results once more prove that suitable use cases are difficult to identify and that the full exploitation of the advantages requires at least a partial adaptation of the lines, the network and/or the schedules. For instance, the 3iBS study cases dealing with an adaptable bus capacity or bus-trailer-combinations clearly showed that they are not feasible, if:

- a seasonal passenger demand peak is to be covered without using the buses and/or trailer throughout the rest of the year in similar applications;
- the demand peak to be covered occurs only on a rather short section of a line;
- the demand peaks are rather short and the trailer would have a rather small annual mileage.

It will be necessary to substantiate this theoretical knowledge with first hand experiences from practical use cases. It becomes clear that modular bus systems still require research and development efforts, and that the market introduction will last for the next decade. However, electric buses, especially battery buses provide completely new possibilities for the layout and packaging of urban buses. Using these new opportunities, specifically tailored European and national projects, which include the development of modular buses and their core technologies as well their demonstration, are recommended.

The most important research and development topics for the years to come are

- More flexible interior layouts for a rapid conversion from maximum capacity to maximum comfort (seating);
- Suitable articulation systems for modular buses aiming to fast and safe plug / un-plug of bus modules both during operation and at the bus depots;
- Development of an adaptable bus concept for addressing “peak/off-peak” demand;

...
• Development of a bus with trailer by using a coupleable articulation system, most likely to be used in combination with an electric propulsion system;
• Monotrack steering concepts for coupleable, adaptable and generally also for high capacity buses;
• Development of high-capacity bus with a length of 30m+ (to fill the capacity gap between buses and trams);
• Development of battery buses with battery trailers including plug-in systems for fast and safe connection of high voltage systems.

Finally, as most of the concepts are still hampered by both European and national legislations, their development and demonstration must be accompanied by necessary changes.

Solutions to improve energy sustainability of bus systems have been addressed in the study cases analysis thanks to real-life measurements from 9 bus networks (provided by project partners or associated members) mostly carried out during passenger service. Diesel and CNG buses still form the backbone of urban public transport in the foreseeable future as other mature propulsion technologies are either not available or too expensive. However, rising fuel prices, environmental concerns as well as increasingly economic and political dependencies from producing countries require new approaches for increasing the fuel efficiency in urban bus operation. There are different possibilities to reach this objective, such as
• further improvements of the efficiency of engines;
• intelligent gearboxes;
• driver incentive programmes and / or driver assistance systems;
• hybrid propulsion systems;
• more efficient auxiliary systems including their intelligent management.

The 3iBS study cases show, firstly, the advantages of intelligent gearboxes and eco-driving systems on the fuel consumption of conventional diesel buses. For the former technology tests took place in medium size urban areas in Italy and France. The gearbox tested is an automatic system which changes the gear program in real time, while driving, according to the line topography and vehicle occupancy. In so doing, the kinematic chain of the vehicle is optimized and the fuel consumption reduced. The comparison of fuel consumptions using an older (latest at the time) intelligent gearbox resulted in fuel savings of 13.7 % for 10 m buses and 17.2 % for 12 m buses under SORT 2 measuring conditions. However, additional measuring carried out during real passenger service partly showed significant differences to the SORT 2 results. In a second project, articulated buses equipped with new intelligent gearboxes have been compared to similar buses with an older gearbox. The measurements which have been carried out in real passenger service resulted in fuel savings of 6.8 % on average. The possibilities of driver assistance systems which give drivers a feedback on their driving style have been explored in two bus networks in the Netherlands and France. The measured fuel saving rates were 1.4 and 5.7 % respectively. However, the tests also showed that the so-called habituation effects decrease the initial fuel saving results after a while. Therefore, the key aspect to guarantee efficient and long term results of an eco-driving system is the training and monitoring by the management. Installing an eco-driving system without any training and monitoring will not have a long-term impact on fuel savings.

A second focus lies on hybrid buses. The last five years saw many projects in which hybrid buses of almost all major European bus manufacturers have been tested. Quite a number of results have been merged within 3iBS and show that some hybrid buses can reach significant fuel savings compared to conventional diesel buses. However, the tests also made it clear that hybrid buses need special line characteristics for saving enough fuel to justify their additional cost. Especially low commercial speeds and rather flat or moderately hilly topologies have a positive impact on fuel saving rates. New technologies are in most cases more expensive than conventional ones, either in terms of procurement or operation. This also applies to hybrid buses and fully electric buses. A comparing life cycle cost analysis between different hybrid bus concepts, conventional diesel buses, CNG buses and light weight diesel buses shows that hybrid buses can already compete economically with CNG and conventional diesel buses if there is a substantial fuel saving rate. However, it also becomes clear that the operation of hybrid buses is only financially feasible if the energy storage must not be changed during the lifetime of a bus. In order to further increase the energy efficiency of urban public transport buses, additional measures and developments are necessary. One major field of improvements are auxiliaries, especially their management, as auxiliaries make up to 45 % of the total fuel...
Building an IT platform that enables communications between different Public Transport applications and enhances communications between on-board units and back-office systems through a unique IP gateway was the achievement of the EBSF IT platform. Based on such specifications, the 3iBS IT focus group has developed guidelines to assist PT operator, PT authorities and bus manufacturer to set up a standard IT architecture and to help them to define and answer to tenders referring to these standards. The guidelines include onboard systems, vehicle installation requirements and backoffice interoperability and are based on “compliancy levels” according to a modular approach: from minimum requirements to prepare the introduction of the standard IT architecture to high level needs for a complete implementation of PT systems and applications.

As a further step to provide bus stakeholders with a clear view of the benefits of implementing the EBSF open IT platform in their fleets, an implementation laboratory based on the Transport for London experience has been performed to identify the requirements for the bus design needed to facilitate the change of Intelligent Transport Systems (ITS) which are based on IP architecture. Thanks to the resulting design requirements, cabling should be quickly and efficiently removed and fitted whenever systems change and sufficient space for equipment should be guaranteed. At a practical level, all areas of the bus should be accessible allowing technicians to install the underlying Ethernet network, existing ITS cabling should be identifiable and easily removed and there should be sufficient enclosure space for the ITS equipment. This process is known as “bus pre-preparation”. The London case shows that bus pre-preparation positively impacts costs and time needed for any equipment changes, and allow higher quality installations with lower failure rates. The design requirements identified have been then translated into a set of specifications which will be used as the basis for setting out the Transport for London requirements in the Invitation to tender for new provisions of bus services and for forward planning of equipment currently being installed.

Finally the IT Focus Group developed a roadmap which describes the main steps to introduce certification processes in the bus sector as a consequence of the IT standardization started within the EBSF project. The former activity focuses on the application of the standard EN13149 (parts 7, 8 and 9) to on-board products and architectures for buses. The aim is to guarantee, through a process held by an independent body, the interoperability between EBSF based on-board architectures, equipment and software services. The main aspects of the certification have been addressed and a list of priority actions to make it effective and well suited for the specific PT sector identified.

In terms of standardization, the outcomes of EBSF project have fed the European standardization groups (EN/TC278 WG3) responsible for managing the preparation of standards in the field of Intelligent Transport Systems. It serves as a platform for European stakeholders to exchange knowledge, information, best practices and experiences in the ITS domain. The 3iBS IT Focus Group has actively contributed to enrich and update EN13149 standard (parts 7/8/9) in order to provide an IP-based approach. When finalized the new technical specifications will allow a more efficient development of PT components, lower cost and risks as well as a smoother on board integration of PT equipments, a more efficient operation and maintenance of on board equipments and high quality passenger services based on intermodal PT information.

Both activities are linked and refer to the work carried out by the ITxPT association [http://www.itxpt.org]. The ITxPT Association has been set up by its Founding Members together with UITP, the International Association for Public Transport, to support the deployment of standards and practices for onboard plug-and-play of IT-systems for public transport and the relevant back-office features.

2. Define a work-plan to move from research to innovation. European bus system strategies: state-of-the-art and future tendencies

3iBS works not only through case studies. In order to identify the actual implementation status of bus system strategies in European cities, a consultation was launched in a form of a questionnaire addressed to PT operators, PT authorities and municipalities. Collected data produces up-to-date quantitative information on both the state of the art of the bus fleet in
operation in Europe and future tendencies by focusing on 4 main areas of interest: fleet composition, propulsion systems, Intelligent Transport Systems and future policies impacting bus systems.

The analysis of a fleet of around 70,000 buses and trolley buses serving a population of over 100 million inhabitants in 24 countries, provided a significant snapshot of 63 bus fleets operated in European cities, metropolitan areas and regions and highlights the importance of bus systems in local mobility policies.

If we consider a vehicle classification length-based, needless to say, the majority of the surveyed buses belong to the standard class (12m). The residual fleet is mainly shared between articulated buses and double-deckers as well as midi buses (9-11m). The snapshot is completed by trolley buses, mini buses (less than 9m) and 3-axle 15m buses. To highlight the main future tendencies in terms of bus fleet composition, it is worth noticing that 75% of the respondents intend to change the current fleet ratio in terms of vehicle size: the majority wants to strengthen vehicles categories already in operation in their fleet, however, one out of five participants of the survey wants to include new vehicle categories. As the analysis shows, 69% of the respondents want to move towards more articulated buses and 40% of them towards midi-buses. This tendency seems to suggest the need, on one hand, to respond to the growing demand of commuters travelling from the outskirts of the city to the city centres and, on the other hand, to buy well-tailored buses to operate services in the city centres (more flexible, occupying less space and more environmentally friendly).

Focusing on the propulsion system, the bus fleets surveyed confirm that the majority of the vehicles in operation in urban and suburban areas are diesel fuelled (79%), followed by biodiesel (9,9%), CNG - Compressed Natural Gas (7,0%), electric vehicles (1,2%) and biogas (0,6%). Also in this case, the comparison between the state of the art and the future plans stated by the stakeholders allows to identify significant trends: more than 40% of the respondents want to introduce in their fleet more electric buses, namely hybrids (43%), fully electric with batteries (28%), plug in hybrids (21%) and fully electric trolleys (9%). This value seems to be coherent with the tendencies mentioned above in terms of vehicle categories. Moreover, it is notable that one out of three respondents wants to stay with diesel - without implementing major changes in terms of present fleet composition - while 28% want to change in favour of more CNG, 18% towards more biodiesel and 13% towards more biogas.

In line with the main objectives of the project, the survey also aims to estimate the role of bus systems in the European mobility policies and the will of public and private stakeholders to improve the efficiency of the bus systems currently in operation. The majority of the surveyed stakeholders (70%) are working on specific strategies to increase the market share of PT and this awareness tends to be higher in larger cities, with the 79% of the respondents representing cities with more than 2.5 million inhabitants. The bus seems to play a key role in such strategies: for the 68% of the respondents bus systems are participating to a great extent in future policies to increase the attractiveness of PT, which will be financed mainly through mixed public fundings at municipal, national and European level, ticket revenues (also considering to increase the ticket price) and extra tax subsidies.

3. Develop a Roadmap for European Advanced Bus Systems

Research and innovation in urban bus domain requires large investment, while the corresponding market is a niche market. The return of investment is always complex and becoming more difficult in the present financial situation, even though the impact of innovation on Public Transport on the quality of life of citizens is very high. In a similar scenario, research funding from European, Regional and National institutions are the necessary support for sharing the financial risks linked to innovation. On this regard, EBSF project has made a breakthrough by showing that European bus manufacturers can join their effort for pre-competitive research in a successful way. Moreover, the project worked as a platform for open dialogue between PT operators, PT authorities, manufacturers, research entities and suppliers and allowed the development of a Roadmap for European Advanced Bus Systems research, supported by more than 100 key bus stakeholders, to help National and European institutions in identifying the main priorities for research on bus systems. The first issue of the Roadmap was published in 2011 in the frame of ERTRAC (European Road Transport research Advisory Council). Such ERTRAC Roadmap has been then consolidated and issued as innovative Bus System Roadmap (IBS) which includes feedback coming from the final results of the EBSF project, recommendations for standardisation/harmonisation of solutions, recommendations for new research and EU activities identified by the project partners.
Within 3iBS, the analysis of more than 30 outstanding study cases allowed identifying how operational or infrastructural solutions, which are in line with the EBSF bus system definition, can be implemented in the real experience of urban mobility. Such analysis, together with the review of several research initiatives’ results on bus systems or specific bus system elements (e.g. ZeEUS, Civitas CAPITAL, NODES, ITxPT, OPTICITES), produced a set of recommendations for further research, development and regulation. The project’s advisors and the members of the Stakeholders’ Expert Group, bus system experts not involved as consortium partners of the 3iBS, have reviewed and validated the recommendations by bringing their direct experience and independent view. Finally the recommendations for further research, development and regulation have been integrated in a final issue of the iBS Roadmap. The Roadmap focuses on six research areas:

- **EBSF integration in the urban scenario:** the “bus system” perspective should be prioritised in order to manage efficiently interfaces with infrastructure, traffic and all users’ needs. Combining a “system” approach which links end-users, vehicles, infrastructure and operations together with a high service quality is a daily challenge for operators and manufacturers. The bus system integration refers also to the coherence and complementary of its own characteristics with other modes of transports and its ability to adapt to the different typology and transport infrastructures of the cities.

- **EBSF IT platform integration:** standardization and harmonization of information system and open architecture are the logical answer to efficient bus system integration. Individual mobility can be achieved only by guaranteeing that clear and complete information are provided to the passenger all along his journey, and independently by the combination of means of transport he uses. For this reason, interoperability between the systems that contribute to the set of information required by the passenger has to be ensured. For authorities and operators, harmonization of information system through an open architecture is the priority to improve quality of the service provided to the citizens, by enabling efficient maintenance procedures that are based on remote diagnostic to the on-board systems, and prediction of failures by applying sophisticated algorithms. It also improves the installation methods and update processes of onboard equipments inside PT vehicles, by enabling pre-equipment of PT vehicle and avoiding functions and hardware redundancy.

- **Sustainable bus system:** a sustainable bus system is fundamental to achieve the 3iBS strategic objectives. Sustainability of bus system can be reached via smart use of the energy all along the bus system (of which the electrification offer an important contribution), and the improvement of the environmental, economical and social performances under a life cycle perspective. One important aspect of evaluation is the definition of a robust baseline (i.e. current status quo), which allows the quantification of the achieved improvements.

- **Research on innovative vehicle technologies:** application of system approach and past projects findings to develop, prototype and test concepts and technologies for different vehicle technologies oriented to drive modes, accesibility and comfort.

- **Modularity:** modularity can bring an important contribution to the attractiveness of the bus system, through the optimization of the capacity, consumption (and emissions), as well as frequency of services during different hours according to the demand. It also provides benefits to operators’ economy thanks to the increase of the capacity and the dilution of driving costs during peak hours. For this reason, modularity is today considered a priority for research for both operators and industries: the first have started identifying the potential benefits, the latter is reaching maturity in the research and development.

- **Meeting the mobility challenges of an ageing society:** an ageing population is a significant challenge for most European countries. Even though there are large differences between individuals, normal ageing brings about a number of cognitive, mental and sensory changes and the likelihood of impairments is therefore increasing with age. These impairments have implication for the design of an accessible bus system including information, ticketing, bus stops and vehicles and the interaction between them. At the same time changes in the lifestyle of older people can be noted. Mobility is an important aspect of life quality, people have become more mobile, and travel is likely to increase as new cohorts enter old age. In addition a considerable share of senior citizens have driven most of their lives and continue using their private car also in old age. By the time they are no longer able to drive, public transport may not be a considered option, partly for accessibility reasons but also for reasons associated with perceptions. Future bus systems must therefore also be attractive for elderly people.
4. Disseminate the 3iBS message

UITP led the 3iBS dissemination activities supported by cities and universities networks as well as National Public Transport associations. The 3iBS website, e-newsletters and Social Media such as Linkedin and Twitter have been largely used in the course of the project and potential synergies have been driven in-between all project’s and external events.

The 3iBS website (www.3ibs.eu) was created at the beginning of the project. It contains static information (like background and objectives of 3iBS, the project’s structure and schedule, the list of the Consortium members as well as all the members of the different working Groups) and dynamic information (like latest news and media, events calendar, relevant links to other projects, publications). Another important element is a free and open access to 3iBS deliverables. Thanks to regular updates about the project’s progress and its intermediate results, latest news and information about organised events, the 3iBS website has been a great source of information throughout the lifetime of the project. The users’ level of interest for the 3iBS website was closely monitored. According to the statistics obtained, it continuously increased the number of visits, arriving at almost 700 sessions in the last month of the project (March 2015). Another interesting feature is the ratio of returning and new visitors: the 3iBS project managed to attract numerous new visitors in all phases of its duration. More than 76% of new visitors suggest that the project constantly reached new circles of audience who became interested in the activity of 3iBS.

Overall 3iBS has been presented in about 40 European events with dedicated presentations, sessions or roundtables. International activities have been organised as well to deepen exchanges of knowledge and best practices among the bus community worldwide and in specific regions. Notably, international bus experts from Hong Kong, Taiwan, Australia, Brazil, Argentina, Mexico, Ecuador, Abu Dhabi, Iran, India, and USA were invited to take part in dedicated roundtables to discuss about the 3iBS 7 key topics.

In addition, the 3iBS training “A new generation of urban Bus Systems” was aimed at sharing and transferring concepts and solutions about innovative bus systems to stakeholders (universities teachers and researchers) coming from target regions with less advanced technologies. Representatives of the academic world from Lebanon, Jordan, Egypt, Palestine, Algeria, Morocco, Tunisia and Syria joined the training.

The 3iBS Stakeholders’ Expert Group, consisted of bus system experts not involved as consortium members of the 3iBS project, actively followed the evolution of the project’s activities, contributed to the project development and validated the project results through their participation to 6 meetings, conceived as dynamic workshops with dedicated sessions for discussion and assessment exercises on major issues raised during the project. The group contributed to the project by bringing an independent vision, which allows the Consortium to adapt and re-orientate their activities in line with the expectations anticipated. Equally, they also enabled to approach the work in an innovative way and enlarge the review of the project results by gathering a wider panel of different public transport stakeholders.

Potential Impact:

The 3iBS consortium and the associated working groups are widely representative of the European Public Transport sector. The joint collaboration of industries, PT operators, PT authorities, suppliers and research institutes all along the project life allowed providing a significant overview of the current status of bus systems operation and research in European cities and identifying, as an overall final result, the priority actions needed for the further development of such systems.

Accordingly, the 3iBS “message” can be summarised in 5 points:

1. In view of the 2015 mid-term revision of EU Transport White Paper

High quality and affordable public transport is the backbone of a sustainable urban transport system; the European Union should install quantitative targets for improving of public transport market shares in 2025 based on 2005 reference line. Where do we stay in 2015? Public transport (including by bus) greatly contributes towards cleaner air in cities and reducing greenhouse gas (GHG) emissions in the European Union. There is the need to evolve mobility towards more collective modes, as part of a more sustainable transport system which must rely upon a backbone of Public Transport strongly integrated with other sustainable modes of transport.

A good example is Vienna, where the use of alternatively-fuelled buses in combination with policies that encourage the use of...
public transport raised the modal share of public transport from 29% in 1993 to 39% in 2012, while it causes only 6% of the city’s transport-related CO2 emissions.

Also interoperability of IT systems based on standard IT architecture can significantly help improving efficiency and attractiveness of PT system by offering real-time multimodal passengers’ information and new public transport services. The European Union should include the development and promotion of public transport as part of any European CO2 reduction strategy and require cities to set ambitious quantitative targets for improving of public transport market shares in 2025 based on 2005 reference line.

Public Transport is at the cross road of manifold policy domains such as transport, environment, climate change, clean air, etc. There is no middleman to align and inter-connect the different policy fields in a view to drive the public transport agenda.

2. In terms of campaigning for a new identity of bus systems

Bus system (and a more competitive public transport as a backbone) needs to be considered as a mode on its own. The sector calls for a Europe-wide campaign institutionally supported to re-dignify the bus. Urban and regional bus systems transport around half of all public transport passengers (30 billion per year) in the EU, and this average pattern changes from a 50% share in large cities with multimodal networks up to 100% in smaller towns and medium-sized cities. The full potential of buses as a resource-efficient and sustainable mean of transport is exploited when all the elements of the bus system (vehicle, infrastructure and operations) are deployed, i.e. when buses operate on reserved priority lanes with priority traffic lights and benefit of an accessible design of both the vehicle and the physical environment (bus stops, stations and intermodal hubs) and an easy access to ticketing and information systems.

At the European Institutions level, the bus system does not have the place and attention it deserves respect the one given to air, car and rail. The bus system (and public transport in general) doesn’t fit in one of the ‘silos’ and gets scattered. The bus stakeholders in 3iBS project and in UITP call for a Europe-wide campaign aimed at re-dignifying the bus system and thereby ensuring a new perception of the bus as a cost-efficient, flexible, fast, capacity-appropriate and clean tool to answer to the growing sustainable mobility needs of our cities and regions.

The city of London, with one of the largest bus networks anywhere in the world which makes 2.3 billion journeys a year, in 2014 launched the “year of the bus” to celebrate 60 years since the creation of the iconic Routemaster and pay tribute to the undeniably important role the bus has played, and will continue to play, in the life of the city.

3. Create financial support mechanisms supporting accelerated modernisation of the bus systems in EU cities.

Almost 50% of the buses used across Europe are Euro III or older (3iBS data). Scrapping the older parts of a bus fleet implies accelerating regular renewal quota and calls for more investment budgets from the companies. In the city’s bus fleet Diesel is often seen as pollutant, noisy and out of fashion but that reflects only the oldest part of any existing fleet overtaking nevertheless the perception.

Funding for an accelerated renewal of the oldest parts of the bus fleets would lead to an immediate improvement in terms of pollutant emissions.

Overall, a switch from the current European local bus fleets to a fleet composed only of Euro VI buses would lead to a reduction of more than 75% of non-methane hydrocarbons (NMHC) and more than 85% of nitrogen oxides (NOx) and particulate matter (PM).

Oldest Euro standards buses (pre-Euro II, II, III) can be replaced by existing solutions today which included Euro VI as well as some alternative solutions which have been existing for quite a long time, and used by environmental friendly customers such as Trolleybuses, Compressed Natural Gas, Bio fuels. The PTA of Madrid CRTM launched in 2009 an ambitious plan to modernise its suburban fleet of about 2000 buses. In 5 years more than 900 Euro II and EURO III buses have been scrapped in favour of cleaner technologies, mainly Diesel Euro V and VI but also LNG and electric hybrids, with an overall impact on the fleet’s emissions estimated in: -30.4% carbon monoxide, -29.8% of non-methane hydrocarbons, -40.7% of nitrogen oxides, -57.7% of particulate matter and -0.3% of carbon dioxide (source CRTM).

Modernization of bus system should also impact the other elements, the infrastructure (more dedicated lines and modern traffic management systems) and the operations (remote / predictive maintenance, and use of automation). Use of standard IT architecture on vehicles would offers benefits by reducing efforts and costs to install, maintain, replace and update IT systems.
4. Create financial mechanisms supporting market uptake of newer propulsion technologies in EU cities.
New, newer, newest: market pull is strong for more modern propulsion technologies in the bus vehicle market which is small in number of units sold. The European bus sector has invested heavily in the development of cleaner technologies and today the propulsions used in the bus sector are much diversified. On the one hand, there are proven and reliable technologies, such as bio fuels (i.e. bio diesel, bio gas and bio ethanol) and natural gas (CNG); on the other hand, new experimental technologies, such as hydrogen, new generation bio fuels, bio waste, etc. are emerging.
Electric buses have been used by public transport operators since trolley bus systems were established in several EU Member States. Besides trolley buses, hybrid electric buses are on the verge of becoming a reliable technology, too, while fully electric buses are still considered an experimental technology. Nevertheless, diesel buses constitute by far the largest part of the current bus fleet (80% of the bus fleets across Europe, according to the 3iBS bus stakeholder consultation, 2013). Additional resources should be made available for the further testing and market uptake of alternatively fuelled electric and buses as well as their respective infrastructure.

5. In terms of Research and Development
There is not an adequately supported long term strategy with the ambition to boost research, renew/reshape the bus scenario in Europe and reach critical investment mass in order to maintain the leadership of the European bus industry towards upcoming overseas exporters. Research and Development on Public Transport requires a deep involvement of all stakeholders for close collaboration between industries, mobility authorities and operators. In this way the developed products are a balance between the technology “push” of industry and the market “pull” of users.
The European Union has been supporting Research & Innovation for years, as part of its growth and industrial strategy. In July 2013 a large Public-Private joint undertaking called Shift²Rail was launched, with the ambition to boost research, renew/reshape the rail scenario in Europe. For the Bus domain the situation is different. While common strategies for research have been developed by many European stakeholders, and heavy investments have been done by manufacturers (e.g. for comfort, accessibility, energy efficiency, engine developments), there is not an adequate institutional support to the implementation of such long term strategy. This is particularly important to keep EU leadership in bus systems industry in particular for what concern the introduction of new technologies for more sustainable transport, as research in bus requires high investment which return is very difficult due to the relatively low sale volumes. On the other side the benefits provided in answering citizens’ mobility challenges by more attractive and efficient bus systems are very high.

For the above reasons financial support to research on bus systems from institutions is of utmost important for ensuring innovations taking place in the bus domain. The Innovative Bus System Roadmap developed and supported by many bus stakeholders already indicates areas for innovation and priorities research. The 3iBS analysis of the financing instruments available at European Level to be put in relation with the implementation of the Roadmap suggests the PT sector to set up of a dedicated consortium aimed at proposing to the European Commission an adequate structure, like a contractual Private-Public-Partnership (cPPP) concerning public transport. Horizon2020 foresees the possibility of creating Public-Private Partnerships to support research and innovation in industrial sectors considered of general interest for Europe’s competitiveness and society. The consortium needs to be formed among industries interested to commit substantial investment in the cPPP and a representative network of research organisations, universities and in general knowledge centres to guarantee scientific excellence of the proposed innovations. The vision reached within 3iBS and supported by many bus stakeholders about the common challenges and associated research and innovation priorities for the further development of bus systems, shall encourage European PT stakeholders in setting-up an implementation entity based on the Innovative Bus System Roadmap.

The 3iBS message has been summarised in dedicated publications produced by the Exploitation platform working group, namely: the brochure on the analysis of European bus fleets based on the statistics collected through the survey “European Bus Systems: current fleets and future trends“ and the plan “Priority actions for the fast development of innovative Bus Systems in European cities“. The contents of the two deliverables, which are indeed part of the same strategy set-up by the
working group at the beginning of the project, have been widely disseminated. Such exploitation strategy is based on a mixed bottom-up / top-down approach which capitalizes on the comparison between the current bus services in operation in Europe and the future trends for their evolution versus the strategies impacting bus systems at European and national level. The bottom-up approach is based on the 3iBS bus stakeholders’ consultation (European Bus Systems: current fleets and future trends) launched in 2013 by the members of the Exploitation Platform. This bottom-up approach, based on cities’ experience, has been merged to an inventory of selected long-term sector strategies (White Paper, UITP PTX2, etc...) as well as European legislation impacting the PT sector. The results achieved have been reported and analysed with top-leader bus manufacturers, operators and suppliers thanks to the cooperation between the 3iBS Exploitation Platform and the members of the UITP Bus and Vehicles and Equipment Industry (VEI) Committees as well as the members of the ACEA Bus & Coach General Managers group (the five bus manufacturers associated within group are also called “big five” and represent an estimated 70 to 80% of the total annual market of public transport bus procurement in Europe).

UITP and other 3iBS members were invited on a regular base to report about the main results achieved. The interaction and cross-fertilization between the members of the UITP Committees, the ACEA group and the Exploitation Platform working group greatly contributed to develop a long-term strategy for the modernization of bus systems which takes into consideration the vision of bus manufacturers, operators and suppliers. The agreed messages have been then addressed to authorities that can influence decision regarding implementation of advanced bus systems in Europe. The authorities directly involved through the participation in roundtable discussions are the European Commission and the European Investment Bank.

Finally the findings of the working group have been actively disseminated through dedicated exploitation material and the participation to conferences and events which reached a wide audience within the PT community.

List of Websites:
www.3ibs.eu

Related information

Result In Brief
New bus systems to improve efficiency and reduce emissions

Reported by
UNION INTERNATIONALE DES TRANSPORTS PUBLICS
Belgium

Subjects
Scientific Research

Last updated on 2015-11-11
Retrieved on 2019-06-25

© European Union, 2019