THE ROAD MAP FOR
SMART CYCLING:
A CALL TO ACTION

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1. Introduction

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Smart Cycling can play a significant role in achieving the EU's goals for safe, sustainable and smart mobility, including substantial reductions in greenhouse gas emissions and promoting cycling as a key component of multimodal transport systems.

The time for Smart Cycling is now! Cycling has emerged as a pivotal component of multimodal transport systems across Europe, driven by technological advancements, health and environmental considerations, supportive policies, and infrastructure improvements and is more and more considered one of the main angles to achieve a sustainable mobility system. To understand this evolution, a number of technological leaps, trends and societal changes in cycling can be noticed:

1. E-Bikes: Expanding Reach and Accessibility
E-bikes have become mainstream, dominating bicycle sales in several European countries. They extend cycling's range and utility, making it feasible for longer distances, hilly terrains, and cargo transport. This versatility attracts a diverse user base across various age groups and social demographics.

2. Health and Climate
Cycling contributes to physical fitness, mental health and addresses the growing health concerns of the society. Furthermore, cycling is a zero-emission mobility option, it plays a vital role in combatting the climate crisis.

3. Political Momentum and Infrastructure Development
Increasing recognition of cycling's benefits has led to stronger policy frameworks and political commitment at local, national, and EU levels. Road authorities and operators are integrating cycling into mobility and climate strategies. Their investments in cycling infrastructure enhance both actual and perceived safety, encouraging more people to cycle. Urban densification supports shorter travel distances, making cycling more practical.

4. Technological Advancements: C-ITS and Connectivity
Smartphones and wearables have transformed cycling from a low-tech solution to a smart, connected mode of transport. In addition, the rise of connected e-bikes and smart devices enables real-time information sharing, improving the cycling experience. Integration of Cooperative Intelligent Transport Systems (C-ITS) has the potential to enhance road safety and infrastructure efficiency through technologies like sensors and communication units.

5. Shifting Perceptions and Market Growth
Cycling's image is improving, with more people viewing it as a viable and attractive transportation option. The market now offers diverse models, including cargo bikes, providing alternatives to car usage. In general, cycling remains an affordable mode of transport, appealing to a broad audience.

2. The Potential of Smart Cycling

Smart cycling refers to intelligent and cooperative systems (ITS and C-ITS), digital applications and digital services that make cycling safer and improve the cycling experience on the basis of cycling-relevant data, communication technologies and products and services based on these. Smart Cycling comprises both the smart solutions and the collection and use of cycling data. In the context of the smart city, it mainly refers to the interaction between infrastructure and bicycle. In the context of smart mobility, the bicycle is part of a combination of transport modes.

Traditionally, cycling policies focus on infrastructure, parking facilities, education, promotion and penalisation. Smart Cycling adds a digital layer to these policies, offering tools to make cycling safer and more attractive. To give some examples:

- **Safety:** Variable Message Signs informing cyclists about busy traffic, encouraging speed reduction.
- **Speed:** An app in allowing cyclists to get faster green at traffic lights.
- **Convenience:** Access to bike-sharing reduces public transport pressure during peak hour traffic.
- **Experience:** Apps for citizens giving incentives (rewards) to people cycling to work.

Smart Cycling supports various European Commission (EC) policy objectives, including the Green Deal, Sustainable and Smart Mobility Strategy, and the Mobility Transition Pathway. By making cycling more attractive through ITS, Smart Cycling can help achieve goals like reducing greenhouse gas emissions and promoting zero-emission urban mobility. To mention a few examples:

- **Green Deal:** Smart Cycling can make the usage of the infrastructure safer and more attractive. Therefore, citizens will be stimulated to shift from fossil fuelled motorised traffic to environmentally friendly cycling.
- **Road Safety:** ITS and C-ITS can enhance the safety of the growing number of cyclists on the European roads, which is more and more digitalising.
- **Digital Future:** Creating mobility data spaces to facilitate data sharing and support data-driven innovation.

Smart Cycling has the potential to make cycling more attractive as a mode of transport, significantly improve road safety, reduce emissions, and optimise traffic flow. By integrating digital solutions into cycling policies and infrastructure, Smart Cycling can contribute to a sustainable and smart mobility system in Europe.

3. A vision on Smart Cycling

In a world where Smart Cycling is as integral to urban mobility as smart solutions for motorised traffic, bicycle data, Intelligent Transport Systems (ITS), Cooperative ITS (C-ITS), and Connected, Cooperative, and Automated Mobility (CCAM) services are seamlessly integrated across Europe in standardised formats and specifications. This vision is underpinned by a user-centric approach that prioritises the needs and experiences of cyclists and citizens.

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Collaborative Ecosystem
An ecosystem thrives where companies, cycling organisations, researchers, and authorities collaborate on Smart Cycling solutions. All information related to Smart Cycling is centralised and accessible without discrimination, ensuring that every stakeholder can contribute to and benefit from this collective knowledge.

Policy and Support
EU policy lays the groundwork for raising awareness and visibility of Smart Cycling, actively fostering the exchange of experiences and best practices. The current state-of-the-art technologies and evaluations are well-documented, enabling targeted and effective use of public funds. Smart Cycling is championed by European, national, and regional programs that adhere to uniform minimum technical requirements, recognising the unique characteristics and needs of the cycling ecosystem.

User-Centric Focus
Cyclists are well-informed about the advantages of Smart Cycling applications and experience their benefits first hand. They are assured of data privacy, with measures in place to prevent the misuse of personal data. Cyclists and other data user groups, including cities, regions, and service providers, have access to the cycling data they need—such as real-time data, infrastructure data, parking information, and floating bike data—all meeting minimum quality standards and accessible on a non-discriminatory basis through platforms like National Access Points.

Integration and Equality
Revised Delegated Regulations on Real-Time Traffic Information (RTTI) and Multimodal Travel Information Services (MMTIS) include requirements for collecting and sharing cycling data, ensuring its application in traffic management and other services. Cycling is recognised as an independent and equal mode of transport, with its requirements considered on par with motorised transport, fostering a balanced and inclusive mobility landscape.

4. The Smart Cycling ecosystem

The ecosystem of Smart Cycling includes political decision-makers, road operators, cycling organisations, the cycling industry, technology providers, research institutions, and cyclists themselves. Each group plays a crucial role in the development and implementation of Intelligent Transport Systems (ITS) and Cooperative Intelligent Transport Systems (C-ITS) for cycling. Effective collaboration among these stakeholders is essential for the successful rollout of Smart Cycling services.

High quality cycling data is important and there are challenges related to data privacy and security. There is the need for harmonised, high-quality cycling data across Europe, which can be facilitated by projects like NAPCORE. Data security measures such as end-to-end encryption, privacy by design, secure storage, and strong authentication are needed to protect personal data collected by Smart Cycling applications. Transparency and user education are required to build trust and ensure compliance with legal requirements like GDPR.

Standardisation is crucial for ensuring seamless data exchange, interoperability, and efficient management of cycling infrastructure. The benefits of standardisation include improved data quality, compatibility, and cost reduction. There is the need for standardised interfaces between smart systems and the need of harmonising technologies and standards within the smart system ecosystem. Standards need to be developed for cycling data, integration of cycling network data into existing standards like DATEX II, and

promotion of cooperation between public authorities and peer communities.

C-ITS for Cycling offers potential benefits for cyclists, such as improved road safety, time savings, and convenience. Already applications exist like an app for traffic light prioritisation and Floating Bike Data Collection. Future applications could include (among others) warnings for hazardous conditions, traffic light prioritisation, and real-time information on road

closures and parking availability. Challenges to broader implementation include standardisation, safe human-machine interfaces, and achieving critical mass for user adoption.

Road authorities should focus on high-quality digital network data for cycling all over Europe and provide it

to their NAPs. It should take into account the INSPIRE regulation as well as the ITS directive. Nevertheless, beside this Open Street Map (OSM) could be a valuable additional tool for spreading comprehensive, accurate, and up-to-date information about cycling networks because it is widely used by many cycling systems and service operators. Using OSM offers benefits for navigation, traffic modelling, and accessibility analysis. To speed up the availability of cycling data public authorities could promote OSM tools, address licensing

issues, and develop tools to support the technical reference process. As additional benefit cooperation between public authorities and peer communities is essential for enhancing the availability of relevant information for cyclists.

5. Gaps and obstacles for Smart Cycling

Safety: Improving cyclist safety is a high priority, with C-ITS services believed to have a significant impact. However, implementation is complex and requires careful consideration of human-machine interfaces and safety-related data. Reporting of dangerous spots by cyclists, 3D cameras or on-bike sensors can help address gaps in safety data.

Data, Data Protection, and Security: A significant challenge is the availability and representativeness of cycling data. Compared to motorised traffic only relatively little data is available about cycling (counting, infrastructure, parking, etc). In addition, many data collection initiatives target specific groups or areas, leading to underrepresentation of certain demographics like schoolchildren and the elderly. Data quality is another concern, as National Access Points require quality controls that commercial platforms may not offer. Additionally, there is a lack of data standardisation and system interoperability, which limits the widespread use of intelligent systems. Privacy protection is crucial, as ITS systems collect personal data that must be safeguarded against misuse.

Legal and Regulatory Framework Conditions: The introduction of new technologies must align with existing laws and regulations, which often lag behind technological advancements in digitalisation. Different interpretations of EU laws across countries can create uncertainty. The existing legal framework is suitable but has to be adopted to integrated the perspective of Smart Cycling.

Financing and Economic Sustainability: Smart Cycling initiatives face funding challenges, as many projects lack structural funding for data provision and diffusion. European and national funding programs often have few calls for Smart Cycling proposals. There is a need for dedicated budgets for research and development, pilots, and deployment of Smart Cycling solutions. The economic value of cycling data is still unclear, and business cases for cycling data are rare.

Integration into Existing Road and Digital Infrastructure: Integrating intelligent systems into existing infrastructure requires extensive adjustments and coordination among various stakeholders. Investment in digitalising traffic light systems offers opportunities for Smart Cycling services. However, information on the benefits of Smart Cycling systems must be shared quickly to support cooperation among stakeholders.

Creating Awareness and Acceptance for Smart Cycling: There is a shortage of expertise in Europe and knowledge sharing at cities and regions, with many policymakers lacking expertise in using cycling data.
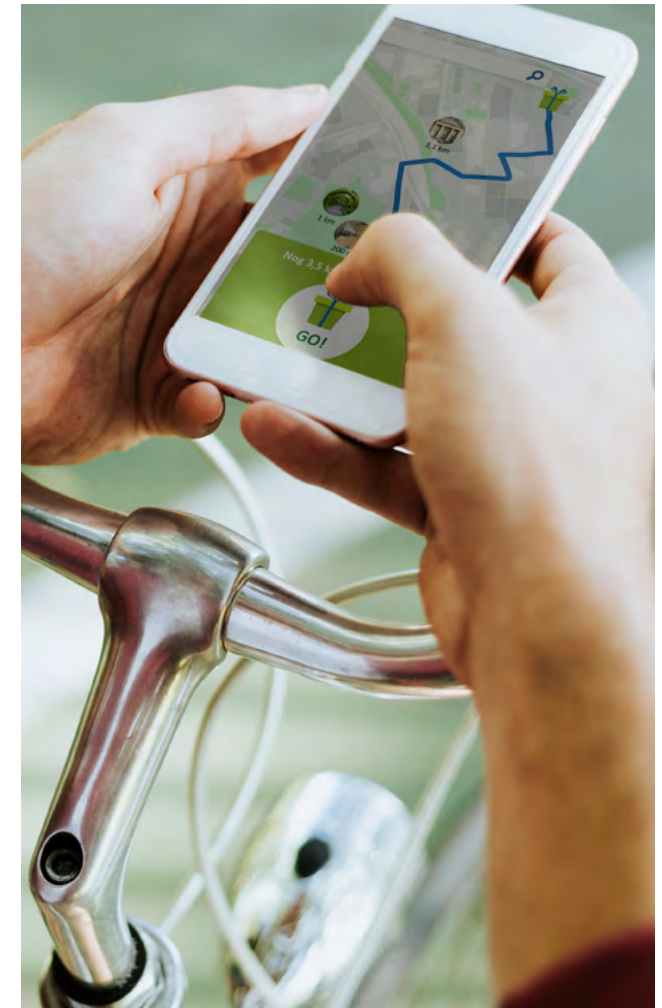
Acceptance by the general public is also a challenge, as cyclists may be reluctant to share data or see the added value of Smart Cycling applications. Transparent communication and proper public participation are essential to build trust and support for Smart Cycling initiatives.

6. Key actions

Cycling is healthy, sustainable, efficient and cost effective and therefore an important mode of transport in mobility policies on all levels, as described in the EU "Declaration on Cycling".

Smart Cycling is not just an added value for cycling, just as smart mobility not only is beneficial for motorised vehicles. It has the potential of making big societal impact.

It makes cycling safer, faster and easier. But the concept of Smart Cycling is not yet widely acknowledged by cycling policy makers and planners at EU, national and local level. This roadmap defines four key action that are required to give Smart Cycling the same status as smart applications for motorised traffic. Not by merely copying smart mobility services for motorised traffic to cycling, but by recognising the specific characteristics and strengths of cycling.

1. Improve safety and attractiveness of cycling by putting Smart Cycling on the policy agenda
Smart Cycling should get a prominent part in the policy on active mobility and the policy of smart mobility at all government levels. The EC should lead by making Smart Cycling a mandatory part in SUMPs needed for urban nodes and making it part of the program for the 100 climate neutral cities. In addition, Smart Cycling should be integrated in the revision of relevant Directives and Delegated Regulations, such as the ITS Directive, and the Delegated regulations on SRTI, RTTI and MMTIS. National cycling plans should have a section on Smart Cycling and regional and local cycling plans should consider the opportunities offered by Smart Cycling solutions.

2. Foster innovation and digitalisation of the mobility system by stimulating the development of Smart Cycling systems and services
European and national funding schemes for smart mobility should earmark a dedicated budget for the funding of research & development, pilots and deployment of Smart Cycling solutions (both ITS and C-ITS), requesting minimum technical requirements to ensure seamless services in Europe. These solutions can be focused directly to the cyclists and/or target public authorities (indirectly benefiting cyclists). These Smart Cycling solutions might serve various purposes, such as increasing safety of cyclists, reducing congestion, increasing health, improving liveability, etc. A specific point of attention is the development of guidelines for safe product/service design (HMI) for Smart Cycling applications, which should avoid distraction of the cyclists in traffic.

3. Enable Smart Cycling services by collecting and standardising cycling data and making cycling data accessible
The EC should request from Member States to deliver national action plans on cycling data. Authorities should collect more and better cycling data (including floating bike data) by using different kinds of smart counting and measuring tools. These data should be made accessible, preferably free of charge, via the National Access Points and European Mobility Data Space. Common standards for various cycling data (e.g., infrastructure data, counting data, parking data, real-time data) are lacking. NAPCORE has made a start to standardise these data and this activity needs to be continued with higher intensity. Attention should also be given to issues regarding minimum quality of data and privacy aspects of collecting and sharing cycling data.

4. Raise awareness on Smart Cycling by sharing knowledge and create a collaborative Smart Cycling ecosystem
The European Commission should facilitate the creation of a European Smart Cycling organisation or platform, which will function as a catalyst and driving force for research, innovation, deployment and knowledge sharing for the Smart Cycling Ecosystem in Europe, that consists of mainly small cycling and ITS companies, research institutes and universities and national, cyclist organisations and local/regional authorities. This should be done in close cooperation with other relevant platforms like for example NAPCORE (data, data standardisation) and the C-ROADS platform (C-ITS specifications). In addition, regular high-level dialogues on Smart Cycling should be organised on a political level to boost the take-up of Smart Cycling at the administrative level.