13th ITS EUROPEAN CONGRESS

FULFILLING ITS PROMISES

Brainport Eindhoven, the Netherlands | 3-6 June 2019

Post-Congress Report

www.2019.itsineurope.com

Organised by:

ERTICO

Hosted by:

EINDHOVEN

Gemeente Helmond

Supported by:

Connekt ITS Netherlands

Ministerie van Infrastructuur en Waterstaat

BRAINPORT EINDHOVEN

Provincie Noord-Brabant

ACKNOWLEDGEMENTS

The Organisers and Host of the 13th ITS European Congress would like to thank the Sponsors, the Partners the Programme Committee and the National Committee for their contribution and support to make this Congress a success pushing forward the intelligent mobility agenda.

Sponsors

Main sponsor

Platinum

Diamond

Gold

Silver

Official Media Partners

Dutch Media Partners

Media Partners

Media Supporters

ITS National Partners

Contents

INTRODUCTION

The Congress's principal theme "Fulfilling ITS Promises", was chosen to highlight how Intelligent Transport Systems (ITS) can deliver affordable, impactful and innovative solutions that make daily life and mobility safer, cleaner, and more efficient. At the same time ITS can deliver improvements to network capacity, air quality, energy use and safety. The Congress was organised around six key Topics:

- **Deploying new mobility services – from experiments to experience**
- **A breath of fresh air**
- **Connected, cooperative & automated mobility**
- **Enhancing the efficiency of freight transport**
- **Enablers of digital infrastructure**
- **Transport network operations**

A seventh Topic, "**Disruption, start-ups and the future workforce**", was a cross-cutting element supporting all the other activities.

The Congress Programme Committee, co-chaired by Gert Blom from the City of Helmond and Didier Gorteman from ERTICO, appointed rapporteurs for each topic tasked with capturing the key messages and outcomes from the Congress, the exhibition and the demonstrations. The topics were addressed by a wide range of different types of sessions, over 110 in total – Plenary, Executive, Special Interest, Technical, and Scientific.

This Report summarises the Congress proceedings. The first part focuses mostly on the Technical & Scientific papers and the Special Interest Sessions; the second part paints a picture of proceedings at the three Plenary and Executive Streams; and the third summarises the proceedings at the ITS Summit, a "round table" format discussion involving Mayors, local and national politicians and their officials, and senior academics and industrialists.

I give my profound thanks to the main team of rapporteurs who contributed so much to this document:

Simon Edwards
Hannah Steele
Efi Tzoura
Fieke Beemster
Delphine Krieger
Risto Kulmala
Peo Svensk
Efi Tzoura
Peo Svensk

My thanks as well to the facilitators and note-takers of the ITS Summit – Stephanie Leonard, Laura Mols, Margriet van Schijndel-de Nooij, Sophie van Velzen and Inês Viegas. Additional support in documenting the Plenary and Executive Streams is gratefully acknowledged from Rita Bhandari, Manuela Flachi, Emily Hemmings and Lidia Signor.

I also thank colleagues from Eindhoven and Helmond City Councils, ITS Connekt and especially the ERTICO teams for their cheerful handling of all my enquiries and questions.

Professor Eric Sampson
Chief Rapporteur
Brussels July 2019

Under its main theme "Fulfilling ITS Promises" the Congress was organised around six key Topics:

- Deploying new mobility services – from experiments to experience
- A breath of fresh air
- Connected, cooperative & automated mobility
- Enhancing the efficiency of freight transport
- Enablers of digital infrastructure
- Transport network operations

There was also a cross-cutting theme "Disruption, start-ups and the future workforce". mobility solutions.

The main issues covered by the seven topics were distilled into three Plenary and Executive Streams:

- **Smart Cities**
- **Automation**
- **Mobility as a Service (MaaS)**

The conference programme featured more than 100 sessions and the Congress started with a dynamic and inspiring opening Ceremony where the First Vice-President of the Commission, Frans Timmermans, addressed the audience highlighting the need for changing the way we provide the increasing demands for mobility towards a more sustainable way.

Complementing the programme there was a very busy Exhibition, the largest to date for a European Congress (more than 1,800 sq m; 20,000 sq ft), involving over 150 organisations. It included a large area giving up to 40 start-ups a space to showcase their ideas and have discussions with future sponsors and customers.

In addition to these indoor activities there were technical tours to local control and service centres as well as major engineering sites, and more than 20 demonstrations with user participation that are described in the Topic sections predominantly Topic 3.

A common issue at the Congress was traffic – some of it vehicles with conventional drivers, some of it driverless or highly automated vehicles – and its management in small towns and large cities and whole regions thereby benefitting users, passengers and also freight. Cities represent a hot spot with the most difficult problems, but also the most innovative solutions and there is an inevitable challenge to balancing multiple city objectives. Many sessions discussed how society should regulate new technologies such as micro-mobility, change consumer habits from private vehicles to public transport, cope with population movement and ageing, and react to the pressure for low carbon sustainable solutions.

On the topic of the deployment of **new mobility services** there were many examples from experimenting with new ITS applications, for example Mobility as a Service (MaaS), to adopting some practical results. Despite the published and available information on operational MaaS schemes, globally there are not many in existence. Those that do exist are on a relatively small scale rather than country- or Europe-wide with the ticketing and payment elements not yet developed as real time integrated information services.

A key focus for MaaS (and all innovative mobility services) was the role required by government at all levels with communication as a key element. It was agreed that government bodies need to set top level strategies and loosen regulatory regimes in order to encourage integration across the parties (public sector, private sector and users) to facilitate shared mobility and the deployment of open, interoperable systems. The Congress reported slow but steady progress in understanding traveller behaviour and designing solutions to encourage people to move away from using their private cars and to encourage car sharing, public transport, walking and cycling.

Air quality, especially in cities, is a cause of concern worldwide and the technical sessions showed conclusively that we have tools that can deliver traffic management and emissions reduction; speed optimising that reduces fuel consumption and noise; parking guidance that saves time and fuel and cuts emissions and noise; and researchers are continuing to explore new solutions.

Connected, cooperative and automated mobility presented an extraordinarily wide range of discussion topics, exhibits and cutting-edge demonstrations. The subject has moved quickly from testing what might be possible one day to addressing real world deployment tomorrow with rail featuring as well as road. This combination, plus integration with electrification and Mobility as a Service, was of much interest for what it will mean to the use of different transport modes and the use of transport-related networks.

The issue of automated vehicle acceptance was quite prominent. Factors presented and discussed included influencing consumer intentions, building trust, driver training needs, automated vehicle uptake, and scenarios for different use cases. The potential safety benefits are exciting; but some concerns about safety remain – 'how safe is safe enough?'

It was clear we still did not have quite enough trials data to address questions as to whether automated transport conflicts with or supports cities' goals on social inclusion, quality of life, sustainable development

– and what are the real benefits for ageing or limited mobility travellers?

The **freight transport** sector was seeing major developments from the use of data from all types of vehicles for real-time information and predictive traffic management. However the industry overall remained rather fragmented, slow to address interoperability issues, and driven by visible supplier costs rather than a wider perspective of social benefit. The solutions are available but the deployment policies are missing although cities are very interested in the possible gains from driverless freight vehicles.

The **digital infrastructure** topic had a range of discussions and papers concerned with the joint work between authorities, academia and industries on projects for future innovative technologies for traffic management, communication systems (including satellite and hybrid) and data management, but relatively little on deployment results. It was felt that the sector needed to do more to adopt existing Europe-wide guidance on interoperability and data policies to support open platforms.

The **transport networks operations** topic gave many examples of new services following the growth of vehicle-infrastructure connectivity and the increasing numbers of on-vehicle sensors. Dynamic, integrated and data driven traffic management was a key benefit from connected vehicles and the data they can supply enabling predictive as well as reactive solutions. Big Data and Artificial Intelligence were already answering real needs in the transport sector and there is potential value from Big Data in areas that include new business models such as data driven retailing, better customer services and travel experiences and improved efficiency such as operational analytics for maintenance.

The ITS Summit held at Helmond Castle was also a key element of the Congress with over 75 Mayors and representatives of national and local governments, coming together with senior industry and academic leaders to explore the current challenges and opportunities in the field of intelligent mobility and smart cities. Cities represent the hot spots for both difficult problems and innovative solutions as a result of economic growth, population movement, ageing, and limited physical space.

A strong message from this Congress was that as a society we are firmly placed in the Fourth Industrial Revolution – with Data Connectivity as a guiding mantra: Connectivity anywhere, all the time, between everything. And as one speaker put it "If data is the new fuel then Artificial Intelligence is the new engine".

It was clear that technology was not the big issue for fulfilling promises – it was getting its suppliers, regulators, customers and users together to work as a partnership. A holistic approach was essential to show how issues inter-relate and it needed all stakeholders to cooperate in delivering it.

Topic 1: Deploying New Mobility Services – from experiments to experience

The overall situation

This was one of the busiest topics with the second highest volume of Special Interest Sessions and the third highest total of papers. Two of the Plenary and Executive Streams (Smart Cities and Mobility as a Service) were in the same broad area and looked at:

- Lessons learnt from testbeds and other operational examples of MaaS
- The benefits and potential disbenefits of MaaS
- Ticketing / payment role in MaaS
- Role of Traffic Management in MaaS
- Role of MaaS in Smart Cities
- Role of politics / government and business in MaaS
- MaaS and sustainability

More detail regarding proceedings in the Streams is given in Part 2.

The topic title "New mobility services – from experiments to experience" reflected the continuing shift since Copenhagen in 2018 from pilots, trials and demonstrations to real-world practical applications. Last year the lack of information on operational schemes was noticeable as not many were operating globally. In a key development there are now some examples of operational MaaS schemes that we can learn from, albeit operating on a small scale (town- or city-wide, rather than country- or Europe-wide). There was a definite enthusiasm for applying MaaS to bigger schemes but papers and published literature were still mainly theoretical.

The topic in detail

Key issues discussed included:

- Mobility as a Service (MaaS), particularly what needs to be done to enable MaaS:
  - to change user behaviour / get people out of cars
  - to deliver what users really want and need
- The role of government at all levels in facilitating MaaS
- The importance of communication
- Paving the way for autonomous vehicles in new mobility services. (This point is mainly reported in topic 3 – "Connected, Cooperative and Automated Mobility")
- How MaaS might feature as a component of Smart Cities

The 10 SISs covered a variety of issues. Urban mobility laboratories again featured with a focus on involving multiple stakeholders to develop innovation and business cases in urban mobility. One significant lesson learned was the importance of addressing all the mobility options on offer when engaging with communities, for example bringing e-bikes, e-scooters and similar vehicles to community events for people to try. Another lesson was the need for researchers to be 'living the city' – using the transport solutions available for everyone thereby understanding what it was like to commute, for example.

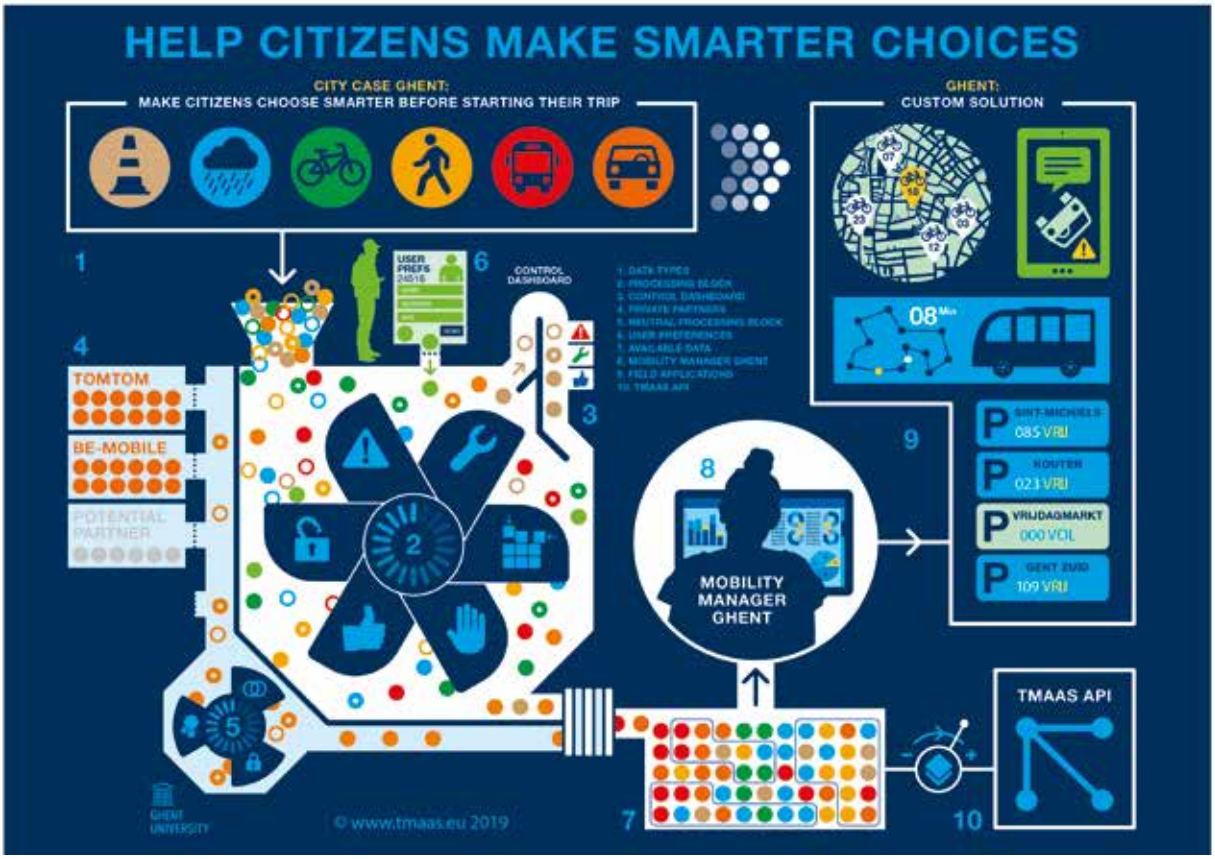
As well as the labs progress with Mobility hubs was reported, particularly designing smart hubs to promote efficient, sustainable and safe multi-modal transport through ease of transfer between modes. Linked to this was the need to ensure that ticketing and payment systems were fast and adaptive in order to support MaaS and not be a barrier.

The idea of Traffic Management as a Service was first floated in Strasbourg as a concept then some work was described in Copenhagen.

This idea has now matured and a number of pilots and trials were presented in a wider context of creating traffic management systems that can cope with multi-modal MaaS. A key message from all speakers in a special interest session was that both communication and data sharing were paramount in ensuring the success of MaaS. The importance of ensuring a modal split was also discussed.

A number of sessions looked at ways to accelerate the deployment of MaaS and to widen its scope. Data was a key factor in creating markets and achieving impacts that promoted new mobility services. New approaches should not be avoided: it was noted that Pokemon Go had been designed to obtain Point of Interest data but its gamification had delivered over 60 M users worldwide. The question was put: "What is the Pokemon Go of mobility?" Another key point was understanding the roles of all stakeholders in both public and private sectors and their interactions in the MaaS ecosystem which included as well as users:

- Transport Service Providers
- Mobility Service Providers – gaining access to transport offerings



TMaaS Framework; Traffic Management as a Service 2019 (Stephanie Leonard)

- Regulatory Service Providers – using the platform to steer processes to reach defined policy goals

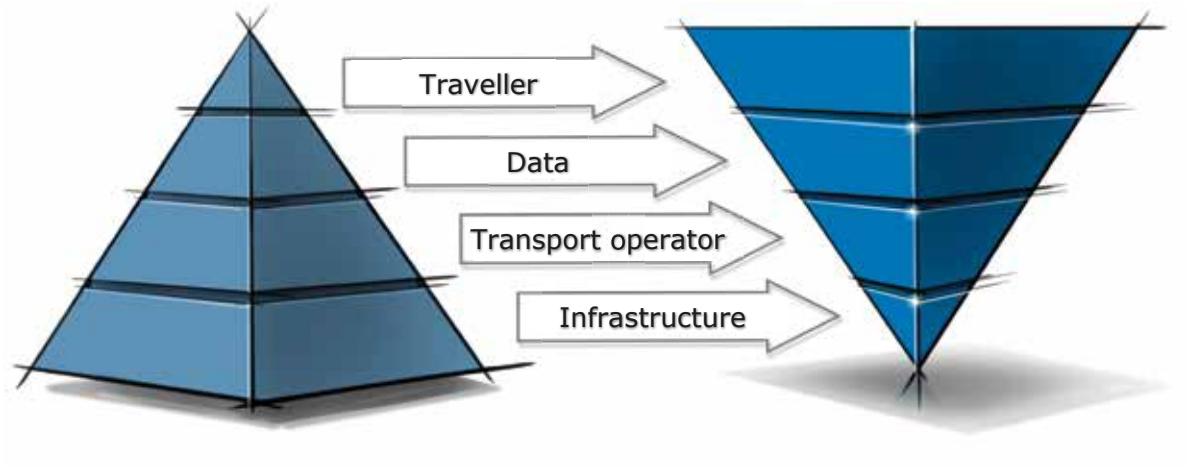
There was a marked emphasis in sessions on understanding how users, society and industry can all benefit from MaaS by discussing stakeholder roles and key performance indicators. The importance of developing from APIs to ensure operation to KPIs and a focus on practical benefits was stressed – a user-centric approach was required for MaaS to get people out of their cars and ensure the uptake of new mobility services. We also need to understand what users really want to achieve modal shift.

Different models of MaaS governance featured in a vigorous discussion on the best ways to bring together public authorities' and industries' perspectives. There was a firm consensus that a central platform was required to ensure MaaS schemes were successful, and run by a neutral body at authority level rather than at operator level. Data sharing was also discussed here, particularly around ensuring the data was the right data and in a standard format established across borders compliant with the GDPR.

The sessions did not focus exclusively on established transport modes such as buses, cars, and rail. There was a detailed look at the problems some cities are facing with large numbers of shared electric bikes or electric scooters. Such services tended to be popular but early evidence suggested they were appealing to walkers so did not necessarily get people out of their cars. They also prompted many cities to address the issue of where people could park the bikes / scooters when there was already a shortage of parking space for cars. Cities needed to have a major rethink about space allocation.

Some sessions based around authors' papers looked at a wide range of topics. Papers assessed the roles of governing bodies at multiple levels (town-, country- and EU-wide) in creating effective MaaS systems and the architecture required. The key message was that government bodies needed to set and align strategies and also encourage communication between the parties (public sector, private sector and users) to facilitate shared mobility and MaaS.

Various sessions discussed examples of deploying successful user-centric mobility services and explored the insight from behavioural studies into what users really wanted. A clearer understanding of real demand was seen as a vital guide to ensuring mobility moved forward and innovative services came to the market. Overcoming users' unwillingness to adopt shared mobility was a key step towards making a greater



A new approach to Mobility (Netherlands Ministry of Infrastructure and Water Management)

impact on sustainability and on the wider "Greener Cities" agenda.

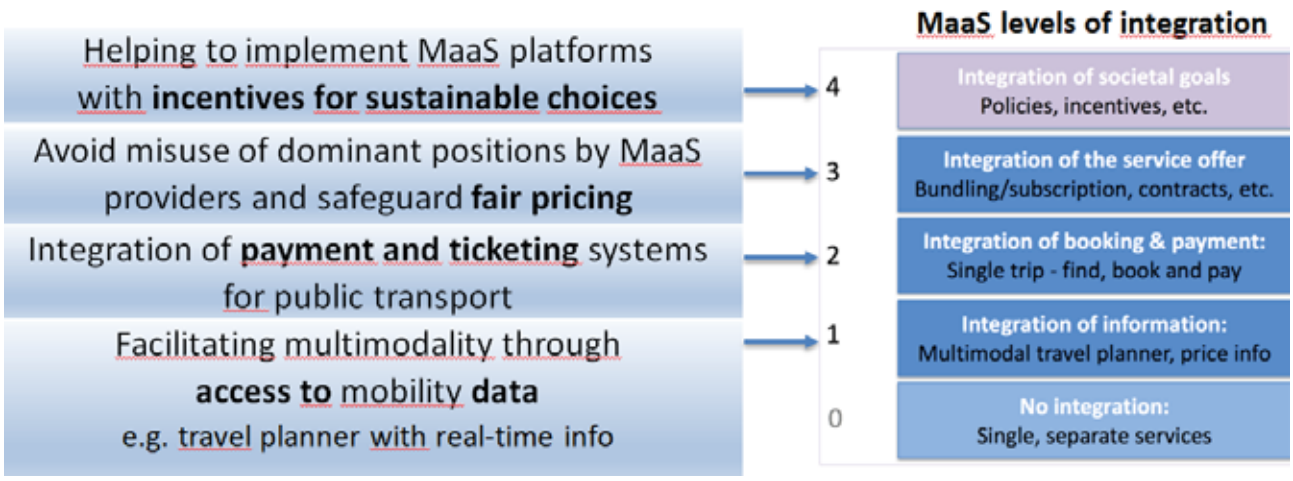
A key message from a number of sessions related to the importance of car sharing and of public and private sectors working together for MaaS to be successful. The question had been put "What makes a successful MaaS platform or MaaS environment?" and answers from discussions proposed models to facilitate MaaS and models to assess the impact of MaaS. It was also necessary to be clear about how and where services such as MaaS brought added value to communities.

Old vs new

MaaS remained the predominant focus of this topic. There were some examples of successful applications of MaaS on a small scale, although none yet country- or EU-wide, with discussion focused around what needed to be done to apply MaaS more widely. This seems to be a small step forward from last year as a key finding from Copenhagen was the lack of information on operational schemes. This move forward has now turned attention to the ticketing and payment elements of MaaS which are not as developed as real time integrated services data / information.

A growing focus under MaaS is the role required of government on all levels and a message repeated in many sessions – that communication is paramount in ensuring the success of MaaS. Government bodies needed to set and align strategies and encourage communication between the parties (public sector, private sector and users) to facilitate shared mobility and MaaS. Cooperation between governments, companies and knowledge institutes was an approach that would contribute to 21st century solutions for our 21st century problems.

Another key focus was how to change or influence user behaviour to facilitate MaaS –encouraging people to



How could MaaS enable modal shift? (David Schoenmaekers)

move away from using cars towards shared mobility such as car sharing, public transport, walking and cycling. This remained a popular theme, as it was last year. It was noted that car ownership and use is not just meeting a need it is also meeting a desire and is a status symbol. The challenge was how to make MaaS more desirable than the car through more than just price.

Another message was keeping users at the heart of MaaS and focusing on what they really wanted from mobility.

A number of variables significantly influenced mobility behaviour and the acceptance of MaaS: habit and control beliefs. Some key findings here were:

- Perceived usefulness of a new technology is far more important than a perceived ease of use
- Social normative factors have a much bigger impact on mobility than previously thought
- People might choose to get rid of their car not because they no longer needed it, but because they felt that they had paid enough for mobility through a monthly package
- People underestimated the monthly fixed costs of a private car and easily lost any reference to the real cost of individual motorised mobility
- Future research should enhance the focus on mobility habits and routines and how they possibly might be altered

The importance of sharing data was also prominent in discussion while not the key overall message, as it was at Copenhagen. A number of technical papers noted the importance of standardised formats for all traffic and travel data in providing MaaS on a Europe wide level in the future. Data challenges were discussed in a range of sessions and included API standardisation, poor quality data and integration. It was pointed out that a number of governmental bodies collected data because they could but then sat on it as they did not realise the value of what they had yet were reluctant to give it away or share it. The risks of having completely open data were also discussed.

Where might we be going?

The topic was developing compared to Copenhagen and recent ITS European Congresses and as the title suggested was moving away from the theoretical towards the practical. There was definite continuity of themes between the Copenhagen and Eindhoven Congresses and some new messages including:

- More practical applications of MaaS, although currently on a small scale. There were indications that more schemes would become operational over the next year and there was a definite appetite for applications on a larger scale
- The need for more focus on communication between parties to facilitate MaaS
- MaaS seemed to be largely accepted as shorthand for "new mobility services"
- There was very little on specific modes; everything was framed as multi-modal
- There was considerable emphasis on business cases, governance, the roles of public and private stakeholders, and impacts, with key emphasis being engagement of the general public (the user market)
- There was growing focus on deployment issues such as integration into wider traffic management and user acceptance
- How to ensure MaaS fitted with wider urban mobility objectives was increasingly important. There is increasing crossover with other major topics, especially CCAM and Smart Cities and with sustainable urban mobility plans

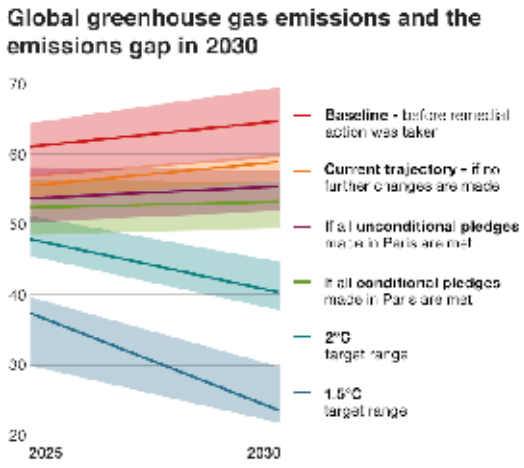
Topic 2: A breath of fresh air

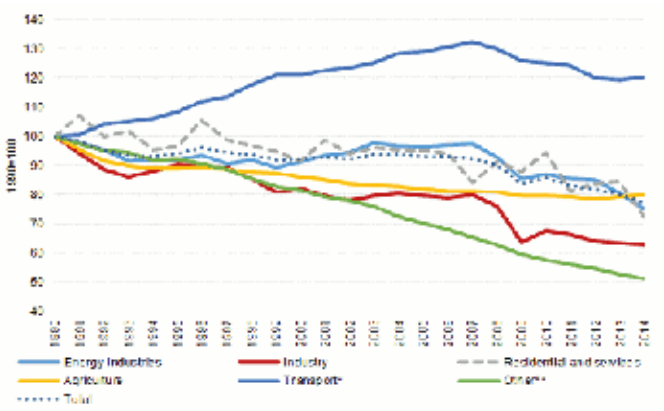
The overall situation

At all Congresses since Bordeaux 2015 there have been strong references to our being in a climate emergency yet at all, and again in Eindhoven, the environmental topic has remained small in size. The main Eindhoven focus was on reducing emissions from heavy-duty vehicles and air quality in cities with links to electric vehicles, C-ITS, Mobility as a Service for Climate (MaaS4C), and traffic management solutions. Sessions focused on ways to reduce emissions in cities and on what solutions were available now for commercial vehicles. The background position was clearly illustrated using UN data (see below).

The topic in detail

Two sessions addressed the question "Can we really deliver on committed goals?" and it was clear that we are missing the targets. Various suggestions for solutions were offered and cities were the favoured location for air quality improvements. Smarter mobility was suggested in many papers as a solution to the problem of the environmental impact from transport systems and delegates were introduced to the term "Mobility as a Service for Climate (MaaS4C)". More use of electric vehicles was advocated to complement C-ITS and smart mobility solutions but papers and presentations did not address the environmental aspects of electricity generation.





Why action is needed (Paul Kompfner)

Potential CO2 savings:

- HGVs: average 10% reduction (mixed roads); Range 0-25% (ecoDriver, 2016)
- Up to 25% CO_2 reduction at junctions, traffic lights, bends, etc.
- Little or no CO_2 benefit in congested situations and limited benefit on motorways
- Scania Driver Support system provides real-time coaching in HGVs with tips and feedback via a visual HMI: 10% improvement in fuel efficiency

Next step in the **MODALES project** (starting September 2019) is to evaluate **Low-emission driving** (cars, trucks, non-road mobile machinery) which will also take into account brake and tyre emissions (particle matter)

Use of in-vehicle eco-driving techniques (Andrew Winder)

Heavy duty vehicles represented one of the main sources of greenhouse gas emissions in transport and the dedicated session on this topic reviewed the technology advancements for improving trucks' fuel consumption. There were some very interesting success stories. In-vehicle eco-driving techniques are beginning to be adopted and deliver strong benefits.

Other discussions on addressing heavier vehicles looked at work being done under the EU's Horizon2020 programme to establish design criteria for future reduced emission heavy passenger and freight vehicles, the ORCA project.

Sessions noted that a "Smarter Cities" concept could be realised in multiple ways with differing political implications, such as applying smart sensing/ monitoring systems, smart parking management, and emphasising local authority policies that encourage cycling. Increased use of EVs was expected to have a significant positive impact in minimising the greenhouse gas emissions. Various types of EVs were suggested for both cities and highways environment. Light commercial EVs and electric buses can be a good solution for the cities while electric cars provide solutions for the highways environment provided that battery capacity is good enough to eliminate "range anxiety" and support adoption by drivers.

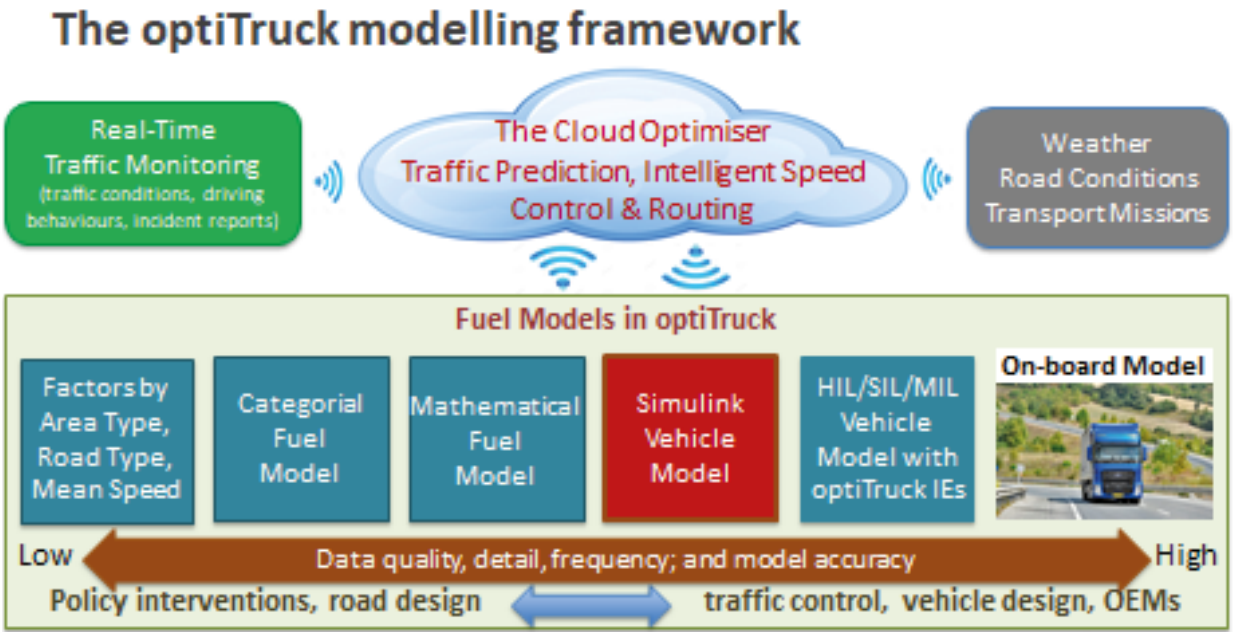
Papers described how C-ITS can play an important role in improving air quality. The technology is established but it relies on connectivity between vehicles (V2V) and vehicles to Infrastructure (V2I) that allows real time information exchange to enable efficient and integrated traffic management. Geofencing in combination with C-ITS was suggested for use cases with promising results. It was clear from sessions that intelligent traffic management solutions to improve the air quality of cities and highways were available; the gap in deployment had insufficient priority with policy makers and road operators.

Old vs new

Almost a third of the papers presented related to electric vehicle solutions whereas Copenhagen seemed to have a shift in focus away from electric vehicles and on to city policies. Despite the lower numbers the quality of papers remained high with increased emphasis on collaborative work between research institutes, industries and government authorities. Ways to monitor environmental conditions with sensors did not feature very much in Eindhoven although there were many more papers under other Topics addressing "smart" sensing mainly of traffic and environmental conditions.

Forwards vs constrained

It was very clear that technology advancements were enabling electric vehicle performance optimisation, traffic management systems, smart mobile applications and the implementation of novel technologies. Numerous use case studies were presented to support this. The work on optimising the fuel consumption of heavy duty vehicles was very promising but the research teams acknowledged that there was still much that needed to be improved to allow routine commercial deployment.



Predictive models to reduce truck fuel consumption (Haibo Chen)

However one issue seems not to have advanced very far since the Copenhagen Congress – the establishing of a pan-European data management framework to allow data exchange in an integrated legal framework to support common policies and practices concerning transport eco-systems.

Apart from legislation concerning data sharing the discussions identified a need for common strategies and common legislation concerning other important aspects of ITS such as electric vehicles, V2I and V2V connectivity, traffic management policies in Europe and worldwide. Air quality is a global issue and needs a holistic approach to achieve optimum solutions.

Where might we be going?

The ITS supply side had delivered multiple ways of dealing with the air quality of urban and highways environments that had high potential for meeting targets for the greenhouse gas emissions reduction. These technological applications, either singly or in combination, were able to deliver significant improvements. By contrast the demand side was lagging and nationally there seemed to be many delays in putting the policies in place to reduce emissions and move towards the climate change targets.

It was clear from the numbers of case studies presented that technology was in principle able to achieve many environmental targets and that if the current pace of technology progression was sustained then future applications would probably not need to rely on significant investments in infrastructure as many processes would be enabled through connectivity between infrastructure to vehicles and vehicles to vehicles.

However it was vital that a citizen-centric approach was retained.

Citizens' opinions were crucial for future strategies and planning to make cities better places in which to live and many future scenarios depended on travellers changing their behaviour.

Combined efforts from local, central authorities, research institutions and Industries would definitely be the way forward to achieve the air quality that is safe for humans and the natural environment in general. Setting common goals in Europe and Internationally was the foundation for further collaboration to achieve them.

Topic 3: Connected, cooperative & automated mobility

The overall situation

The topic of connected and automated mobility was again the Congress's largest in terms of the number of papers and sessions. Both connectivity and automation were well covered, and several papers and sessions dealt with connected and automated driving.

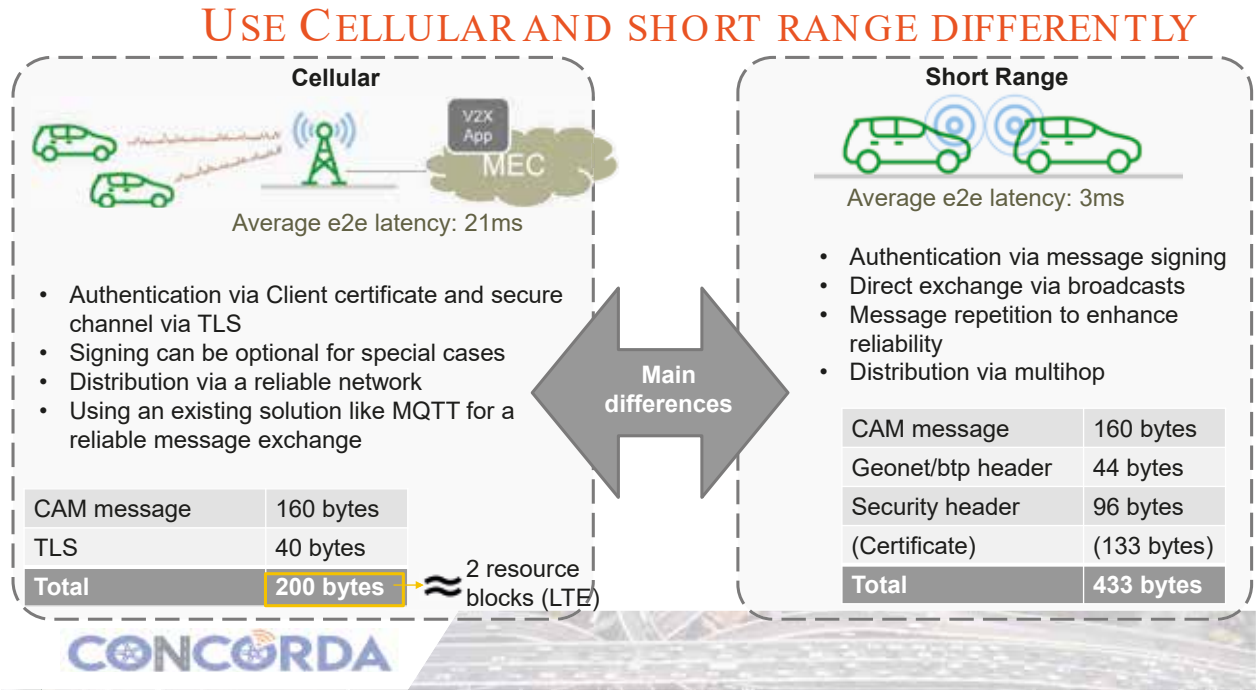
Many sessions, papers, and statements in the past had been rather sceptical about the outlook for deployment of automated driving for 2018 and 2019, although Eindhoven gave positive signals for the future. In a session about automated shuttles one speaker stated that a company would be launching a new generation of driverless shuttles that would take extra steps from the current offers and would be able to function without any human intervention in mixed traffic. At the same session another speaker gave an opinion derived from domestic experience from his country that technology development had been very slow, and there had been no breakthroughs in the past three years. It will be interesting to see the development of such sentiments in the next ITS World and ITS Europe Congresses.

Short-range ITS-G5 and C-V2X as well as cellular medium- and long range connectivity, and their mix as hybrid communication were covered with emphasis on interoperability, service models, practical experiences, use of connected vehicle data as floating vehicle data, issues in data availability and access, utilisation in traffic management, and the description of the several European test sites and pilot deployments linked to the C-Roads platform.

The topic in detail

Connected and cooperative applications presented included enhancement of digital traffic management by utilising vehicles to replace or complement roadside sensors, predictive eco-cruise for hybrid electric vehicles, several advances for traffic signal controllers utilising different data sources including connected vehicles, signal control evolution for automated vehicles, provision of parking information and multi-brand truck platooning.

The concept of an Operational Design Domain (ODD) was explained as determining the set of



The need to use cellular and short range differently (Geerd Kakes)

conditions (road type, lane markings, kerb properties, communication infrastructure, positioning support, digital maps, traffic conditions, weather conditions etc) in which the automated driving system can operate and safely control the vehicle. The ODD depends on the vehicle's sensors and software including AI, and is determined by the vehicle and/or automated driving system manufacturer.

The concept of ODD was discussed in connection with Tesla lane-keeping; traffic management procedures to enable coexistence of automated, connected, and conventional vehicles while minimising transfers of control between automated driving system and vehicle occupant; the physical and digital infrastructure requirements of automated driving; and the vehicle control take-over at the end of ODD.

The impacts of connected and automated driving on traffic management, the role of road authorities and operators, socio-economic indicators, mode choice, mobility equality, road network and its capacity, and finances were discussed extensively in addition to the implications of allocating a dedicated lane for automated vehicles.

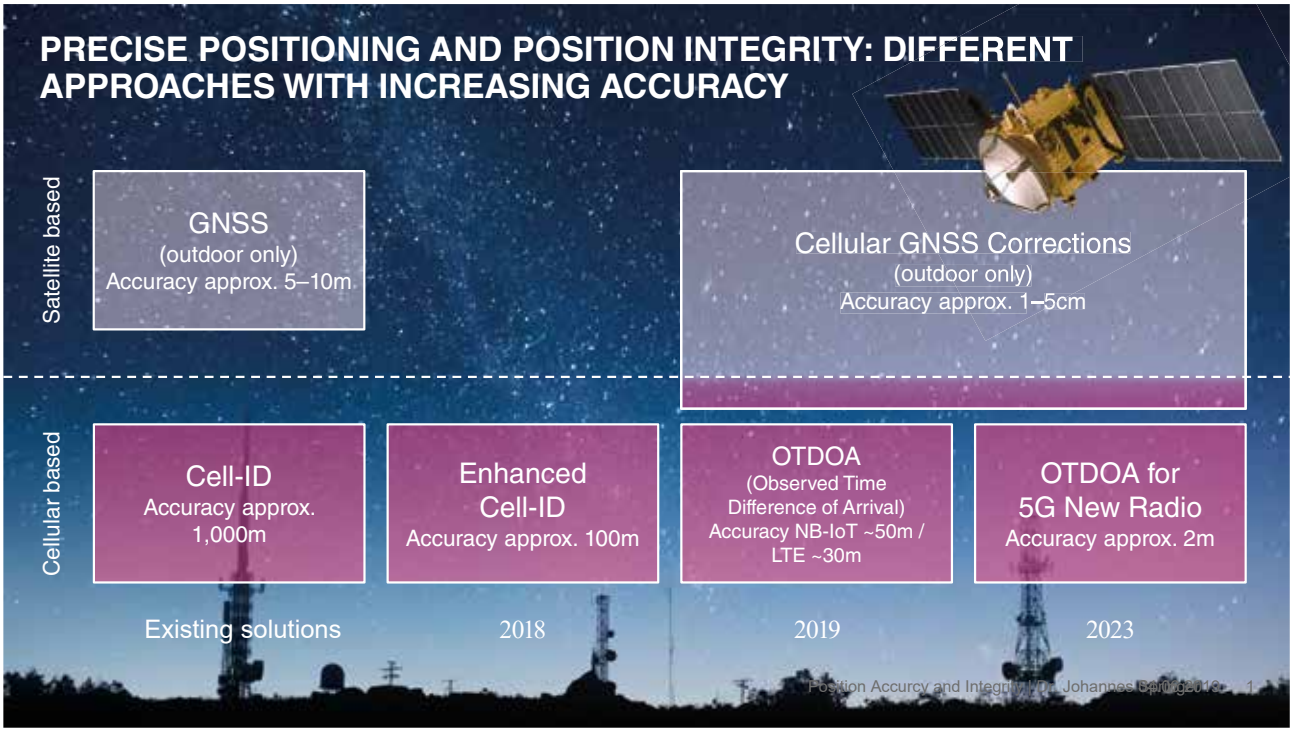
The automated mobility discussions dealt with accurate positioning and considered icy and snowy roads and conditions, issues for driverless shuttle buses including a mobility system integrating them, and automated valet parking. In positioning, the high-accuracy positioning utilising GNSS and 5G in combination was shown to have much potential.

The presentations on evaluation experiences stressed the importance of testing before piloting, allowing multiple iterations of data collection, effective sharing of information and experience, scaling up transparently, starting evaluation much earlier than was usually done, and understanding how drivers were best supported in different situations (what kind of messages, how presented and timed). One expert remarked that the culture of learning from making mistakes was not highly developed in Europe – while mistakes were allowed in research, in deployment they could mean losing your job.

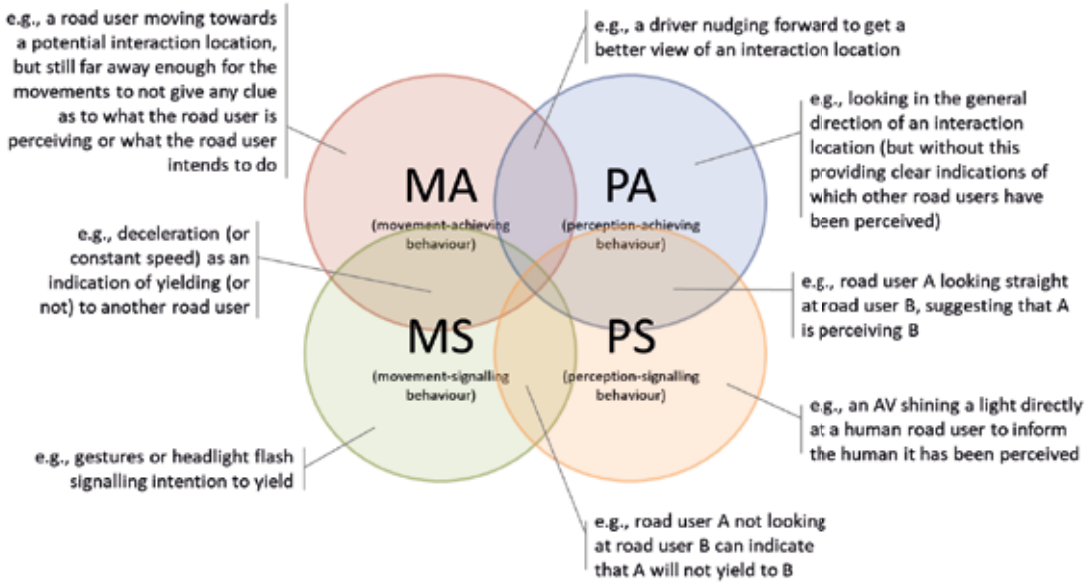
Evaluation activities were supported by a user-friendly approach to evaluation, an open specification of log data for cooperative and automated driving, and AV-ready micro-/macroscopic traffic flow simulation and assignment models, and presentation of test sites, innovation platforms, and living labs. Simulation had maintained its central role in evaluation of automated driving impacts.

The issues relating to automated vehicle acceptance were quite prominent. Presentations looked at:

- factors influencing consumer intentions
- user preferences
- building user trust
- driver training development needs
- automated vehicle uptake fleet & penetration scenarios for different use cases.



High-accuracy positioning for CAD (Johannes Springer)



Definition of interaction behaviour (Anna Schieben)

It was stressed that safety concerns played a major role and the question "how safe is safe enough?" was addressed from different angles.

Human centred design was highlighted in a number of papers, including the use of a co-designer approach, and HMI design for professional operators of automated buses and trucks. The SAE taxonomy does not take into account the human-in-the-loop perspective so with the help of HMI we needed to make the vehicle occupant(s) aware of the operation and intentions of the automated driving system. The HMIs should preferably be designed with iterative participation of the end users.

Sessions and papers also addressed how to ensure safety via fallbacks and redundancies of automated vehicle subsystems; the implications of the General Data Protection Regulation in the collecting and processing of driver-related data; and ways to minimise user distraction. It was clear that liability was still high on the agenda, concerning sensing, information quality, crashes, and thereby also insurance.

Overall, the collaboration between public and private sector stakeholders was becoming more predominant as city leaders were more aware of the role of ITS for urban planning and sustainable mobility development.

Old vs new

There was a reasonable balance between bringing forward new ideas and reporting how the older ideas were performing or could be developed. For connected and cooperative mobility some basic issues were highlighted such as balancing road safety with data protection requirements for C-ITS via Privacy by Design and enforcement; and essential C-ITS time standards. Some interesting ideas for evolution of manoeuvring through intersections came up. One presented a cooperative intersection support system exploiting the concept of mirroring in cognitive science to perform inference of intention, supported by additional and more accurate information on the intersection scenario provided by infrastructure sensors. Another proposed a hybrid intersection management to gain benefits from autonomous vehicles already in the situation with mixed traffic, without having to wait for automated intersection management.

The utilisation of agreement patterns to manage negotiations between humans and the automated systems in vehicles was seen as a viable solution in the future. Using a digital twin to improve road network operations was presented – the twin enabled vehicles to recognise road regulations, signs and markings without relying on cameras/other sensors or a driver, leading to improvements in road safety and the operation of road networks as well as enhancing the

complete development cycle. Specific ideas for solving the issues in the interaction of automated vehicles with other road users were proposed.

Cooperative adaptive traffic signal control for vulnerable road users was proven to work with Green Light Optimised Speed Advisory (GLOSA) for cyclists. Other new ideas included:

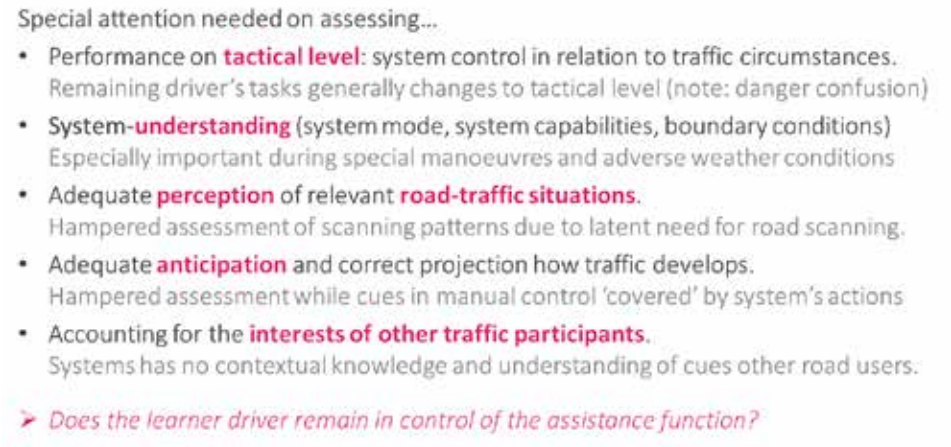
- a comprehensive railway level crossing warning system
- improved situational awareness in tunnels and for their emergency situations
- a longitudinal control system to increase both the capacity and the safety of motorways
- lane change behaviour inference through deep-learning-based environment analysis
- a motorway merging assistant for automated vehicles utilising data fusion from legacy sensors, cooperative data and camera views of the situation in order to cope with non-equipped vehicles.

An interesting idea was estimating the (near) future traffic conditions ahead for the automated driving controller by combining data science and traffic modelling techniques to produce a virtual patrol detecting congestion and incidents for urban and non-urban networks. Another proposal was increasing safety margins utilising the concept of nudging – specifically reducing speeding via a dynamic light system in the infrastructure and an in-vehicle HMI solution.

The monitoring of vital signs in order to estimate a driver's state and then take action had progressed rapidly during recent years. The fusion of ballistocardiography, radar, magnetic impedance, pulse plethysmography imaging, infrared thermography etc was likely to provide for driver state estimation of unprecedented reliability in the near future. The task of the driver in the near future (lower SAE level and in mixed traffic) would likely not to become easier but just different; and therefore the driver would need a different set of competences. In terms of "in control" there should perhaps be only two levels, one where the driver was in control and one where the car was in control. There should be no blurred interpretations of who was in charge.

The drivers' new roles of supervision and intervention were addressed in several presentations. Three innovative papers were the impact of a monitoring request (to prepare drivers for a take-over from automated driving system) on driver behaviour; a method for investigating consumers' intention to accept and drive/use highly automated vehicles by extending the original Unified Theory of Acceptance and Use of Technology (UTAUT) model; and a study measuring the emotional impact of driving an automated vehicle that provided important new knowledge for the automated vehicle stakeholders.

The interaction between traffic and fleet management centres was gaining importance with the arrival of highly automated vehicles as traffic managers tried to optimise traffic flow and its safety and fleet managers focused on the effectiveness of a fleet of vehicles. The convergence of connectivity and automation was discussed earlier in this report but the multiple convergence and integration of connected and automated driving with electrification and Mobility as a service (MaaS) was highlighted. There was considerable interest in what this would mean for the use of different transport modes and use of the transport-related networks. The integration with MaaS was stated as essential to prevent the negative impacts predicted for highly or fully automated vehicles in private use.



Assessment aspects of drivers' supervisory roles (Arie van den Beukel)

The recent developments in the field of data collection and IoT had also brought a new approach for the cycling sector. A growing number of intelligent solutions for cyclists had emerged such as connecting cycle lights to an app in order to encourage modal shift towards cycling as well as specific IoT tools shifting the focus from technology back towards people.

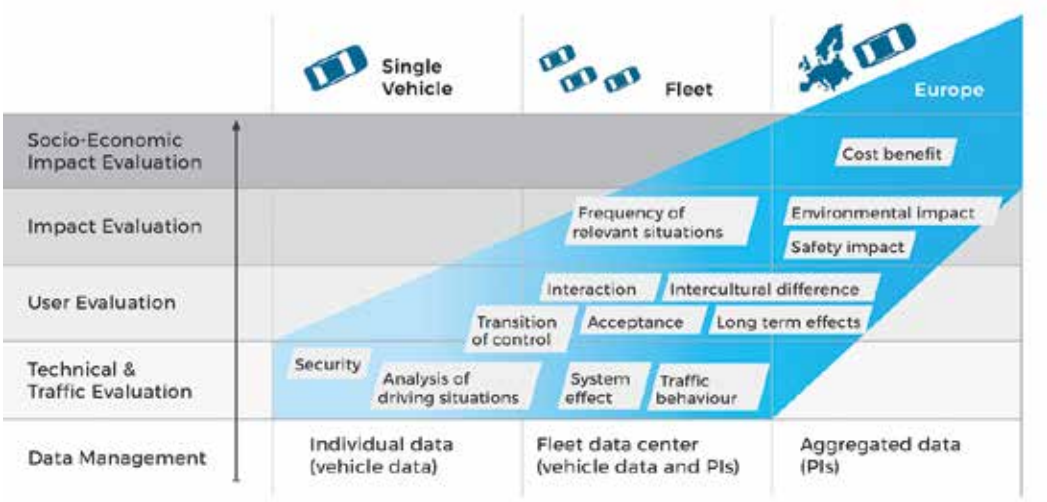
Where might we be going?

Overall, the topic had maintained its importance in the ITS Congress, being the most popular topic again. The connected and cooperative mobility domain had clearly moved ahead along with the technology readiness. The technical performance of different connectivity solutions was not as prominent a topic this year, and papers on deployment issues were more to the fore. Business model aspects were not dealt with in any detail and whereas technical evaluations had decreased impact evaluations had increased somewhat. It seemed that assessment of quality was done only rarely although quality and trustworthiness were seen as important for the success of cooperative services. On this latter point the essential aspects were seen as a common set agreement, effective quality assurance, and maintaining trust among users. The user acceptance studies maintained their strong position. Solutions for railway grade crossings were another subtopic that had gone forward.

In automated mobility the sensing, ethical and security issues were not as high on the agenda as during previous Congresses whereas user uptake and acceptance issues were more highlighted than before. Safety was a major driver for governments, authorities, cities and road operators; but for consumers the major drivers were social influence, trust in automation. and driving enjoyment. Machine learning and artificial intelligence (AI) had clearly gone forward, and the importance of having data of sufficient variety, quantity, and quality to train the AI was strongly emphasised. In the near future the vehicle AI may know more of you than you yourself – but it was agreed that today the AI and sensors were not yet at the level of human beings.

Nevertheless the main challenge at this point remained in the access, control, and business models related to the data – collected from connected and automated vehicles and also collected by other devices that mobility devices such as smart phones, credit cards etc. The first promising steps were being taken with the signing of the MoU on sharing of safety-related data between vehicle manufacturers, member states and other stakeholders during the Congress. City solutions were getting more attention than in the past with regard to combination with urban design, parking, charging points for electrical automated vehicles, etc., while motorway solutions less so although a fair number of papers dealt with them as well. In contrast solutions for rural roads were quite restrained.

For future Congresses it would be interesting to see how long the battle between G5 and 5G (ITS-G5/DSRC/802.11p vs C-V2X and cellular in general) would continue. The market demand and related industry decisions would almost certainly decide eventually as with VHS and BETAMAX. Which Congress would have a report on the success of the H2020 project to launch a new generation of driverless shuttles that can function without any human intervention in mixed traffic? And similarly when might we travel to the event by robot taxi?



Development of toolbox of evaluation methods (Satu Innamaa)

Topic 4: Enhancing the efficiency of freight transport

The overall view

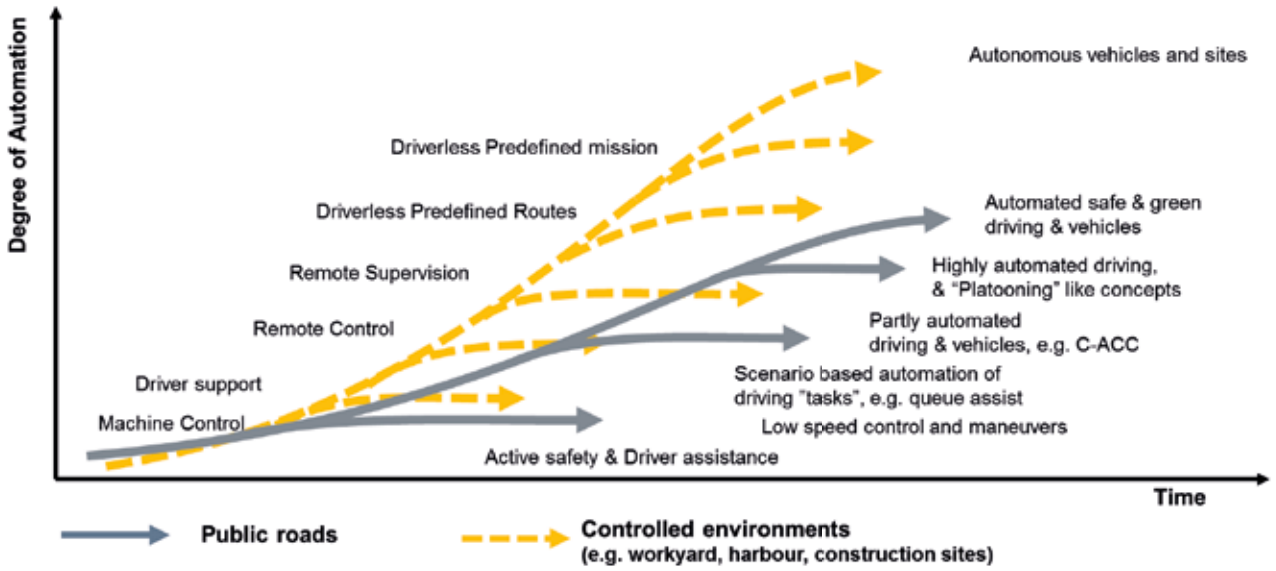
Freight and the transportation of goods are very important parts of ITS and many initiatives (eg automation and platooning) were likely to be introduced on a large scale for commercial vehicles before the introduction for other kinds of vehicles. As with Copenhagen last year this topic was one of the smallest with only two technical paper sessions and two Special Interest sessions although a number of key freight developments (Platooning, data platforms, connected vehicle–infrastructure information etc) were covered by other topics. ITS practitioners have many services available which if deployed in the industry ought to bring enhanced efficiency and effectiveness not least in the bottom line.

The sector was seeing major developments from the use of data from sensors on all types of vehicle for real-time information and predictive traffic management. But the industry remained rather conservative – hardly surprising when delivery timing is critical – and visible supplier costs, rather than a wider perspective of social benefit, dominated. Discussions were therefore more about incremental changes, and ensuring there were robust business cases for technologies and services that can increase the productivity and minimise the negative impacts from goods transport on the roads.

The key issues in the topic all related to ways to improve the efficiency of freight transport and were driven by a range of stakeholders. Freight and logistics companies were seeking overall efficiency savings and productivity gains. Cities were wanting to find new ways to cope with the rapidly increasing volumes of light goods vehicles linked to growth in e-commerce and same-day delivery services, and were also seeking better space utilisation for loading and unloading. Cities were also very interested in the possible gains from driverless electric freight vehicles deployed during off-peak times. Network operators were involved in exploring traffic flow optimisation from deploying platooning, traffic signal prioritisation, and C-ITS solutions for heavier vehicles. All parties were looking for ways to reduce energy consumptions and emissions and maximise security and reliability.

The topic in detail

A number of the papers and presentations in SISs explored the concept of autonomous trucks. These were seen as offering many advantages, not just addressing driver availability, training and working hours, and especially suitable for closed environments such as distribution centres and ports. A number of trials were described and the project goals outlined. A presentation on the general case of heavy vehicle automation differentiated operation in open and closed environments:



Different application arenas for automated vehicles (Mats Rosenquist)

The wide but very interesting topic "Truck automation and platooning" was covered by a number of contributions. The latest technological developments were presented and both extended automation and platooning were discussed not only from the vehicle perspective but also from the infrastructure point of view in the context of logistics. Work in this area was developing even though the benefits from platooning had been questioned recently by some heavy vehicle manufacturers. Technical standards are of course essential for the creation of multi-brand platoons. An architecture and results from a test with 6 different OEMs were presented.

A number of presentations reported on trials and the linked topic of C-ITS for heavy vehicles. Some very interesting results on connectivity were reported in a paper on trials of 'smart traffic signals' where the network acted to give some priority to heavy vehicles to try to avoid 'stop-start' at red lights. The results showed that with around 20% connectivity of heavy vehicles there were significant time savings for all categories of vehicle in the morning and evening peak periods.

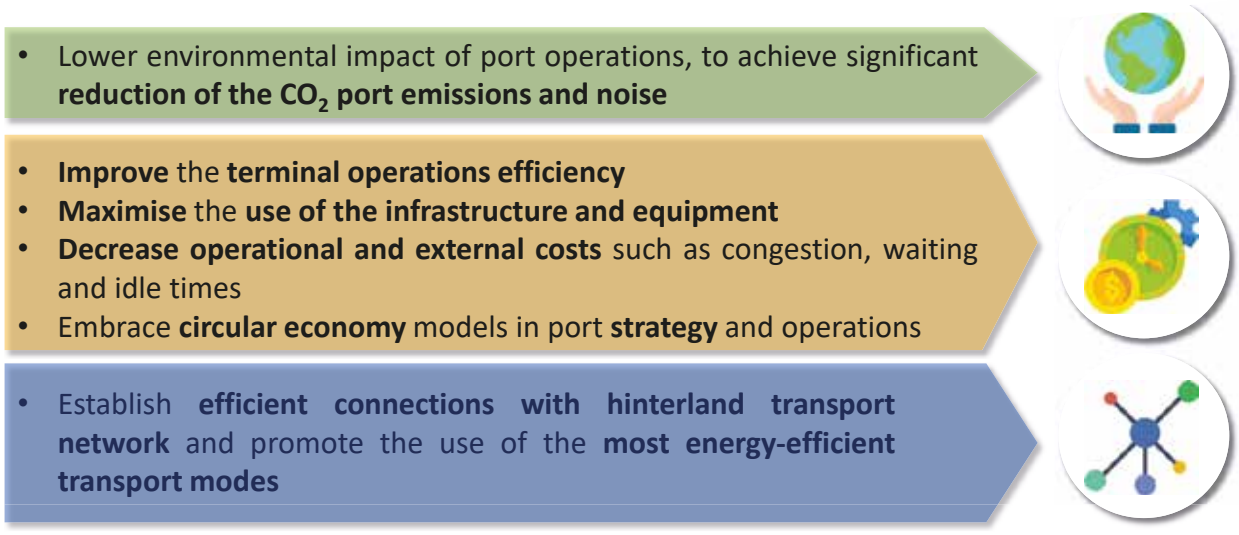
Globally attention had moved on from platoons of the same brand and model of truck; the objective was now multi-brand vehicles from different Member States operating on public roads. Topic 3 included references to activities very closely linked to platooning. Road operators confirmed interest in the outcomes of demonstration projects and trials while acknowledging that the benefits from platooning needed to be fully demonstrated in closed environments before they could be permitted on open, public roads.

To help to achieve this point there needed to be more extensive sharing of data from all tests and pilots than hitherto. Road operators were committed to using platooning to increase safety and reduce the amount of primary or secondary accidents caused by, or involving, heavy goods vehicles. However there were still many unresolved questions regarding the interaction of platoons of heavy vehicles with lighter cars especially when the platoon was being formed or when a lighter vehicle needed to turn off a road.

The Port of the Future was an important topic launched in previous Congresses and one that will feature in Singapore 2019, Los Angeles 2020 and Hamburg 2021. The discussions in Eindhoven tended to focus on the port as a closed environment which was beneficial for trials. Ports were facing multiple pressures. Cargo volumes were increasing but arriving at ports in reducing numbers of vessels. Ports operators needed to comply with increasingly stricter environmental regulations and societal views for sustainability and in many locations sustainable land-use strategies were being introduced in and around ports. Port operators were looking for new, service-based management models to improve capacity and efficiency.

Route optimisation is both more important when it comes to freight transport compared to route optimisation for smaller vehicles and at the same time more challenging. In the city of Amsterdam for example commercial transport was responsible for 15% of vehicles, 34% of traffic's CO2 emissions and 62% NOx emissions (2016). These figures showed clearly that route optimisation for freight transport was important.

Optimising the route and the velocity profiles for fuel consumption savings and travel times, required transport mission data (departure, destination, waypoints, maximum duration time, etc), info on road topography (2D maps and altitude) but also other sources of heterogeneous data such as traffic and



Port Multimodal Inland transport (Stefano Persi)

weather conditions. Other challenges connected to route optimisation for freight included the fact that very often many stakeholders were involved from several transportation modes. Data had to be available from stakeholders such as Port Authorities, terminal operators, inland transport operators and of course from the commercial vehicles themselves. The European project COREALIS had tackled this issue by developing what they termed a Cargo Flow Optimizer (CFO). This was being trialled as a way to boost port economic performance while reducing the environmental footprint.

A number of papers discussed processes for route planning for freight vehicles in the sense of employing additional information in order to calculate the most fuel-efficient route (eg road topography, altitude, slope, traffic, weather conditions) but also using C-ITS techniques to assemble information on a much longer, cross-border corridor in order to give driving advice in addition to route navigation.

Old vs new

The relative fragmentation of the freight and logistics industry was not a new point but there were signs that some degree of aggregation was occurring as a result of the increasing availability of data management platforms. The work on multi-brand platooning had moved on since Copenhagen as had the performance of autonomous freight vehicles. There seemed to be evidence of greater cooperation between world ports regarding approaches to common problems; we will perhaps see more of this in Singapore.

Forwards vs constrained

The freight sector has some heavyweight external constraints – for example the European targets to reduce CO2 by 2050 which are likely to have greater impact on light vans and heavy vehicles than other categories; the increasing demand overall for road freight transport set against moves to limit heavier vehicle movements to help to avoid congestion; and the pervasive shortage of funds as just about all National Road Authorities have budget constraints.

The discussions on platooning explored the likely benefits from platooning and wider vehicle autonomy for freight transport but there was little if any reference to the future role of the freight drivers. Many countries had a shortage of truck drivers, particularly for long haul transport. For many stakeholders a move to full driver replacement as a benefit from autonomous operation would be very attractive but this scenario looked rather distant and as one speaker put it "Who will supervise the unloading of the truck if there is no driver?".

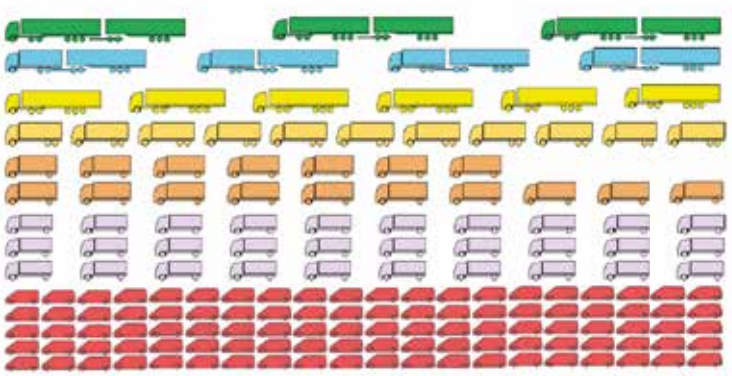
Where might we be going?

The freight and logistics sector could well see a number of arguments about the ways forward for businesses. Cities were becoming increasingly interventionist regarding space usage which would impact the passenger / freight access balance and the value of parking and kerb space. The second key area was the relatively slow adoption by the sector's smaller players of open platforms despite the wealth of proven ITS services available 'off the shelf'.

The third factor was the extent to which increasing pressure for better air quality, not just in cities, would force changes in the make-up of fleets of freight vehicles. It will be interesting to see the extent to which there will be faster adoption of technologies and services that can increase the productivity and minimise the negative impacts from goods transport on the roads.

Capacity needed for the transport of 200 pallets* between Malmoe and Gothenburg

Trucks Drivers	Total space on road	Fuel	Fuel Index	CO_2/ Pallet	Max imum authorised vehicle weight	EU driving license
#/o	meter	ml/km	40 t base	kg	tonnes	category one
3	294	14	72%	7	(76-90)	CE
4	364	15	80%	8	60	CE
6	492	19	100%	10	40	CE
11	836	28	150%	14	26	C
17	1275	34	180%	17	18	C
30	2220	47	250%	25	12	C1E
100	7100	94	500%	48	3,5	B



A different way of looking at road space utilisation (Frans)

Topic 5: Enablers of digital infrastructure

The overall situation

The infrastructure digitalisation topic attracted a good deal of attention in Eindhoven and many of the papers and all of the discussion sessions involved joint work between Industries, research institutes, public authorities and network operators across Europe. The main focus was on different types of connectivity/ communications systems; trust and security of the systems; positioning systems; efficient data management; KPIs; and the legal framework within which these systems will be operating for providing smart and sustainable mobility.

Examples of the advantages and drawbacks of different connectivity systems were used to highlight the need for mixed connectivity for the future. 5G can enable harmonious integration of heterogeneous networks whether terrestrial or satellite. It was predicted that by 2025 almost a third of automotive use cases would use satellite connectivity.

The topic in detail

Achieving truly integrated connectivity between all the components of transport systems requires the identification of the capabilities and limitations of the existing connectivity technologies. In technical papers and discussion sessions the coverage areas and capabilities of the different systems were presented.

Vehicular connectivity can be achieved through satellite-linked devices no larger than a smart phone. Both suppliers and users argued that it was necessary to move forward with what was available and it was not acceptable to wait until more frequencies became available.

5G capabilities can provide:

Improved reliability
- Connect intelligent traffic lights wirelessly to the cloud
- Guarantee connectivity with the cloud for critical C-ITS vehicles (e.g. emergency services)

Massive Machine Type Communication (mMTC)
- Asset management using wireless sensors and actuators

Ultra-Reliable and Low Latency Communication (URLLC)
- Emergency brake light
- Intersection safety
- Vulnerable road user safety (power consumption also critical)

Enhanced Mobile Broadband (eMBB) + URLLC
- Cooperative perception
- Cooperative manoeuvre
- Remote vehicle control
- HD maps (creation and distribution)

Opportunities offered by 5G (Caspar de Jonge)

A number of speakers explained the multiple opportunities arising from 5G capabilities and argued that 5G will represent a real enabler of ITS of the future for increasing safety levels and providing fast and enjoyable journeys to the passengers. However, the technology levels differed between countries, hence the network latencies were different and achieving interoperability across borders was significantly impeded.

Future connectivity mix (Andrew Faiola)

Speakers presented a number of trials and use cases demonstrating mainly V2I and V2V connectivity, but also mobile connectivity for a vehicle's passengers. It was argued both here and under Topic 1 that connectivity services could be a key lever for persuading travellers to move from private and owned vehicles to shared vehicles and public transport.

There was considerable debate on systems to ensure the trust and security of connected systems – points that were seen as vital to their operation and therefore in C-ITS. The design of a new assurance framework under the project SAFERtec was presented showcasing enhancements to current processes and emphasising that strong assurance can be affordable.

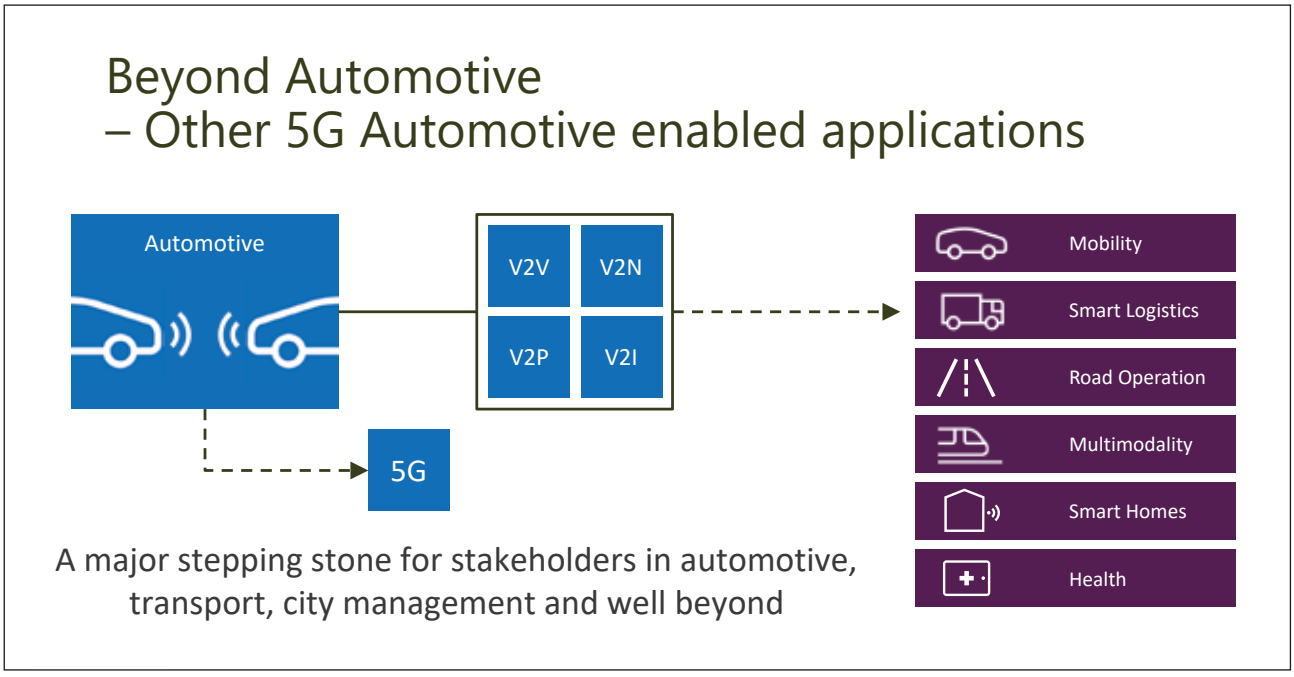
Satellite positioning (GNSS) plays a significant role in connected and automated driving and a number of papers discussed its integration with sensor data and terrestrial-derived information. The combination of GNSS and 5G was already helping to reduce overall costs while for providing more precise localisation solutions inside cities. This type of hybrid approach was also helping to overcome satellite visibility limitations and the early results from trials suggested it could guarantee seamless accuracy and reliability during autonomous driving.

Achieving integrated ITS across Europe for seamless travel services relied on digital data exchange between countries to harmonize discoverability and deliver rapid access to data. Speakers described a number of initiatives to deliver this goal including TN-ITS (Transport Network Intelligent Transport Systems) services which will be reflected in the existing National Access Points (NAPs). There were also presentations on new initiatives such as the Management of Electronic Traffic Regulations (METR) coupled with moves to harmonise EU traffic regulations. The outcome of METR will be a set of technical specifications and guidance to support a reliable exchange of road traffic regulations between the definitive sources of that information (road administrations) and a variety of users in a machine centred way.

Speakers in this Topic and also Topic 6 made the case for developing the idea of digital twins with extended digital functionalities linked to KPIs. Presentations from a range of countries described different ways to set these and also how to evaluate them. It was generally accepted that a common legal framework for data issues in European countries was imperative for building a harmonised digital ITS infrastructure. Many Member States were configuring their NAPs to facilitate access, easy exchange and reuse of transport related data, in order to support the provision of EU-wide interoperable travel and traffic services to end users.

Old vs new

As in Copenhagen satellite and 5G connectivity was again one of the main topics of papers and presentations. Mixed connectivity was demonstrated with numerous use cases and seemed to be accepted as an affordable way forward to achieve optimum connectivity between different interfaces. Judged by discussion content a key current issue was a move from debating technological advancements



Connected car applications (Matthias Sauder)

to considering the legal framework that would allow the implementation of new technologies on the Infrastructure. The key issues were enabling data exchange, common strategies on traffic management, common legislation concerning communication protocols and types of connectivity, common strategy on KPIs and their quality metrics.

Forwards vs constrained

It was clear that the technology advancements across infrastructure were in turn enabling developments in user services, network management, electric vehicles' performance, improvements in urban environments etc. The connected and autonomous vehicles (CAVs) of the future would provide the drivers with the safety and satisfaction to make their journeys enjoyable. Affordability was regarded as unlikely to feature as discouragement to investments in satellite technologies and mixed connectivity systems for ITS. Digital infrastructure technology was following the same path as much transport – as the technology advances physical sizes get smaller, power consumption reduces and the prices drop significantly – for example the mobile phone's evolution.

An increasingly concerning issue was the lack of data analysts – significant now and expected to become more pronounced in the future. Connected systems provide the transport sector with the ability to collect and analyse huge amounts of data which in turn led to problems with storage capacity and the lack of specialists to analyse and interpret these data further to provide solutions for improvements of the ITS implementation.

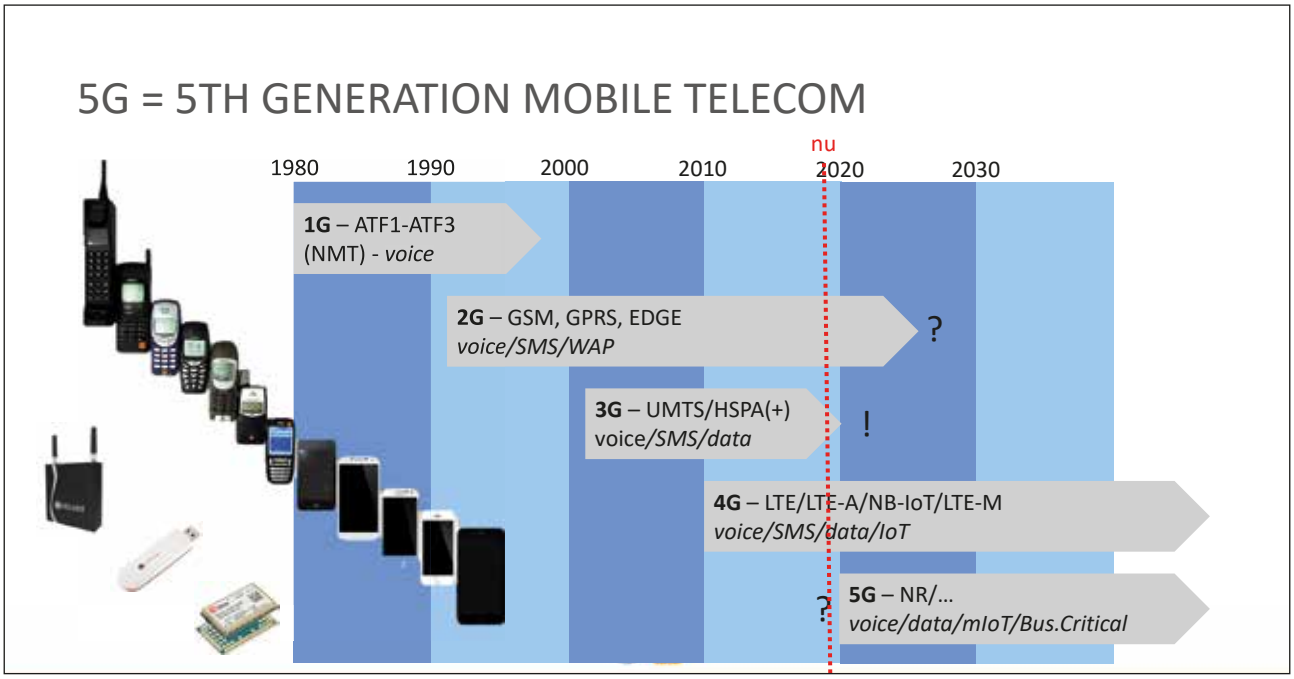
It was also noted in many sessions that there remained a significant gap between the public and private sectors that needed to be bridged. Digitalisation of the infrastructure for supporting the connectivity between vehicles and humans required a closer collaboration between industries, research institutes and public authorities.

Where might we be going?

Novel connectivity systems were affordable as demonstrated during the Congress and could lead to smart and sustainable ITS. Preparing the infrastructure to support such systems was seen as one of the main key elements to achieve it. Digital twins were becoming a useful tool to use for predicting the future and designing infrastructure accordingly.

Despite the technology advances there was still a long way to go to achieve integrated digital infrastructure and especially to achieve same level of connectivity quality, safety and integrity of the connectivity systems for all European countries.

By 2020 LTE is expected to cover more than 60% of the world's population but only 37% of the landmass mainly concerning Europe, the USA, and few countries in Asia. Despite the unbalanced distribution it was clear that connectivity was becoming more and more affordable and in the near future the cost would not be a constraint.



The evolution of mobile telephony (Matthias Saude)

Topic 6: Transport Networks Operations

The overall situation

The topic was very busy with a very large number of technical and scientific papers but a smaller share of the Congress Special Interest Sessions. Subjects covered included:

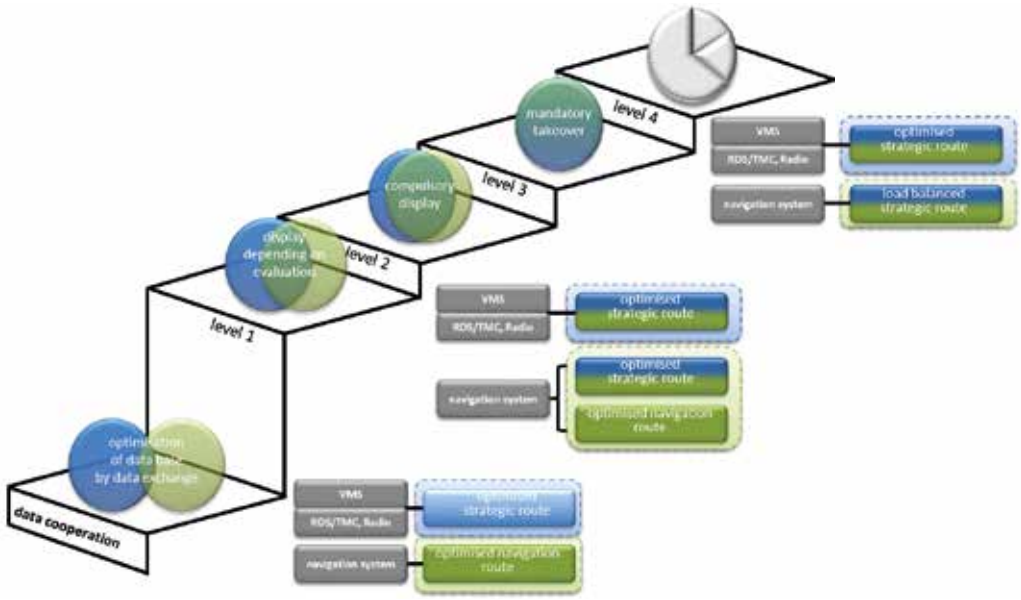
- Dynamic traffic management
- ITS for safety and safer cities.
- National ITS strategies
- Methods for object detection and data collection
- Cross-border solutions
- Parking
- Big Data, artificial intelligence and machine learning
- Simulations and traffic modelling

In line with the Congress theme "Fulfilling ITS Promises" implementation, and specifically implementation of ITS and traffic management in cities, was often the subject of sessions and papers. The importance of public-private cooperation was highlighted in several sessions with the reservation that it needed to be based on sustainable business models to allow serious involvement from the private sector actors. Dynamic, integrated and data driven traffic management featured frequently as an expected benefit from connected vehicles and all the data they would make available. The overall objective was safe, accessible and environmentally friendly transport and several speakers highlighted the need to address traffic management at a network level.

The topic in detail

A number of presentations looked at the introduction of automated procedures into traffic management centres at peak times when it became increasingly difficult to apply rules scenarios and traffic management plans manually. The same requirement was noted when networks became more complex and the numbers of scenarios and plans to be considered increased the burden on the employees.

A number of trials were described of systems to implement integrated management by using traffic measures (traffic management and traffic information) automatically and in a coordinated manner to improve the traffic situation. It was essential for road authorities and service providers to cooperate to enhance the traffic experience for users and assure win-win-win results for them all. Identification and agreement on sustainable business models was also an important prerequisite for this kind of cooperation in order to facilitate serious involvement from the private sector.



Interoperability of public traffic management & individual navigation services (Susanne Schulz)

	No joint approach – exchange info	Exchange info - common insights	Joint approach – common insights – coordinated approach
Situational – status sensors, actuators	Monitoring with own instruments	Share data, jointly set up CSP and optional improve own monitoring	Joint development CSP and all agree to use it
Operational – actions, measures	Independent choice and deployment of measures	Share actions and measures and optional improve own measures and actions	Joint development, choose and deploy coordinated measures and actions
Tactical – approach, TM services, motivation	Independent development and choice of tactical approach	Share approach and motivation and possibly improve own approach and motivation	Joint development, choice and deployment of coordinated approach
Strategical – policy, priorities, objectives	Independent development and deploy of policy framework	Share policies and prios and possibly improve own policy and prios	Joint development and deployment of policies

The SOCRATES2.0 cooperation model matrix (Giovanni Huisken)

It was emphasised that Digital Transport Infrastructure was essential for future traffic management, maintenance etc and must extend beyond just connectivity – it needed to address digital information and the whole transportation data eco-system governed by institutional processes. The need for public-private cooperation in traffic management was obvious with the increased use of smart mobility solutions provided by the private sector. These solutions influenced the road user behaviour and had a significant impact on road traffic conditions.

The large CEF-financed project Socrates2 was based on outcomes from the ERTICO TM2.0 platform and the work of the C-ITS phase 2 platform 'Enhanced Traffic Management' group. Socrates2 was presented in two sessions and was also on show in the exhibition. The concept was expected to lead to more business opportunities for the private partners, a more cost-effective traffic management for the public authorities, and better service for the road users. Some of the Socrates2-pilots were ready to be launched later this year and it would be very interesting to see results coming from them at next year's Congresses in Los Angeles and Lisbon.

The theme of cooperation between public and private sectors was illustrated by a paper on incorporating private smart mobility services into a wider dynamic traffic management concept. This was being done in the C-MobILE project and the ideas are to be implemented and tested in Thessaloniki.

The concept of TMaaS (Traffic Management as a Service) was brought up a couple of years ago and the concept starts to be more mature now. The goal is to create a stable and sustainable solution to which cities can subscribe instead of operating their own technical solution for traffic management. Many cities in Europe had shown interest in being a part of the first test of the concept, which will start rather soon. TMaaS is also described in Topic 1.

Collecting and analysing data, and the associated subjects of Artificial Intelligence and Machine Learning, featured in a number of papers and presentations. Collecting and using data is of course crucial for implementation of future ITS-solutions. Traffic management, maintenance, planning, safety etc will benefit from the availability of more data provided that there is also a capability to analyse and use it. A variety of examples on how to collect and analyse data were seen:

- Data collected from many vehicles over several years to establish a risk model for the roads in New Zealand.
- Automatically collecting data from an app for urban public transport passengers, and analysing it to understand demand.
- Estimating traffic volumes and origin-destination from mobile phone data.
- Combining the data from mobile phones, GPS, traffic signals, national surveys, traffic forecast models and virtual & augmented reality resulted in a joint approach to smart cycling cities and ITS cycling developments. This work was done as a national collaboration in the Netherlands to push cycling to the next level.
- Integration of multiple sources of bicycle data to understand cycling behaviour.
- Learning how best to grant permits for road closures and road works in the Hague using an accessibility control traffic model to determine the likely effects of closures of specific streets for each day of the year.

- A crowd-based feedback system for determining the perception of construction sites and the quality of construction site information on German motorways.
- Anonymising floating car data to enable data sharing and the use of the data for several purposes.
- Using open data sources to find demand patterns, distribution of origin and destinations etc.

Mobile phone data was already being used as a comprehensive data source for several purposes – estimating traffic volumes, calculating OD-matrixes, understanding movements of vehicles, bicycles and pedestrians.

Big Data and Artificial Intelligence were already being used to bring answers to real challenges in the transport sector. A very interesting paper presented the additional value of Big Data in three dimensions:

- New Business models such as data driven decision making in retailing at airports;
- Better customer experience such as improved driving and travel experience in highways;
- Improved operational efficiency such as operational analytics for managing maintenance in the railway domain.

Other examples of the use of Big Data, AI and Machine Learning included:

- Optimizing shared mobility
- Vehicle classification for tolling tariffs
- Traffic and accident prediction on Highways
- Emergency Management Information Systems
- Estimation of train arrival time

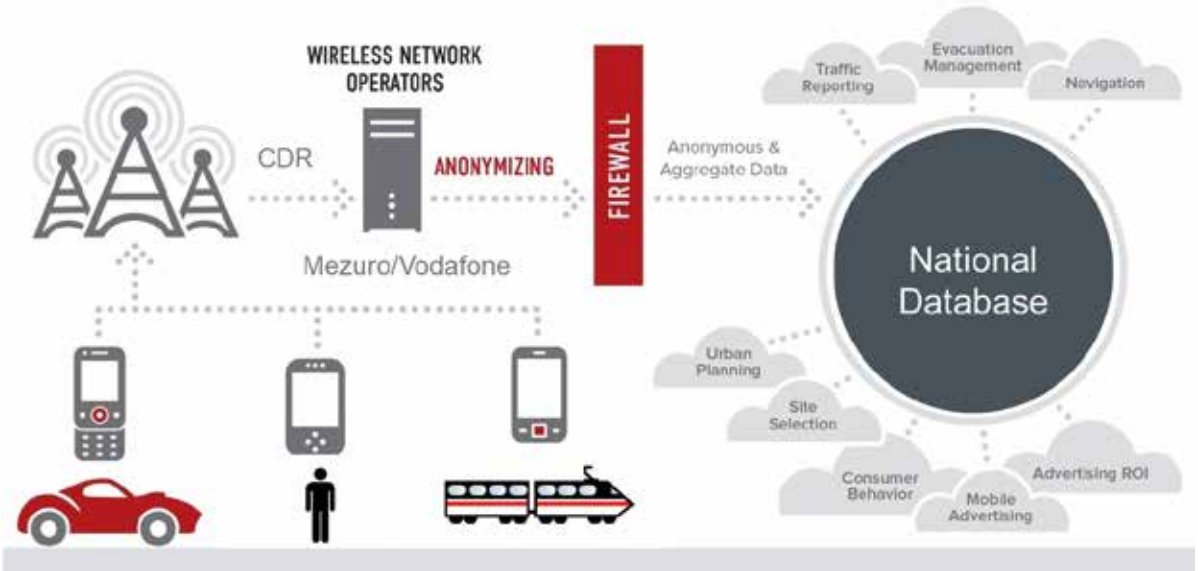
The advancements in Artificial Intelligence across all areas of transport were increasing the quality and definition of the data captured, amplifying the impact of the decisions that could be taken and boosting a city's ability to move people in a safer and more efficient way. Combining these developments with modelling and prediction algorithms was providing new techniques for were identifying and classifying not just motorised vehicles but also bicycles and pedestrians.

Old vs new – topics discussed in Eindhoven

Many interesting subjects were covered at the Congress as described above but in the majority of case what was seen was evolution – development of what has been seen at previous Congresses in ways that are faster, more efficient and more reliable. This was certainly the case for analysing data for different purposes and using Artificial Intelligence and Machine Learning. In general we did not see any totally new subjects in the topic but we had numerous cases of doing things better for example some innovative ways of using data analysis for different purposes.

Forwards vs constrained

In general, the topic Transport Network Operations was going forward. We saw more focus on implementation and real life solutions than earlier, which is in line with the Congress theme "Fulfilling ITS Promises". Dynamic and data driven traffic management was clearly developing in a positive direction with a range of public-private initiatives etc. We had increased focus on ITS in cities compared to earlier Congresses with



Travel information out of Mobile Phone Data (Stefan de Graaf)

presentations on traffic management in cities, parking in cities and the use of ITS to enhance safety in cities. A very intriguing question was raised more than once at the Congress – "Are fixed sensors no longer necessary?" The prompt for this challenge was that today data from mobile phones and vehicles (FCD and FVD) can probably fulfil most of what is needed.

It was noticeable that Big Data, Artificial Intelligence and Machine Learning in ITS were of increased interest and that more, and more mature, solutions were presented.

Even though the topic in general was advancing we had some areas that seemed slow:

- Business Models were not common but it was agreed that they needed more attention.
- There were no papers on cybersecurity under the topic of Transport Network Operations and very few at the last Congress. The subject is very important and might need more attention at future ITS-Congresses.
- The use of social media as a source for traffic related information was on the agenda at earlier Congresses but was hardly mentioned this time.
- Infrastructure for electric vehicles was previously under this topic but there were no papers.

Where might we be going?

ITS and transport networks for cyclists have grown over the most recent Congresses and Eindhoven also had some presentations related to cyclists and network management. As the Congress was held in the Netherlands where cycling is very popular subjects related to cycling were of course very relevant but a bigger issue was the more general one of ways to give more priority and protection to all categories of vulnerable road users especially in cities.

The Netherlands was prominent as leading the evolution of Traffic Management to be more data driven, interactive and cooperative in relation to all actors in the sector. This was very obvious at the Congress where many initiatives and implemented solutions were presented.

Data flow was an essential part of the modern transport eco-system and there was even more discussion of data, big data analytics, artificial intelligence, machine learning than at earlier Congresses. An expression often heard was "Data as the 5th modality".

Comparing to the larger ITS World Congress held in Copenhagen last year, some subjects seem to have disappeared – perhaps just because the event was smaller (eg cybersecurity, social media usage).

Plenary and Executive Streams

The Congress included a number of Plenary and Executive sessions grouped into three streams focussing on **Smart Cities**, **Automation**, and **Mobility as a Service (MaaS)**. The key discussion points and conclusions from these streams are summarised below:

Smart Cities Stream

Panellists

Herald Ruijters	European Commission
Cees de Wijs	Dynniq
Jos van Kleef	Goudappel
Stijn Vernaillen	City of Antwerp
Sarah-Jayne Williams	Ford Europe
Caroline Hazlehurst	Bird
Anat Lea Bonshtien	Israel Prime Minister's Office
Vasco Móra	City of Lisbon
Peter Broekroelofs	Dynniq
Richard Vielvoye	Deloitte
Sascha Westerman	City of Hamburg
Vassilis Agouridas	Airbus
Piia Karjalainen	ERTICO – ITS Europe
Maria Tsavachidis	EIT Urban Mobility
Manu Lageirse	Transdev
Rein Westra	Giventis International

The four discussions under this heading covered a very wide range.

There was a general agreement that a Smart City was one that used ITS technologies to connect city services, people, information and infrastructure to address urban challenges and work towards a sustainable greener city, a competitive and innovative economy, and an enhanced life quality.

Different cities had different priorities but common goals were reducing congestion, improving air quality, and mobility for all especially people with limited access.

For many cities to make progress the governance structure needed to change as it reflected the earlier separation of land use from transport service provision, energy use and the whole social services dimension. In Smart cities the technology capabilities of digital and physical infrastructure were seen as different aspects of urban planning and not two competing subjects.

In his **keynote address** Herald Ruijters stressed the need for integrated solutions – large-scale deployment of ITS would be beneficial but on its own would not generate a Smart City. It was essential to include as well links to energy use, spatial planning, a range of community social services; and waste and water infrastructure. And linked to all of these elements was the need for user consultation and user involvement in the deployment plans. We were in the fortunate position of having available a range of proven technologies and solutions for citizens but we needed to connect the different communities – our principle should be "integrated not isolated" and key goals were zero emissions and zero fatalities.

In the **Plenary session on How do cities benefit from ITS** the dramatic changes in emphasis over the last decade or so were stressed. Instead of a focus on technologies, research and development we could now deploy affordable solutions to increase transport sustainability, increase safety and improve air quality. There was also a strong move to decentralise with increased engagement of local government bodies, cities, public-private communities and citizen groups.

The deployment of ITS had also enabled a number of changes to urban mobility models. Traveller behaviour was starting to change, driven by real-time information, apps delivering market choices and public transport prioritisation, and the single-occupant private car was no longer seen as the day-to-day mobility norm. Understanding and then changing behaviour was a key for the adoption and acceptance of a smart mobility ITS system.

Another major change in the past 10 or so years was the availability and use of data and especially its use to persuade people to change behaviour for a wider social benefit. The keys to behaviour change were more comprehensive information and an underpinning business model that supported both a city's managers and the end users. Information relied on good data and it was clear that people were willing to share their data, including personal data, if in return they saw something of value to them.

The panel reviewed the likely direction for future developments and highlighted the need to reassure users on cybersecurity and using ITS to find better solutions for freight deliveries to cities. As our systems

become more connected they risked becoming more vulnerable. It was therefore important for system architects to take security into account from the beginning and especially the new risks linked to the Internet of Things. The freight issue was also complex – city residents and those working there were enthusiastic users of on-line retail with "at home" deliveries. It was clear that this added considerably to city congestion, poor air quality, the volume of waste to be cleared each day and overall societal costs. Trials of load consolidation and greener 'last mile' delivery modes were looking promising.

A keynote address from Bird, looked at **the roles of alternative transport modes in the mobility options,** outlining the benefits for cities from adopting micromobility options with particular reference to shared electric scooters. These offered a large reduction in congestion as the space occupied by a scooter with its one user was markedly less than that of a car with typically 1.2 occupants. A typical two-lane inner city roads was at least a four-lane scooter route. There was also zero emissions at the point of use. Micromobility options generally were affordable ways to bring transport to areas where public transport was not cost-effective and there was new evidence that the associated ease of parking was encouraging travellers to spend money in smaller corner shops rather than larger, centralised malls.

The following session explored the question **Smart mobility – more hype than reality?** and began with considering what is a smart city and what is smart mobility? It was suggested that any city with regular congestion could not be termed 'Smart' as the techniques for reducing it through traffic management or pricing were well-established. However there were many practical issues to resolve when seeking to reduce congestion and decisions were often difficult politically – for example what was the role of the car? What priority should be given to freight?

There was not much published material on best practice regarding city business models partly as there were still disagreements as to who should fund digital infrastructure – the public or the private sector? It was important to encourage the development of open platforms to assist integration. One way forward would be to treat digital infrastructure in the same way as physical meaning governments would invest in infrastructure and open interfaces so that companies could develop interoperable services not just within cities but across national boundaries and between countries.

The panel agreed that while Smart Mobility might have been over-sold progress towards 'Smart City' status would be significantly accelerated if there was wider access to the data collections held by

public authorities and – perhaps as a reciprocal agreement – the data held by private operators There needed to be more integration of proprietary solutions for information, ticketing and payment into open platforms and the adoption of open standards with benefit to all stakeholders. Solutions needed to be scalable across, not just within, countries and assessing performance needed to put more emphasis on users' needs rather than suppliers' The evidence suggested we were travelling in the right direction but we needed to speed up.

The next discussion topic was a new one for Congresses: **Urban air mobility – what adding the 3rd dimension brings and requires**. It was emphasised that ITS products deployed in cities were constantly evolving and a major development involved the third dimension: aerial services based on drones. The session launched with a brief scoping description: using the air above cities, taking this in a loose sense of the space above areas with overloaded or insufficient infrastructure, for moving goods or people. It was an umbrella term as it covered a range of vehicle sizes, manned and unmanned versions, and used for a range of purposes.

Aerial mobility was neither a revolutionary transport mode likely to replace all other modes in due course, nor was it an instant solution to the biggest mobility problems. Rather it was a new technique complementing the solutions we already have. Using the air space was at the same time controversial and exciting. There were many potential stakeholders pressing the case for wide-ranging low regulation to support emergency distribution of medicines, food etc. However most city authorities were instinctively uneasy about an open access regime and in many places studies had started to see what regulations might be necessary for safety, noise, security, privacy, traffic control etc and whether the use for passengers or freight should be limited in any way.

There was a strong need for clearer definitions of objectives – systematic studies illustrating where aerial services would bring benefit and where their particular advantages were required rather than the current situation where in many cases simply experimenting with the technology was driving the demand. The future success of aerial mobility was likely to depend on integrating the 'air' world with the 'ground' mode with a focus on multi-mode hubs; and the solutions would vary significantly from city to city. Nearly all the key questions were political and societal rather than technical.

The final discussion session in the Stream was **Sustainable mobility for all** with an initial focus on the need to align accessibility, affordability, safety, security, sustainability multimodality not just within cities but for all potential users in countries. Looked at across Europe the picture was very uneven. There were areas where strong progress had been made and was likely to continue but many cities and countries were lagging. We had all the technologies, solutions, data and other elements for a smart city; the difficulty in many cases was getting the political drive to integrate the policy goals of multimodality and sustainability and decide on the role of the car.

Some cities were basing their strategies on a growth of shared mobility using electric vehicles to resolve future mobility issues but there was a risk that this oversimplified a complex issue that needed much collaboration of stakeholders. Cities that were hostile to car use through pricing and parking policies were detecting relocation of businesses to areas where it was easier to use personal rather than public transport. The approaches to urban planning were not keeping up with changes to mobility demand and mobility provision. There was also a lack of central coordination in Regions where cities with similar mobility requirements were able to adopt different policies that often interfered with each other and were a barrier to seamless through transport.

An ideal mobility design for urban areas was one or more multimodal transport hubs with fast and frequent mass transit links to a an outer ring of smaller centres from which travellers would complete the 'last mile' of the journey using a range of modes and including active transport options. But this type of solution could not work for rural or outer-urban areas as the volumes of business could not support public transport. To extend sustainable mobility to all locations we needed to develop affordable demand–responsive transport options and perhaps rethink the underpinning subsidy models.

The path to sustainable mobility depended not just on the integration of transport services but also on an open payment and ticketing platform that extended beyond transport to other retail services such as entertainment and food. To ensure the widest possible integration we needed to open the data on traveller movements held by government bodies so that all parties wanting to offer services could see the preferred origins and destinations and use that information to design appropriate public transport alternatives as well as a range of 'lifestyle' services.

PART 2: PLENARY AND EXECUTIVE STREAMS

Automation Stream

Panellists

Jean Francois Aguinaga	European Commission
Olivier Lenz	FIA Region I
Lluís Gómez	Barcelona City Council
Karel Smits	VDL
Marko Sillanpää	Traficom
Patrique Zaman	Avy
Antoine Vergne	Missions Publiques
Kristine Hess-Akens	City of Aachen
Stephane Dreher	ERTICO – ITS Europe
Martin Russ	AustriaTech
Clément Aubourg	Keolis
Kevin Mayne	Cycling Industries Europe
Evert Schaeffer	TomTom
Ellen Townsend	European Transport Safety Council
Mats Rosenquist	Volvo
Joost Vantomme	ACEA
Claire Depré	European Commission
Aria Etemad	Volkswagen Group
Armin Gräter	BMW Group
Serge van Dam	Rijkswaterstaat
Svetlana Dicheva	AKKA
Apostolos Malatras	ENISA

This stream covered three broad areas – a stock-take of where work on connected and automated vehicles had got to; a review of the likely impact on safety; and a look at plans for further work and preparation for deployment. The stream received a lively launch with a keynote address by Patrique Zaman, CEO & Founder, Avy, on ways on which both piloted and semi-autonomous drones were being used to deliver medicines to remote or inaccessible locations. He noted the need for a revision of regulations to reflect that drones were neither conventional aircraft nor helicopters so a fresh analysis of the issues was needed, and stressed the additional freedom of movement brought about by moving from a 2D to a 3D world.

The discussion on "**What do the citizens want?**" noted a distinct mismatch between the issues that designers, manufacturers and suppliers thought ought to be of concern to citizens and what in practice did concern them. There was a similar mismatch between what was expected or required as a longer-term vision or goal. It was essential to establish trust – citizens were not automatically hostile to new mobility developments such as highly automated driving but they needed to see them demonstrated in familiar surroundings, ideally with the opportunity for a personal trial. Public consultation exercises should not focus on a particular technology; rather they should sketch the future daily scenarios once the technologies were deployed.

The **Plenary session on** "**How far are we?**" began with an address by Jean-Francois Aguinaga who noted that the Brainport demonstrations showed an evolution from protected test locations to mixed traffic environments and were a sign of progress since the last ITS Congress. However there were still roadblocks – technical, social and regulatory. He reviewed the European Commission's strategies, which proposed action to tackle issues around legal frameworks, social impact and supporting competition. He reminded that automation in itself was not a goal but rather an instrument to reach policy goals to make vehicles safer, greener and more efficient.

Overall the panel and audience felt that we had come impressively far. It was interesting to consider that 10 years ago the early advanced driver-assistance systems such as anti-lock braking were optional and not a default feature on the whole fleet. We were progressing well but to make things happen more quickly citizen engagement and building citizens' trust was crucial. The ITS Congress had an important role in this. Faster progress with automated driving required progress with connectivity across the entire mobility context.

It was conceded that most European cities lagged behind China regarding 5G connectivity but that was to a degree offset by hundreds of years' experience in managing cities for greater liveability. Opportunities should be used to maximise 5G implementation but the advances must be city-specific with the ultimate goal of doing good for citizens. All speakers agreed that automated driving had advanced a lot in the last 10–20 years but the "Holy Grail" of fully autonomous driving was still a big leap to take.

Regulations had still to be aligned for mixed driving situations, and sensor technology while good was not yet as good as human perception. Citizen engagement and trust in the technology were also a factor in determining the speed of implementation. Past tests and deployments had shown that implementation took time and one must look to all the benefits that each incremental step brought, especially in the area of safety and environmental aspects. One panellist

summed up neatly by saying that "the glass was half full rather than half empty" as far as automation was concerned.

The discussion on "**Optimising conditions for road safety**" began by examining whether it was realistic to think of achieving zero accidents through automated driving and assuming that was the case how might we accelerate deployment?. Panellists noted that we were at an intermediate level of automation with a number of advanced driver-assistance systems routinely in vehicles and other applications such as Intelligent Speed Assistance linked to the EU's General Safety Regulation. We needed to think of safety in the round: a mix of pedestrian, cyclist, motorist behaviour; the design and availability of infrastructure; and the degree of law enforcement.

In-vehicle systems had developed steadily since the early PROMETHEUS work 25 years ago and were able to make safety corrections when drivers made mistakes. The new technology applications, including automated driving, aimed to prevent mistakes happening and we should recognise that we needed to build users' trust in them and accept that we would advance through many incremental steps. There was still a massive amount of work to be done to meet the 2020 goal of halving road accident fatalities as the rate of improvement had fallen and vulnerable road users were more at risk than car occupants. This was a key message for those working on highly automated vehicles of all classes.

Much work remained to be done to support delivery of zero fatalities and it was agreed that it was not only technological improvements but also progress with regulation and user acceptance. More investment in infrastructure improvement was needed. Digital infrastructure elements, such as digital maps with their ability to look beyond sensors and work in all weather conditions, played an important role in improving road safety. Dynamic maps using a blend of sensor fusion and map data increased driver confidence levels but there needed to be standardisation and international rollout.

Some doubt was expressed as to whether the current systems were safe enough to be acceptable to end users – would they perform as well as the best drivers? It was argued that there was no direct correlation between automation levels and safety; Level 4 was sufficient and there was little need for the expense of Level 5. The panel were clear that much had been

achieved towards road safety and that the focus should be on the thousands of lives potentially saved by deployment rather than the handful of accidents that had occurred and which had been reported widely by the media with little overall context.

The panel reflected the key message that automation was not an end in itself but rather a means to road safety. However it was vital to consider the overall picture and not focus just on safety. Improvements in safety for the individual drivers had to be balanced against the wider impact on the road network. For example early evidence suggested that users of adaptive cruise control maintained longer inter-vehicle distances so the gains for an individual were offset by increased congestion for society as a whole.

The session on "**The road towards high level automation**" began with a series of position assessments by the panellists. On the whole the case of an autonomous vehicle operating on a highway or equivalent quality road was very well understood but this was a simplified environment: all traffic going in the same direction at roughly the same speed, no pedestrians or cyclists. There were a number of challenges to moving forward – in particular establishing a safe and reliable process for handing back control to the driver, and cross-border testing of vehicles as licensing and certification regimes were national and not pan-European. There was also a need to manage expectations – the implications in the media of Level 5 vehicles able to travel anywhere and available in 2021 were wildly inaccurate.

There was still much to do regarding cybersecurity especially beyond Level 3. The problems were not helped by there being very many players in the supply chain with different views on the nature of the issues, their seriousness, and who should be responsible for designing and paying for solutions. Some progress was being made particularly through ISO working groups but there were still stakeholder organisations seemingly unaware of the bigger issues.

For road owners and operators the deployment of automated vehicles needed to be understood at network level – the safety arguments for highly automated vehicles were always prominent but it was essential to make sure that there were not simultaneous negative impacts on traffic flows. It would take many years to develop infrastructure to the quality seen as ideal for widespread operation at Level 4 so the way forward might be the introduction of geofencing to limit vehicles to Level 3 at most in areas where the digital infrastructure was weak.

Cross-border testing posed a challenge because of differing licensing and registration procedures in different countries. Legislation was also needed to facilitate registration of test vehicles beyond test roads. There was a call for a new type of regulatory framework that matched type approval with driving licence types: a vehicle driving licence. The security aspect of Cooperative, Connected and Automated Mobility (CCAM) was emphasised as something that must not be overlooked at any level of automation because it was closely tied to safety. On this issue, it was important to work on policy requirements along with the different stakeholders as each new actor in the CCAM field brought new dangers of hacking.

Panellists agreed that we had perhaps been too ambitious in the past when talking about the timeline for achieving autonomous driving and it seemed unlikely that Level 5 autonomous driving would become a reality by 2021, if ever. Advanced automation was expected to come first on highways and in parking situations as there were fewer vulnerable road users involved. But even here, better connectivity was needed everywhere to allow robust operation of digital and road infrastructure for automation through real time data exchange.

It was agreed that there needed to be greater connection between the numerous tests under way in Europe so that governance, regulatory approaches and agreements could be shared. The Commission's Single Platform for Open Road Testing was mentioned as a way to benefit sharing experience and accelerating automated driving. The future was all about automatic or automated driving not "Autonomous" and the speed of achieving it would depend on performance and cost improvements for sensors; continued development of digital maps as a part of a connected digital infrastructure; the availability of multimodal traffic information particular for the urban environment; and greater standardisation of the regulatory regimes.

But perhaps the strongest message from the session was the need for greater cooperative working by the various stakeholders – neither industry nor the public sector could deliver the required outcomes operating alone.

Mobility as a Service (MaaS) Stream

Panellists

Claire Depré,	European Commission
Jacob Bangsgaard	ERTICO – ITS Europe
Leen Balcaen	HERE
Giancarlo Scaramelli	Transdev
Eric Mink	Rijkswaterstaat
Christof Schminke	Trafi
Henrik Haenecke	BGV
Krista Huhtala-Jenks	MaaS Global, Finland
Isabelle Vandoorne	European Commission
Marijke De Roeck	City of Antwerp
Hans de Penning	Amber
Laura Eiro	ITS Finland
Paul Rooijmans	Tranzer
Ozhan Yilmaz	European Investment Bank

The **opening Keynote "Mobility is a joint effort!"**was delivered jointly by Trafi, a mobility service provider and BGV, the public transport operator in Berlin who emphasised the importance of partnership and collaboration. The city of Berlin was keen to ensure that its citizens were supported in their assessment and selection of the ever-increasing range of mobility options so had collaborated with a range of partners to deploy an app incorporating eight different transport modes and enabling payment and ticketing across them.

Discussion on the topic "**Are silos & 'walled gardens' threatening open mobility innovations?**" started with panellists interpreting 'Open Mobility' in the context of MaaS. A number of elements were expected to feature in any open solution – first, it should not constrain choice leaving the end-user to decide whether to opt for a particular supplier or mode rather than another. It should recognise and cater for a variety of classes of user (eg a city resident, an occasional visitor, someone of school age, a person with impaired mobility) and offer different payment plans (eg monthly subscription, pay-as-you-go etc) so that users could see clear sets of alternatives. For many suppliers a change of mindset was needed as the MaaS and Open Platform philosophy did not match the traditional business model of 'owning' the customer.

The development of MaaS-type schemes was highlighting many difficulties that had previously tended to be ignored or by-passed – for example the structure of fares; policy for sharing real-time data; whether

competition regulations needed to be updated; whether a commercial operator should be subject to some form of public service obligation to encourage continuity. The European Commission was studying these issues to see where there were genuine barriers and whether there were areas where regulatory interventions might be needed to open markets.

Cooperative working of the private and public sector was not the only requirement for success – cities needed to work closely with national governments to ensure that the incentives, regulations, policies they wanted to introduce for local benefit were a sensible element of a larger national strategy. This was particularly important for area traffic management schemes where it was often too easy to reduce congestion in one city by transferring it to another.

The session on "**MaaS circular economy approach to mobility**" began with panellists exploring what contributions MaaS might be able to make to a circular economy – one in which we kept resources in use for as long as possible, extracted the maximum value from them whilst in use, then recovered and regenerated products and materials at the end of the service life. It was recognised that MaaS resonated strongly with the circular economy concept of products changing to services. Similarly MaaS enabled much more intensive use of transport assets especially personal cars and so reinforced the case for a smaller overall fleet. The key ingredient was developing a sharing economy.

Finland had introduced a roadmap to help moves towards a national circular economy that was based on policies to reduce greenhouse gases emissions from the housing, food and transport sectors. Reaching the transport targets relied on electrification, automation, connectivity and vehicle sharing – policies that complemented MaaS very well. It was vital to be clear on the top level policy objectives for both MaaS and circular economy schemes. A difficult point for policy makers was that currently there seemed to be no solutions that ticked all boxes so hard choices had to be made – for example could sustainability policies work with open markets and free user choices?

The panel noted that most surveys predicted population growth especially in cities so more people would be travelling and individually would probably travel more than today's average. MaaS was a major enabler for sustainable mobility through both sharing personal vehicles and by supporting public transport use. Policy makers needed to help its deployment by ensuring that transport pricing and taxation reflected the fuels used and by encouraging greater public–private cooperation. This could include opening public transport assets including information to MaaS suppliers (and vice versa), better communication of information on services to potential users, introducing incentivisation schemes.

The **Plenary session "Integrated mobility today"** began with a keynote reflection from the European Commission – why does integrated mobility matter? Taking the wider societal goal of a more sustainable lifestyle together with the Congress theme 'Fulfilling ITS promises' it pointed to an overall goal of more sustainable mobility. To reach this point is required a lot more integration and cooperation, the use of ITS to change behaviour, promoting the use of collective transport modes, and increased use of active travel modes such as walking and cycling.

There needed to be broader examples of the work done by the MaaS Alliance: bringing the key actors together to learn about each other's capabilities and hear each other's points of view. All the key instruments required were available and proven; the challenges were bringing them together to work in an integrated way for the benefit of all stakeholders to deliver sustainable and affordable solutions and services. Changing your habits was not easy and it would be necessary to try to improve people's awareness as a first step. There were a number of new opportunities available as a part of the solution and she looked forward to seeing at future Congresses how ITS expanded its offer.

Panellists considered the question whether MaaS had revolutionised or was revolutionising the mobility sector. There was agreement that the full picture was complex – the availability of real-time data and disruptive innovation across the transport sector were also strong drivers of change. Consumers seemed to be ready to amend behaviours and take up new services and were perhaps waiting for those services to change. If we looked back at the introduction of taxi services – increased congestion, additional employment, a new public service – it gave an interesting parallel with what was happening now with MaaS. We should perhaps pause to think how to address the three changes for MaaS today.

There were some clear 'revolutionary' changes for example the relationships between operators and local or national governments had changed and were still changing; and the focus had moved from the movement of vehicles such as buses to the mobility of people. A challenge was to accelerate the delivery. It had taken 20–30 years to achieve roaming in mobile

telephony; cross-border MaaS had to be completed more urgently. The key test for suppliers was finding the elements that increased users' buy-in.

An interesting test of user acceptance emerged from discussion – the "Popcorn Test". When going to the cinema or similar users buy popcorn for added personal value so in the case of a MaaS service what to the user is the 'popcorn' element – the extra added value that drives the decision to choose a MaaS solution and a particular product. The marketing needed to explore the reasons why non-users did not opt in. With this thought in mind the session held an audience consultation through SLIDO with the question "What is the biggest priority for accelerating MaaS deployment?" and the equal top answers were 'changing travellers' behaviour' and 'changing operators' business models' with 'getting real private–public partnership' in third place.

The keynote speakers and the subsequent panel discussions focused on the potential for new mobility services such as MaaS to deliver flexible, affordable and sustainable mobility for all; but they also emphasised the difficulties in moving from today's governance regime with its established business models to a more open, less regulated and interoperable environment. There were some simple messages – the need to put the focus on the mobility of individual people rather than the physical movement and ownership of the transport assets; the need to deploy solutions that improved cities' air quality; and the widespread agreement that travellers needed to be persuaded to make changes to their behaviour. "Persuaded" was the key word for the approach to be used.

The way forward would not be through banning some processes or forcing adoption of others but making solutions attractive and making sure that travellers had full information on the new options and the true costs of the traditional approaches.

There was also the need for service providers to do more to consult users – the new mobility models relied heavily on using technology and personal devices and for many potential users there were the associated social concerns about managing technology ranging from social exclusion, to privacy and data protection.

The need for better collaboration and partnership working was often mentioned. The public sector, private sector and end-users needed to work together to facilitate the introduction of new services and changes to people's mobility habits. Increased user awareness and a feeling of ease with the new technologies – and how best to use them – were part of the solution. It was most unlikely that there would be a "Killer app" as opposed to a number of competing products with different special aspects.

The availability of technology was not the main concern; it was getting suppliers, regulators, customers and users together to work as a partnership rather than trying to look at problems one by one and on their own.

The ITS Summit

In June 2016, as a part of the ITS European Congress in Glasgow, ERTICO organised the first ever "Mayors' Summit" to gather city Mayors and similar political leaders from across Europe to discuss problems experienced by cities and solutions to them. The Summit explored opportunities, experiences and strategies related to the present and future contributions that ITS can bring to seamless travel and the delivery of sustainable, efficient and innovative mobility within cities and beyond borders. The Glasgow summit was a popular success so a similar event was held during the 2017 Congress in Strasbourg. The 2018 Congress in Copenhagen was a World Congress not just European so the Summit was widened in scope to include senior officials from local and national governments and Industry Leaders. For Eindhoven we decided to keep the mixed format of elected politicians, their officials, senior researchers and industry leaders.

The Summit aimed to explore the current challenges and opportunities in the field of intelligent mobility and smart cities. Cities represent the hot spots for both difficult problems and innovative solutions as a result of economic growth, population movement, ageing, and limited physical space. Delegates from more than 35 cities & regions and 30 industries took part as well as representatives from the European Commission, the European Investment Bank, POLIS and ERTICO – ITS Europe. Discussions were derived from the ITS Brainport 2019 main theme: "Fulfilling ITS Promises" and focused on five broad topics:

- Making cities more liveable by reducing congestion and improving air quality
- Regulating the deployment of new technologies and new mobility services in cities
- Making mobility data available while maintaining commercial and personal privacy
- Public-Private cooperation in managing urban space and infrastructure
- Enabling deployment of automated transport in cities for both people and goods

There were no formal presentations; rather, after an initial scene-setting the delegates divided into small groups to review each of the themes. They explored political and commercial priorities, identified issues seen as holding back progress, shared views on what has been tried and tested, and generally talked about balancing policy aims with technology possibilities. Delegates shared experiences as to what ITS services are available now and how best to deploy them but they also looked at areas where solutions are incomplete or not readily understood. They noted that mobility technologies were continuing to develop quickly; this was welcome news when problems previously considered too difficult could start to be addressed using innovatory approaches but it put pressure on regulatory activities and knowledge management roles.

Concerning **making cities more liveable by reducing congestion and improving air quality** it was noted that making progress depended on being a little more precise with terminology. Measuring city air quality was not straightforward. Placing sensors was not easy and data was hard to interpret; it was even harder to identify causes and then decide on actions. More generally inner city problems were different from those in the outer and less-dense areas. New mobility models would often be a better 'fit' for outer areas where head-on competition with public transport was reduced.

Ultimately improving liveability and air quality rested on changing modal shares which meant a mix of persuasion / incentives ['carrots'] and penalising anti-social processes ['sticks'] but wherever possible carrots should be used. Cities needed to find solutions that joined up the various contributory elements: planning permission for new developments must include links to public transport and encourage ride sharing and active modes. Different approaches should be tried for example ensuring that payment for large scale events (concerts, sports etc) included the price of a public transport ticket. Fares for public transport must support flexible working by employees. Opening up the data held by public bodies was key to encouraging innovation, Encouraging a mode shift from private cars to public transport was a productive move but in many cities bus fleets were quite old and consequently had high emissions.

Participants felt that cities needed to get together more often to share experiences, especially to learn how solutions had been introduced elsewhere. However a key element of the Eindhoven discussions had been cities and industry looking at problems jointly so the supply side was able to get a clearer view of what was likely to be welcome and affordable and the cities could be clearer on the commercial pressures. Perhaps the final point was the statement that sharing experience was as important as collaborative partnership working as it represented a highly cost-effective counter to shortages of skilled staff.

Regulating the deployment of new technologies and new mobility services in cities was recognised as a sensitive and difficult topic. There was agreement that

current regulatory regimes reflected the problems, solutions and technologies of the past and we must not assume that they would automatically work for new mobility solutions. Both sides had to be flexible and encourage experiments. However cities were finding it difficult to develop regulatory regimes to match their local needs as frequently there was limited freedom of action handed down by national bodies. The importance of cross-border interoperability was recognised but the agenda must not be set by national governments discussing problems exclusively with the supply side.

Industry representatives stressed the importance of a loose regulatory framework that allowed experiments and did not delay approvals while hypothetical deployment consequences were discussed. It was useful to think always of "Learning by doing" for both the deployment business case and the associated regulations where changes were likely to be needed. While pilot trials were immensely useful they did not always reveal the problems of a large-scale deployment.

Regulators needed to monitor what was happening on the ground and be prepared to adapt quickly if matters were moving in very unwelcome directions. But above all regulators had to think "Why does this scenario require regulation? Do the benefits from doing nothing outweigh any negatives?" The difficulties regarding regulation were an example of a wider problem of a mismatch between overall city needs and what was on the market and emphasised the importance of cities sponsoring more trial deployments so people could taste the alternatives that might be on offer. More guidance was requested to share the experiences of countries and cities world-wide; the Summit was welcomed as an opportunity for all stakeholders to come together to exchange thoughts and discuss solutions.

The third topic discussed was **making mobility data available while maintaining commercial and personal privacy**. A key point here was the need for all parties to understand the various terms. For example road operators could derive great value from knowing the flow of vehicles on their networks; this did not require details of the vehicles' identification, the drivers' names etc, the make and model of the vehicle. There was often confusion behind phrases such as "data from the movement of vehicles" and a lack of understanding that such data could easily be anonymised.

At present we tended to think of three types of data: public produced; private and 'user' data such as personal data. In the future there would probably be no distinction between types or sources of data: it would be one pool of blended data available for everyone on a standardised form to create more added value and especially to deliver wider societal benefit. To manage this we needed clear principles in some form of Data Agreement setting out who owned what; who stored what; and who could use what.

Mobility data from vehicles was very valuable: 15 data items had already been identified for public authorities to collect eg data on road works and parking thereby encouraging investments by the private sector. It would be helpful to have more published business cases to learn about the value of data in mobility. Some city transport authorities (eg London) gave free access to data through APIs for companies to use it and had reported huge added value for the city.

There did not seem to be a great deal to do regarding privacy. From the supply side the data needed to be aggregated and mobility focused so no data could support tracking down individuals. The difficult issue was the public one of convincing individuals to opt in and agree to share in return for a greater and wider social benefit. For public stakeholders sharing data was more of an economical long term benefit; for private stakeholders the benefits were more likely to be financial advantages in the short term.

Cities should consider bringing public and private stakeholders to the table for joint planning on how to aggregate data to improve governmental services (like roads) to attain the highest social value from the data. There was also a need for more information on policies or schemes to incentivise making data available especially ideas such as sharing and combining data to reflect both public and private interests eg free parking in return for sharing data; defining minimum data points that commercial parties should give to have permission to operate in a country.

The discussions on **Public-Private cooperation in managing urban space and infrastructure** were wide-ranging and for the most part focused on how to improve what was normally a not very well developed collaboration. Cities tended to take a traditional "ownership" approach to infrastructure which was outdated. The Copenhagen Summit had noted that invariably the pace of development and deployment were much faster than expected and progress towards a joint approach was not helped when what was seen by one partner as a threat to safety and security as regarded by the other was a business opportunity and a way to encourage modal shift away from cars. One topical example was the rapid expansion in many cities of E-Scooters.

The only sure way to make progress was a review of demands, resources and the legal and physical constraints, by the public and private sector working jointly, to guide the production of a roadmap based on current and emerging technologies and products. This would undoubtedly be challenging, not least as suppliers would want quick action to address current changes and demands whereas cities were obliged to take a longer and broader view to maintain mobility options for all classes of user. Many cities had invested heavily in public transport assuming recovery of costs over a long period so suppliers needed to understand a reluctance to open public transport to complete competition.

Despite the difficulties there were a number of excellent case studies where planned developments – housing, businesses, new mobility services for example – had been put on hold to enable discussion with cities on alternative ways to bring the planned changes to the market. It was clear that access to data was a key factor in such discussions: cities could help businesses' planning by making a range of data available and operators of new services could support cities by sharing information on traffic flows, origin-destination etc. It would be helpful to all parties if there were more publications describing the best practices from successful joint ventures.

The fifth topic for consideration was **Enabling deployment of automated transport in cities for both people and goods**. Participants recognised multiple challenges to be tackled to enable moves towards full deployment of automated transport. There was the investment challenge: who would pay for the development and deployment of automated transport? There were legal aspects: there needed to be at least national and perhaps international agreement on who could be held responsible in case of an accident with an automated vehicle? For cities there were space planning challenges: would the design of infrastructure need to change to allow segregation or dedicated lanes for AVs?

The biggest challenge in the deployment of automated transport was probably understanding and changing the behaviour of transport users. The willingness to adopt this technology was not clear yet it had to be taken into account in planning city developments. Citizens would need to feel they could trust a technology which asked them to share personal space with strangers and to rely on the timeliness of others. There needed to be a focus on sharing autonomous vehicles, since merely having autonomous driving as an available service was likely to drive growth in demand for such vehicles and increase city congestion.

Governments could influence behaviour positively by providing information on new mobility services and urban developments to educate users – we needed smart citizens for a smart city. And it was important not to preach only to the converted, all citizens need to be educated. Companies and employers could contribute to change by giving employees a monthly budget to spend on mobility rather than the option of a leased car. There was much discussion but little agreement on the likely pioneering locations for autonomous driving – would it be inner cities as a replacement for established public transport? inter-urban highways with much simpler infrastructure and fewer conflicting traffic movements? or outer-urban and rural areas where public transport was less prevalent?

Participants were clear that fully automated transport would need a long time for deployment. Cities would have to deal first with mixed transport – fleets comprising both automated and non-automated. Overall there was a need for more pilots, in which both national and local governments were involved, to drive learning. The roles of education and the media were important. We needed to control the narrative but explain why vision zero would not happen immediately. The final key action was bringing together trials of the use of AVs for both passenger and freight as today they are almost entirely separated in their own silos.

In conclusion the participants in the Summit

- Noted that
  - Collaboration by the public and private sectors on planning and deployment is key to optimising both passenger and freight services and minimising societal impact;
  - Mobility technologies are continuing to develop quickly which promotes innovation but also puts pressure on regulatory activities and knowledge management roles.
- Confirmed their wish to continue to work together in meeting today's mobility challenges by deployment of efficient and sustainable ITS solutions;
- Committed to promoting the benefits of ITS for reducing congestion, emissions and energy consumption while enhancing safety and mobility for people and freight;
- Invited both public and private sector stakeholders to publicise their experience of ITS implementations to encourage knowledge transfer;
- Asked ERTICO to organise further events where the public sector and private sector meet to exchange views on problems, solutions and opportunities
- Pressed the case for more EU-wide guidance on
  - technology developments and their implication for policies and legislation
  - the availability & usability of transport data and associated privacy and anonymity issues
  - assisting trials of highly innovative transport services through procurement derogations
  - moving from pilots to sustainable deployment of new ITS solutions across urban environments
  - establishing regulatory regimes for highly automated vehicles and new mobility services
- Expressed their appreciation for the impetus given by previous European and World Congresses that have advanced the deployment of ITS solutions to transport challenges.
- Thanked Eindhoven and Helmond City Councils and ERTICO for organising the event.
- Look forward to discussions next year at a Summit in Lisbon Portugal!

JOIN EUROPE'S BIGGEST EVENT
ON INTELLIGENT TRANSPORT SYSTEMS AND SERVICES

18-20 May 2020

SAVE THE DATE

EUROPEAN CONGRESS
LISBON, PORTUGAL
18-20 MAY 2020
ITS: The Game Changer

WHAT TO EXPECT

1200 delegates

120 Exhibitors

2000 Visitors to the exhibition area

50+journalists from trade & news media

50+countries represented

Government, state and city representatives

Private sector representatives from multiple industries

A UNIQUE OPPORTUNITY TO:

- Network with 3200+ smart mobility stakeholders & influencers
- Discover the latest mobility solutions
- Share experiences and lessons learnt
- Monitor progress and measure results
- Exhibit and experience innovative technologies
- First-hand experience though demonstrations

Organised by: ERTICO

Hosted by: LISBOA, ITS

Supported by:

www.itsineurope2020.com

For more information please contact:

ERTICO – ITS Europe

congress@mail.ertico.com