Paper number ITS-TP0785

Contractual Agreements in Interactive Traffic Management – looking for the optimal cooperation of stakeholders within the TM 2.0 concept

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Abstract

Traffic Management has traditionally been agreed and conducted in almost all EU countries by public authorities. Private sector companies acting as data providers with regards to what is happening on the road or offering road side communication channels in order to reach the drivers and communicate traffic management measures to them on behalf of the public authorities have been traditionally termed as Service Providers (SPs). The two traffic management stakeholder groups of Public Authorities (PAs) and private Service providers (SPs) have been seen in traffic management practice as following different, and very often, conflicting objectives as their target groups are not the same: individual drivers vs the collective group of users of the transport network. The 'TM 2.0' concept of interactive traffic management, proposes an alignment of objectives among the various stakeholder groups, where this is possible. Herein the key elements are the exchange of traffic data, traffic control data and a common traffic management strategy. This paper discusses the possible levels of cooperation between the stakeholder groups in TM 2.0 and sets the pre-conditions to the optimal level.

Keywords:

Traffic Management, Interactive Traffic Management, TM 2.0 concept, Mobility Services, Contractual Agreements, Stakeholder roles, priorities and needs, Cooperation models

Introduction, the TM2.0 concept

Traffic Management 2.0, alias TM 2.0, is an Innovation Platform established in 2014 by the ERTICO Partnership. The vision of TM 2.0 is to enable interactive traffic management become a reality and create synergies between individual and collective mobility needs, while providing new connectivity and information services for vehicles and travellers and reducing ICT infrastructure costs for traffic managers thanks to innovative ITS solutions. Being open to all interested public and private stakeholders, as of 2016 it comprises over 30 members from all ITS sectors, such as public authorities (at national, regional and local level), road operators, traffic and transport industries, service providers, research establishments, users associations, and OEMs.

Traffic Management 2.0 is a new stage in the development of traffic management. In the past traffic management (TM) was mostly one way directed. A road authority informed drivers on its traffic management measures or plans (TMPs) via VMS or other dynamic signalling. A road operator can also activate TMPs and dose traffic in the network via several (local) traffic control measures. Another

stakeholder group in TM is that of traffic information service providers. They inform drivers via navigation (embedded in-car or mobile) about the quickest or shortest route to be followed. Currently:

- Traffic management plans (TMP) are not part of the dynamic traffic information that is delivered to vehicles today
- Individual vehicle behaviour (as available from the route guidance system) is not made available to the traffic management system
- Today's traffic control strategies do not address individual travellers
- Today's private parties play an important role collecting and enriching the underlying data
- Access to in-car and hand-held services (e.g. communication with road users) is the domain of private parties.

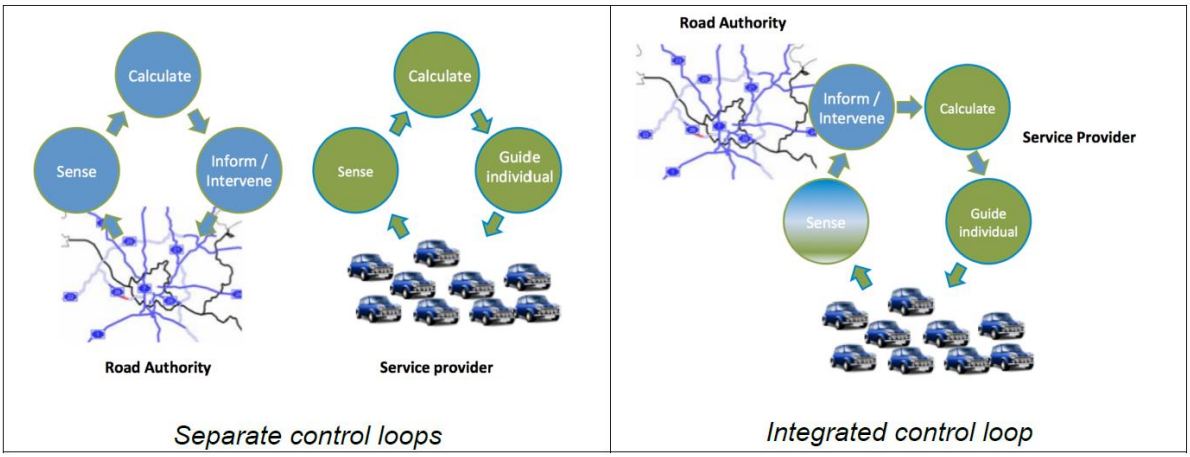

Figure 1: TM 2.0 concept

The TM 2.0 concept aims to merge the previously divided worlds of centralized traffic management and in-vehicle traveller information. For the TM 2.0 concept to become operational a framework of closer cooperation between public and private stakeholders with respect to each other's priorities needs to be defined. As the TM 2.0 Platform aims to agree on common interfaces, principles and business models which can facilitate the exchange of data and information from the road vehicles, service providers, Traffic Management and Control Centers (TMC), and back, the work of the taskforce on Contractual Agreements is key in demonstrating that in order to improve the total value chain for consistent traffic management and mobility services as well as to avoid conflicting guidance information on the road and in the vehicles, there are various levels of contractual agreements which can be used by the parties involved. The TM 2.0 concept is based on achieving a 'win-win' while implementing interactive traffic management.
The TM 2.0 concept is based on the:

- The provision of individual communication channels between TMC's and road users/service providers;
- Development of a new interface for data exchange between TMC's and service providers, necessary for individual and collective traffic information and signage;
- Cooperation and information exchange with other transport modalities;
- Development of (new) business cases with benefit to all stakeholders.

Accordingly, the objectives of the TM 2.0 Platform Task Force on Contractual Agreements and Schemes are:

- Research and determine elements enabling contractual agreement and schemes facilitating win-win cooperation and development of Business Models for the relevant stakeholders;

- Define why TMCs would exchange TMPs with Service Providers (different levels of cooperation: mandatory forwarding of TMPs to optional forwarding of TMPs) and related Business Models;
- Research and define motives and drivers for the different levels of cooperation and related Business Models;
- Define practical steps for cooperation (e.g. with Lena4ITS, URSA Major 2, NAVIGAR).
- Contribute with guidelines and recommendations.

Stakeholder analysis

Previous work by members of the TM 2.0 platform [REF 1] has identified the following stakeholders as

regards the Traffic Management services provision, the Road Infrastructure Owners, Road Side Service Providers, Content Service Providers, In Car Service Providers and Service Consumers. The high-level requirements per category of stakeholders have been analysed within the members of this task force and are presented below.

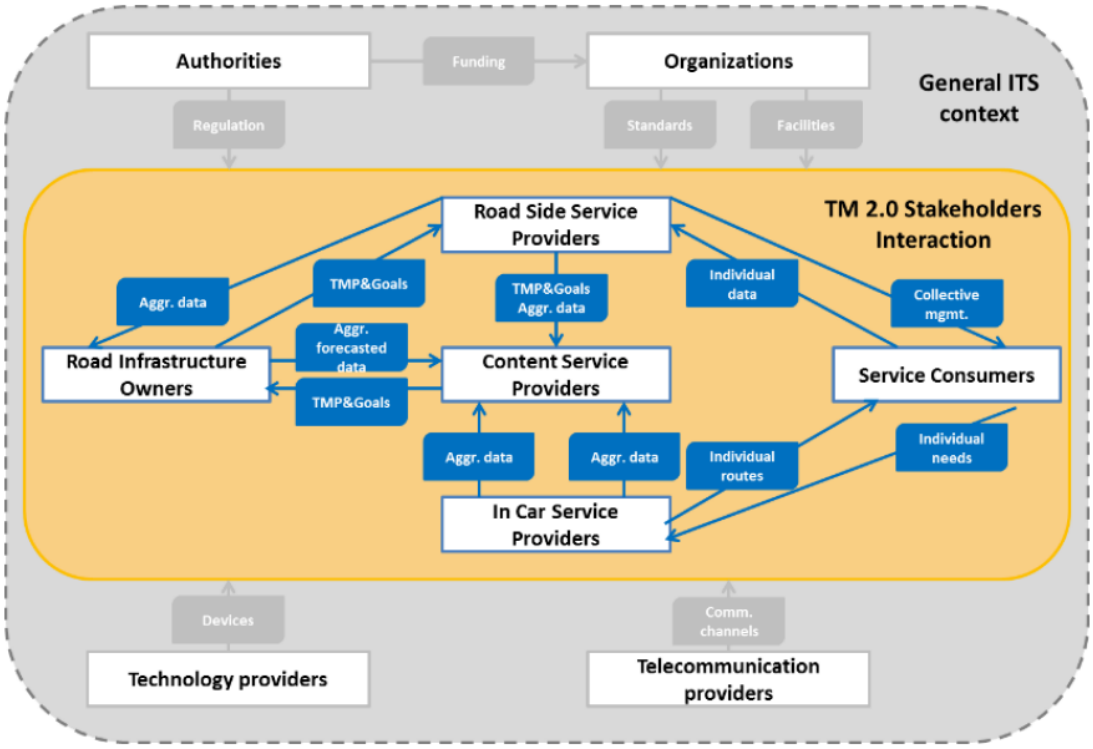

Figure 2: TM2.0 stakeholder overview and interactions

- Authorities: administrations operating the road-side systems; implementing the TM plans; collecting traffic data and providing information to drivers by means of road-side systems.
- Road Infrastructure Owners: cities, regions, national road authorities; concessionaires; responsible for TM goals and/or plans (including safety, efficiency and comfort aspects).
- Road-side / Content Service Providers: data broker and/or aggregator of different data sources.
- In-car Service Providers / Telecoms Providers: OEMs, telematics and navigation service providers, mobility mobile apps; managing interaction with consumers inside the vehicle.
- Service Consumers: professional and private drivers.

For the TM 2.0 task force on contractual agreements, the primary stakeholder groups its work focuses on, are the road infrastructure owners/authorities and the in-car service providers. From the perspective of the TM2.0 concept the main agreement or contract is to be negotiated and set among

them. The priorities and interests of the two stakeholder groups are perceived to be the following:

Priorities and interests road infrastructure owners/authorities:

- Optimise the road network capacity;
- Meet policy targets (safety, environment);
- Provide access to or close part of the network according to TMP;
- Prioritise on certain user categories;
- Improvement of acceptance of strategic route recommendations and therefore better utilisation of road capacity;
- Avoidance or reduction of congestion caused by planned network constraints or other events;
- Consideration of traffic restrictions and strategic goals;
- Simple workflow, low cost-solution, utilisation of available standards.

Priorities and interests in-car service providers (and their customers):

- Want fastest, safest, most efficient and least fuel consuming route;
- Valid traffic information with good quality;
- Simple and easy directions;
- Optimisation of service quality by extension of the database with roadworks and road closures;
- Integration of public route recommendations in consideration of business interests;
- Standardised interfaces, transparency of data quality, consistency in public route recommendations;

The interaction between these two stakeholder groups and a possible strategy for cooperation has been already explored by the Ursa Major project [REF 2], and is shown in the figure below. As indicated three elements are most important in this cooperation strategy: 1) the exchange of traffic data, 2) the provision of traffic control relevant information, and 3) a common traffic management strategy.

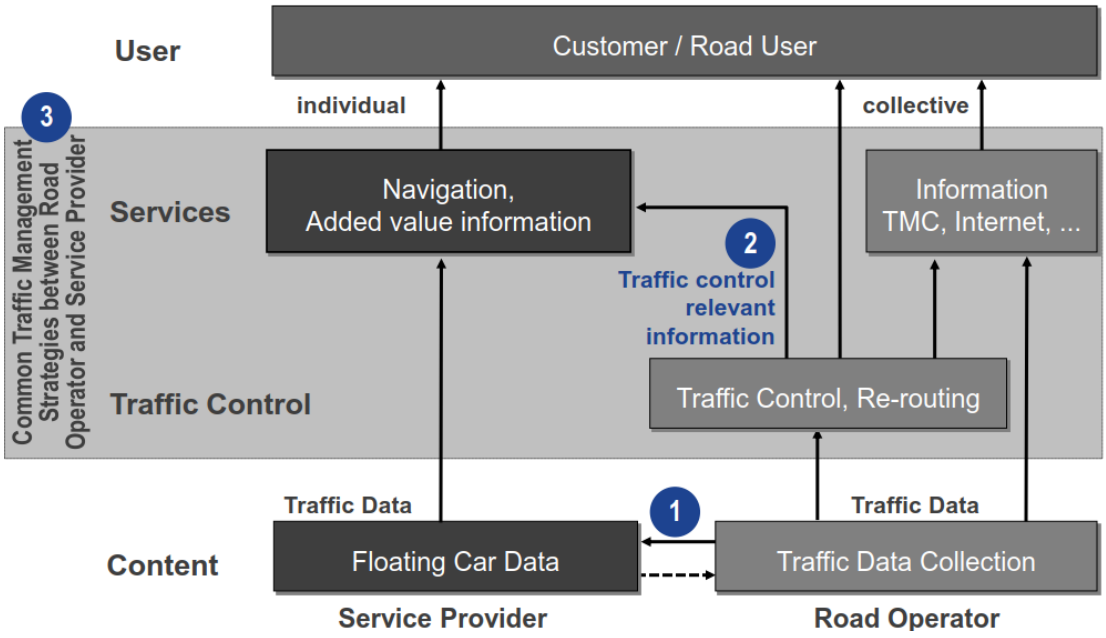

Figure 3: Ursa Major Strategy for the Cooperation of Road Operator and Service Provider

The last two elements of this Ursa Major strategy scheme were jointly assessed by another task force of the TM2.0 platform: that working on the exchange of traffic management plans (TMPs) between

road infrastructure owners/authorities and in-car service providers. This task force published a Report [REF 3] with the results of its work, according to which TMPs should contain the following elements:

- (Where) description of the geographical context;
- (What) description of the traffic situation that might or (in case of events and road construction works) will occur;
- (Why) this traffic situation needs to be managed and what enhancement in traffic this management needs to bring;
- (When) moments in time when these traffic situations are expected (e.g morning rush hours, tunnel closure, football match, et cetera);
- (Who) the target groups on which the traffic management actions will focus (e.g. motorists traveling from the south towards the city centre, or cyclists in order to give them a better position in the traffic flow), or a prioritised combination of these groups in certain circumstances;
- (How) what traffic services will be activated and deactivated (on what triggers and where on the road network) in order to manage traffic. Traffic services can be groups in 4 classes: reduce inflow (influx), increase outflow (outflux), increase throughput and reroute traffic.

According to the Report, the 'where', 'what' and 'when' information is needed to get an understanding of the needs of the traffic manager (read: the collective of road users). The 'who' is needed to get an understanding on whom (of the users) to approach and guide or support. In the 'how' the transition from TM 1.0 (traditional traffic management practice) to TM 2.0 (interactive traffic management) becomes clear. In TM 1.0 the traffic services will be translated in configurations of road side instruments such as traffic signal controllers, ramp meters, variable message signs, or even road closures using barriers. In TM 2.0 the services can be implemented via information, advices and warnings appearing on the human machine interface (the screen) of the in-car navigation device.

Levels of cooperation

To what extend TMPs will be used by service providers is the central discussion taking place with regards to contractual agreements and schemes. The projects of Ursa Major [REF 2] and Lena4ITS [REF 4], A project pioneering the TM 2.0 concept of interactive traffic management in the area of Hessen in Germany, also looked into this topic and already developed preliminary frameworks for cooperation. As a starting point and in order to identify business drivers, the figure below (developed by Ursa Major) shows the added value for both road infrastructure owners/operators and in-car service providers if they chose to operate more collaboratively in TM.

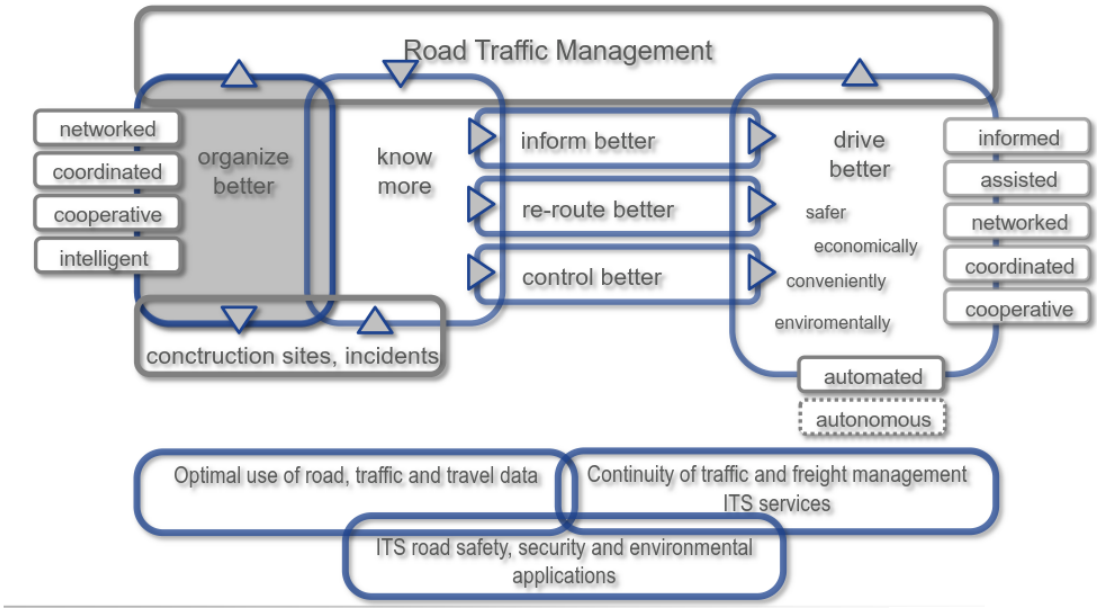

Figure 4: added value chain road traffic system

Building upon that, Lena4ITS stated that for the cooperation between road operators and service providers to be successful, it should be conditional. To that end, Lena4ITS developed a scheme for strategy cooperation, consisting of a base level of cooperation plus four different levels, in which each is set on different principles for traffic and travel information dissemination and processing of strategic routes. The figure below shows these levels schematically.

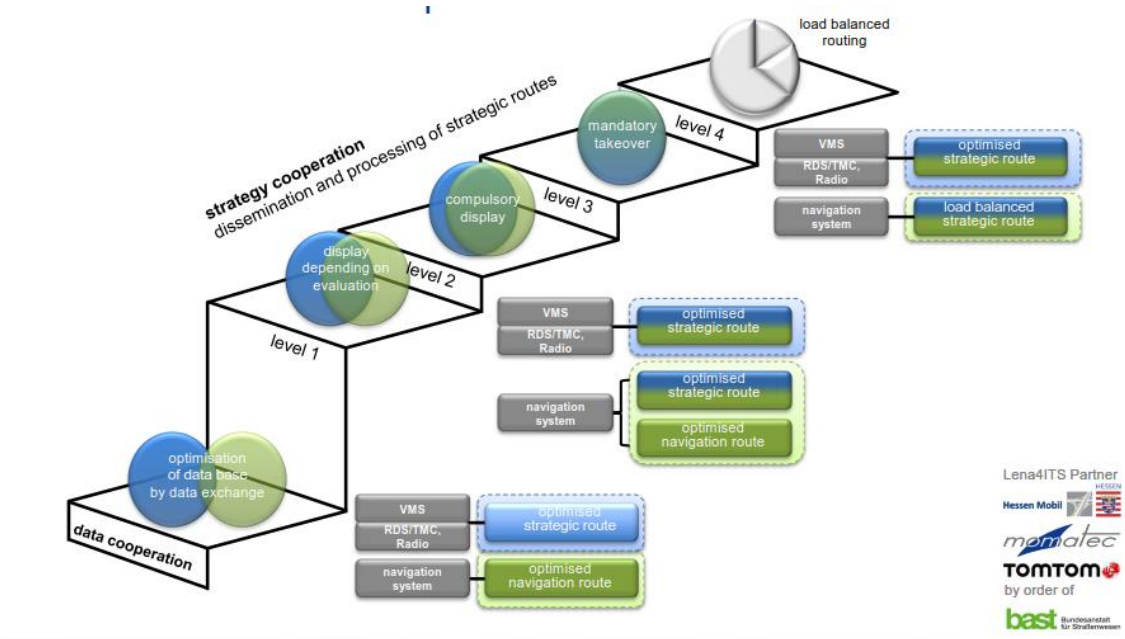

Figure 5: Lena4ITS cooperation levels

The cooperation levels are as follows:

0. Data cooperation: optimisation of database by data exchange

    a. traffic management plans and floating car data are exchanges between road operators and in-car service providers. Both optimise their processes using the new database.

1. Cooperation Level 1: display of the public strategic route after positive evaluation
    a. The public strategic route is received, evaluated by the navigation service provider and in accordance with the evaluation result either displayed or discarded.
2. Cooperation Level 2: compulsory display of public strategic route
    a. The strategic route is received and must be displayed to the user as an option of route recommendation of the road operator. The user decides whether to accept the strategic route or to maintain the individual route.
3. Cooperation Level 3: mandatory takeover of public strategic route
    a. The strategic route is received and must be displayed. The individual route is discarded.
4. Cooperation Level 4: load balanced routing
    a. Traffic will be distributed according to individual destinations and free capacity slots on different routes.

Stakeholder consultation by the Lena4ITS project revealed that a scheme for data cooperation like the one shown in the figure above was regarded as interesting by all parties, and that the strategy for cooperation was positively considered as there was no distinct conflict of interests in any of the cooperation levels proposed. Level 1, in the cooperation strategy scheme above was expected to cover the fast majority of situations, levels 2 and 3 were considered feasible in the short-term, whereas level 4 was considered as an ambitious future model. In addition, road operators stated that there is no need to define further contracts for cooperation, since strategic data utilization should not be complicated by imposing additional regulation and more to that, it must be driven by the expectations on benefits. Nonetheless, according to the results of the project, feedback from navigation system providers about the processing and dissemination of strategic routes would be instrumental for quality improvement and impact assessment in TM.

Business principles

An initial framework was developed within the TM 2.0 Platform, which identifies feasible scenarios and business principles for sharing data and respective pre-conditions [REF 5].

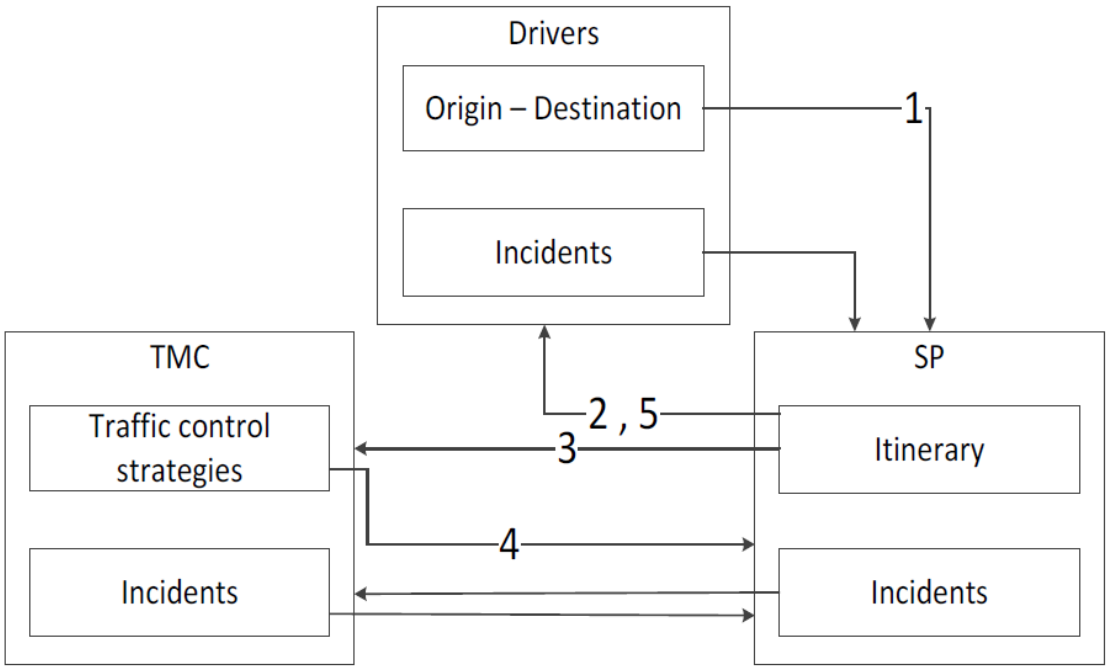

Figure 6: data flows TM2.0

Data exchange	**Scenarios**	**Pre-conditions**
1. Collection of OD data	a. Collect individual data b. Collect aggregated data	a. User permission under terms and conditions agreement
2. SP provide advise itinerary		
3. SP provision ODs and the itineraries to TMC	a. SP share data to TMC for improving (mutual) service(s) b. SP sell data to TMC (Public) operators / infra managers / c. SP sell data to other SPs (real estate, marketing, etc.)	"User permission" or "aggregated (anonymized) in time period and volume"
4. TMC optimizes TMPs and provides to SPs	a. TMC share data with SP1 for improving (mutual) service(s) b. TMC sell data to SPxyz	TMC update back office system: a. (technical) ability to interact with SPs, p.e: exchange of real time data; b. Traffic engineering knowledge/methods p.e.: Traffic state estimation; Load balancing routing; user equilibrium to system optimum
5. SP update itinerary w/ new TMP and provides optimized navigation service	a. SP is free to choose if uses new data or not p.e. longer travel time route w/ green wave instead of shorter route b. SP uses the data (for free)	a. The exchange of information between the parties (small number of iterations) until an equilibrium point is achieved. b. SP develops the load

	under pre agreed conditions, provided as an option to the driver: avoid school areas during peak time even if is shortest route; avoid event location to create buffer; c. SP is paid to use/implement the new data with a SLA agreement, p.e. implementing load balancing d. SP is mandatory obliged to implement the "public" new data	balancing based on pre agreed policy framework

Discussion

The main challenge for the TM 2.0 task force on contractual agreements is to progress in the analysis of the very details with regards to the cooperation among TM stakeholders without interfering with theirs strategic business plans. Nevertheless, on a higher level in this discussion it is relevant to understand what drives the business of stakeholders and what could be motives (not) to participate (or not) to a certain cooperation level.

To reflect on the previous sections in this Paper, one thing that stands out is that in Figure 6 there is no direct link between traffic management centres and drivers. This implies that in the current situation, road authorities are dependent on service providers to reach out to drivers and to achieve their policy objectives.

The cooperation levels as defined in figure 5 in the text above can help to overcome this problem, but the proposed strategic cooperation scheme leads to a debate on morality and ethics: what justification does a road authority have to override an individual's freedom of choice and to regulate service provision in an open market? And why should road authorities make investments which improve the quality of services provided by service providers and therefore increase the latter's revenue? Considering the complexity of this debate, the cooperation framework as shown in figure 5 is perhaps not the best way forward as is .

Moreover, research has shown [REF 6] that a centralised collective approach to traffic optimisation hardly ever leads to an optimum for the transport ecosystem. Instead, an traffic management approach based on distributed (decentralised) traffic intelligence using data from the TMC's and service providers, combined with a targeted supportive traffic management policy framework is thought to be more effective. This policy framework should provide constraints, rules and procedures that allow service providers to develop a business and vehicle drivers/users (customers) to optimise their own network behaviour. The mutual benefit resulting from road authorities, service providers and drivers all operating in the same scheme is that the available road network capacity can be better utilised resulting therefore in reduced congestion or at least in a calculated delay of capacity drop. From multiple perspectives this seems an acceptable and potentially fruitful way to progress with regards to traffic management.

An analogy can be made to 'Spitsmijden'-type projects [REF 7] as these have been applied in the Netherlands. In these projects travellers can earn credits (either monetary, material or immaterial)

when they opt for more sustainable travel behaviour, as regards the overall transport network (e.g. departure times, modes of transport, routes). Generally, for these kind of projects road authorities make investments to finance the necessary credits and award service providers based on the number of sustainable travel behaviour choices they managed to promote and or realise. However, from a road authority perspective such a policy framework requires a change of mind, which is more centred to investing in instruments that support and extend a policy, rather than investing in the development, operation and maintenance of network or traffic management systems, data and/or interfaces (technology).

Building upon this and going back to figure 5 in the text above, on the strategy cooperation scheme as this was defined by the Lena4ITS project, the central and most viable level of cooperation seems to be level 4: load balancing. According to the analysis in this Paper, the extended definition of this cooperation level would be: traffic will be distributed according to individual destinations and free capacity slots within the network on different routes, ***subject to: a targeted policy framework as well as a supportive set of instruments as defined by the road authority involved***. In this case, and according to the proposed extended definition of Level 4, the cooperation levels 1-2 could also be possible outcomes but it remains to the judgment of service providers to decide. Cooperation level 3,(i.e. mandatory takeover of public strategic route), may still exist for exceptional cases with a direct relation to traffic safety or the environmental impact of traffic, and can be therefore regulated and enforced by law.
For example, in case of life or health threatening situations governments transmit a message to mobile phones in the direct neighborhood of this threat based on cell broadcast. In case of life or health threatening situations it is possible that drivers will not be alarmed and drive into the threat. After all, while driving it is not allowed to use your mobile phone. In these situations it is imaginable that there will be a mandatory takeover of public strategic route.

To get back to the extended definition of level 4, in the current situation there are no agreements between service providers and governments related to traffic management information. Service providers continually attempt to recreate the real world within their service as reliable and quick as possible. Having up-front knowledge on traffic measures, infrastructure status will avoid them having to measure these effects themselves with a delay. And if (but only if) the scheme works in such a way that service providers are able to (in gross) provide users with better routes by complying with more collectively optimal routes (avoiding congestion) and saving them time and costs, this improves their service.
Road authorities are only limitedly aware of the status of the infrastructure by only using their own measurement techniques. Insights from service providers are not only way more detailed, and reap the benefits of large numbers of sensors on the road, also do they have a better interpretation of this data (for example, drivers can provide feedback by stating 'I'm in a traffic jam, and I am standing still', or 'there is an object on the road, be cautious'). This helps in understanding why a traffic jam occurs, and estimating how long the jam will take. Service providers also know what the road demand will be in 15 minutes time. If road authorities receive this information, more effective measures can be taken to optimize traffic.

What really should be thought through, is the message drivers receive in their navigation device. The goal is that drivers are willingly to comply to strategic route advices. To get this achievement, it is important that drivers experience the benefits of their compliance. For example, when drivers comply to a strategic route with supportive instruments (e.g. green wave), they experience the benefit of a green wave (no stops) on that strategic route. Therefore it is very important that the data provided by

road authorities is of very high quality. It is not helping if drivers experience no profit at all on the strategic route. The next time a driver receives a strategic route advice, the driver probably is less willing to comply to that strategic route.

Conclusions

The analysis and debate on the optimal cooperation of traffic stakeholders is far from complete. The task force on contractual agreements working under the TM 2.0 Platform will continue its work and plans to also discuss relevant aspects such as :

- What use cases/situations/level of severity match the different stakeholder cooperation levels?
- How will stakeholders be assessed, awarded and/or compensated for the services by road authorities? As already mentioned in the analysis above, one idea is to develop an award scheme based on compliance rates. For example, road operators could award service providers based on the amount of customers that switch to strategic routes (routes suggested by the TMC). Similarly, service providers could award their customers for using strategic routes.

The task force on contractual agreements aspires to base its final report on the results of the analysis of both points mentioned above and it will also attempt to assess the influence of the cooperation agreements on the car drivers; their compliance response to the mandatory route advice; and how the cooperation models differ according to the different levels of vehicle automation.

The ideal level of cooperation according to the TM 2.0 concept, is that of the win-win for all stakeholders involved. Identifying what the mutual benefits for road operators and service providers are as well as clarifying the technical requirements for this TM service (such as data quality) as well as setting a fair operational framework (should all service providers participate and is there a competitive (dis)advantage not to?) should serve as the basic pre-conditions for either service providers or road operators to enter and engage in interactive traffic management.

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