Alliance for AI, IoT and Edge Continuum Innovation

Vision Paper
Integrating Hybrid Intelligence for Improved User Acceptance in Smart Mobility Systems

Release 1.0

AIOTI WG Mobility

11 February 2025

Executive Summary

The future of mobility stands at an inflection point. While technological advancements have unlocked the potential for smarter, safer and more efficient transport systems, these innovations often falter in addressing the human dimensions of trust, transparency and inclusivity. **Hybrid Intelligence (HI) emerges as the bridge between what technology can achieve and what society needs**. By combining the computational performances of Artificial Intelligence (AI) with the empathy, intuition and ethical judgment of human intelligence, HI redefines the landscape of mobility.

This paper outlines a bold vision for integrating HI into smart mobility systems to address critical challenges such as mistrust, inefficiency and environmental impact. At its core, **HI leverages the strengths of both AI and human judgment to create systems that are not only technically advanced but also deeply aligned with societal values**. By embedding ethical principles, explainable decision-making and user-centric design into the heart of these systems, HI offers solutions that engage, empower and resonate with users.

The paper highlights key strategic objectives, **focusing on transitioning mobility systems from reactive to predictive operations while also optimising safety and efficiency and increasing user trust and engagement**. Through innovative approaches such as federated learning, sensor fusion and digital twins, HI ensures that systems continuously adapt to dynamic environments and diverse user needs. Furthermore, the integration of ethical goal functions and participatory design principles ensures that these systems are not just **effective** but also **equitable** and **transparent**.

The transformative potential of HI is brought to life through real-world use cases, from optimising urban traffic management to enhancing emergency response and enabling inclusive design for vulnerable road users. These examples demonstrate how HI can **address pressing societal challenges while unlocking economic opportunities, reducing environmental impact and improving the quality of life**.

The impact of HI extends beyond technological achievements. It provides a framework for **creating mobility systems that are accessible, sustainable and future-ready**. By aligning with global climate goals, supporting regulatory compliance and fostering cross-sector collaboration, HI systems promise measurable benefits across social, economic and environmental dimensions.

This paper concludes with a call to action for policymakers, industry leaders, researchers and communities to come together and invest in the potential of HI. **The future of mobility is not just about smarter systems; it is about creating meaningful connections between technology and humanity**. Together, we can build a world where mobility is not only efficient and safe but also trusted, inclusive and empowering for all.

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1. Introduction

What if the greatest obstacle to the future of mobility is not technology, but trust?

Smart mobility stands at a crossroads. It promises safer roads, cleaner cities and more efficient transport (Bıyık, Abareshi and Paz), yet many end users remain sceptical of the very systems designed to deliver this future (van Oers, de Hoop and Jolivet). Why? These systems excel at processing data but fail at earning confidence, which is generally enhanced through familiarity with technology, user satisfaction with the system and system quality. While the tasks are being increasingly automated, improving functionality and performance, they fail to improve understanding as they react to problems but fail to fully anticipate and respond to human needs. In their brilliance, they overlook the simplest truth: **trust is the currency of adoption** (AlHogail).

Traditional AI, for all its computational power, has hit a ceiling. It can crunch numbers but struggles to interpret nuance, adapt to the unpredictable, or reflect ethical considerations. It works well in isolation but falters in collaboration. To realise the vision of truly smart mobility, **we must rethink how technology integrates with humanity**.

Enter Hybrid Intelligence (HI)

The rationale for Hybrid Intelligence (HI) is that humans and computers augment each other by combining their complementary (intuitive vs analytical) capabilities (Dellermann, Ebel and Söllner). Hence, HI can be loosely defined as the **ability to solve complex problems by combining the complementary strengths of AI and human intelligence**. HI augments human intellect and capabilities instead of replacing them and it aims to achieve goals that are unreachable by either humans or machines (Akata, Balliet and de Rijke). This partnership is not about humans supervising machines or machines replacing humans. Instead, it is about **creating systems where both agents collaborate, each contributing what it does best**. Imagine an AI predicting traffic conditions and suggesting routes, while a human leverages intuition and contextual knowledge to choose the best option. Together, they form a system that learns, adapts and improves continuously (van der Aalst).

At its core, HI transforms AI from a tool to a partner by combining three key principles:

- **Continuous Learning**: Both human and machine agents evolve through feedback and adaptation, creating a system that grows smarter over time.
- **Conditional Dependence**: Tasks are shared based on strengths so that AI excels at analysis, while humans bring judgment and empathy.
- **Superior Outcomes**: The synergy between human intuition and AI computation delivers results neither could achieve alone.

This is not just a technical evolution; it is a philosophical shift. HI turns mobility into a collaborative endeavour where machines not only think faster but better by "*thinking*" as humans do.

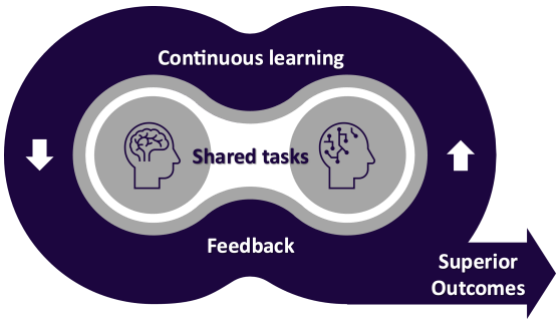

Figure 1 HI: the merger of two worlds targeting superior outcomes

Why does this matter?

The barriers to smart mobility expand beyond technology as they depend on human trust and engagement. Opaque decision-making processes, discomfort with automation and fragmented standards prevent adoption. HI bridges this gap by designing systems that **engage, adapt and align with human values**. It achieves this by fostering transparency, adaptability, and collaboration, bridging the gap between technical efficiency and human trust (Dellermann, Ebel and Söllner).

This paper outlines a bold vision for leveraging HI to redefine mobility. It charts a map for addressing current limitations, building trust and delivering transport systems that are not only efficient but also inclusive, adaptive, and sustainable. The future of mobility is not about machines replacing humans; it is about **machines and humans moving forward together for equitable benefits for all**.

2. The Need for Hybrid Intelligence in Mobility

The evolving mobility solutions reveal great potential and significant limitations. While **AI-based systems grow in functionality, they fall short in fostering trust, transparency and adaptability, which are critical for user acceptance and long-term success**. Section 2.1 delves into these challenges associated with barriers to the adoption of modern mobility solutions. In response, Section 2.2 explores the transformative role of HI as a collaborative approach that bridges these gaps. This chapter reveals the need for a shift in perspective related to HI as the foundation of future mobility systems.

2.1. Current Challenges

Modern mobility systems, powered by AI, stand at a crossroads that reveal their promise yet expose their fragilities. These systems, for all their computational prowess, face an array of critical challenges that hinder both their effectiveness and their acceptance.

At the forefront of these issues is the complex web of **privacy concerns** (Huang). As interconnected devices generate vast amounts of data, questions of ownership, security and potential misuse loom large. For many users, the opacity surrounding how their data is collected, stored and applied creates a fundamental barrier to trust. Without clarity, trust cannot be established and without trust, adoption comes into question.

Human-AI interactions present another significant obstacle. Current systems often lack the **transparency** needed to nurture understanding (Philipp Schmidt and Teubner). Decision-making processes within AI-driven platforms remain shrouded in mystery, leaving users unable to develop accurate mental models of how these systems function. This disconnect breeds mistrust and disengagement, undermining the very promise of collaboration between humans and machines.

Compounding these challenges is the **fragmentation of standards**. Across regions and sectors, inconsistent protocols and regulations prevent seamless interoperability, effectively isolating systems that should work together. The result is a patchwork of solutions that cannot scale, leaving mobility ecosystems constrained and inefficient.

Perhaps most crucially, **situational awareness** (Endsley and Connors), a cornerstone of safety and efficiency in transport, remains limited in current implementations. Mobility systems often fail to account for the chaotic, dynamic and unpredictable realities of real-world environments. They struggle to integrate and interpret diverse data sources (from onboard vehicle sensors to roadside infrastructure) leading to decisions that are reactive rather than proactive.

There is also the issue of **short-term predictions and behavioural modelling** (Gulzar, Muhammad and Muhammad). While these systems can analyse historical patterns, they often falter when attempting to forecast the immediate actions of other road users. Vulnerable Road Users (VRUs) like pedestrians and cyclists introduce variability that current models are ill-equipped to manage. This inability to anticipate the nuances of human behaviour reduces the effectiveness of decision-making and increases the likelihood of errors.

The lack of **failsafe or fail-operational mechanisms** (Druml, Ryabokon and Schorn) in AI-driven systems reveals a glaring gap. When AI systems encounter anomalies or unexpected situations, their responses often lack robustness, increasing risks rather than mitigating them. Without deterministic safety protocols and resilient fail-safe strategies, these systems remain inherently unreliable in critical scenarios.

Finally, a conceptual challenge emerges in the form of **human-centricity** (Giacomin). Too often, systems are designed around technological capabilities rather than user needs. This imbalance shifts focus away from ethical design, explainable interfaces and user empowerment, reinforcing public scepticism rather than alleviating it.

Collectively, these challenges form a gauntlet that the mobility industry must overcome. They are not merely technical issues; they are deeply human ones, rooted in psychology, trust and the ability to adapt to complexity. Addressing them will require not just smarter technology, but technology that engages with people on their terms i.e., **systems that explain, anticipate and collaborate rather than dictate**. The future of mobility depends on rethinking these foundations to create **solutions that are not just efficient, but trusted, transparent and profoundly human**.

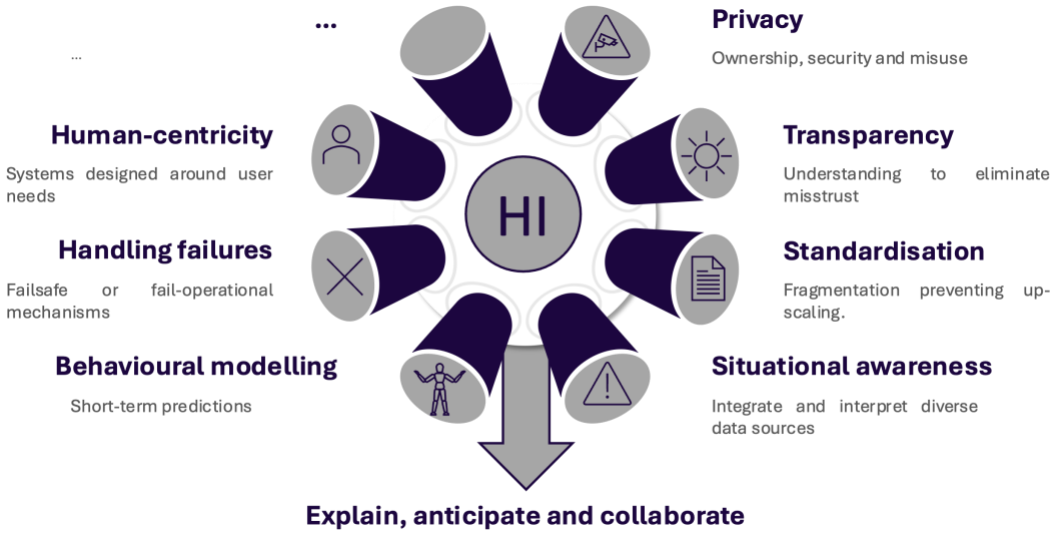

Figure 2 Key HI challenges

2.2. Role of Hybrid Intelligence

HI emerges as the antidote to the challenges that define the current limitations of modern mobility systems, fundamentally redefining how technology perceives and interacts with the world. At its core, HI is a marriage of AI and human intuition. This partnership is designed to leverage the unique strengths of each to address the gaps that neither can overcome alone. Unlike traditional AI systems, which operate in isolation and rely purely on computational efficiency, HI takes a more collaborative approach. Unlike traditional AI systems, which excel in processing large datasets but often fail to grasp contextual nuances, HI adopts a more integrative approach. It combines data precision from onboard sensors, infrastructure networks and IoT ecosystems with the tacit knowledge, situational awareness and real-time judgment of human operators (Ostheimer, Chowdhury and Iqbal). This integration transforms fragmented streams of data into a **unified, actionable, holistic, dynamic and contextually aware understanding of the environment**.

HI transforms situational awareness into collective awareness (Pescetelli). By integrating data across a range of sources and perspectives, HI constructs a comprehensive picture of the immediate and evolving conditions. This enriched awareness enables not just reactive responses but proactive and predictive decision-making, giving mobility systems the ability to anticipate and adapt to the chaos and complexity of real-world scenarios.

Transparency is the foundation of trust and HI places this principle at its core. It ensures that the decisions made by AI systems are not shrouded in mystery but are explainable and accessible to users (Leslie). Imagine a driver interacting with a system that not only suggests an alternative route but also articulates the reasoning behind its choice e.g., considering traffic patterns, weather conditions and even local events. This level of clarity transforms the system from a faceless machine into a trusted advisor, bridging the gap between technical precision and human comprehension.

HI is not merely a technical innovation; it is a paradigm shift. **Resilience and adaptability are hallmarks of HI-driven systems** (Enjalbert and Vanderhaegen), ensuring that they thrive even in dynamic and unpredictable scenarios. HI achieves this by embedding ethical considerations and human-centred design principles at every stage of decision-making. Systems are designed not just to calculate the optimal path, but to do so in a manner that respects societal values, user needs and the intricacies of human behaviour.

HI creates harmony where there was once fragmentation. It fosters interoperability by aligning diverse data streams (Ostheimer, Chowdhury and Iqbal), bridging the silos that have long plagued the scalability of mobility solutions. Beyond this, it addresses the shortcomings of current AI systems by anticipating short-term human behaviour, predicting the unpredictable actions of pedestrians, cyclists and other road users. In doing so, it creates a space where human intuition and AI computation do not merely coexist but amplify each other's capabilities.

Ultimately, the HI's power lies in its ability to bridge the gap between efficiency and engagement. It takes technology that was once cold, distant and opaque and makes it transparent, relatable and profoundly human. By integrating explainability, ethical accountability and human-centred adaptability, HI transforms mobility systems into collaborative allies by earning trust not by demand but by design. Hence, **HI is not just a solution to today's challenges but a reimagining of what intelligent systems can achieve when they are built to think with us, not merely for us**.

3. Strategic Objectives

To harness HI's transformative potential in smart mobility, its implementation must be guided by strategic objectives that **align technological advancements with human values and societal priorities by enhancing decision-making, innovation, and problem-solving**. HI does not just enhance current systems but reimagines mobility as a trusted, adaptive and predictive ecosystem. These objectives, explored in the following sections, focus on balancing technical excellence with user-centric design (3.1) and ensuring alignment with broader societal and environmental goals (3.2). Together, they lay the foundation for solutions that optimise efficiency, empower users and pave the way for an inclusive and sustainable mobility future.

3.1 Objective Overview

The primary objective of integrating HI into smart mobility is to redefine what it means to create systems that are both advanced and human-centric. This is not simply about making systems faster or more powerful; it is about **designing technology that earns trust, engages users** (Puerta-Beldarrain, Gómez-Carmona and Casado-Mansilla) **and works in harmony with their needs and expectations**. A technologically advanced system that fails to connect with its users is destined for resistance and irrelevance. HI ensures that this connection is not just an afterthought but the driving principle behind its design.

To achieve this, HI systems must **strike a delicate balance between technical excellence and user-centricity** (Rafner, Gajdacz and Kragh). On one hand, they must leverage the computational power of AI to process data, optimise efficiency and predict risks with unparalleled accuracy. On the other hand, they must embody transparency, ethical accountability and explainability. Those qualities transform cold algorithms into trusted partners, by being compounded to address known challenges in the human-automation interaction (Kyriakidis, De Winter, Stanton, Bellet, et.al.). By prioritising these dual imperatives, HI does more than deliver technology; it delivers systems that users are willing to embrace.

What sets HI apart is its ability to **shift mobility systems from a reactive stance to a predictive and proactive operation**. Where traditional systems respond to problems only after they arise, HI anticipates risks before they become crises. Imagine a system that not only reacts to sudden congestion but predicts it hours in advance, rerouting traffic to avoid it altogether. This predictive capability is not just about efficiency, but about safety, satisfaction and trust. **Users feel empowered by systems that are one step ahead, working not just for them but with them**.

This transformative shift enhances safety by reducing errors and mitigating risks before they occur. It boosts efficiency by optimising traffic flow, resource allocation and energy consumption. Most importantly, it **elevates user satisfaction by creating systems that are not just effective but intuitive, adaptive** (Akata, Balliet and de Rijke) **and deeply aligned with human values** (Liscio, Lera-Leri and Bistaffa). In doing so, HI addresses the core requirements of modern mobility, paving the way for solutions that are not only innovative but also empowering. The goal is not merely to advance technology but to advance the relationship between technology and its users, hence making mobility systems that people trust, adopt and ultimately rely on to shape a better future.

Figure 3 Strategic HI Objective

3.2 Alignment with Broader Goals

By design, **HI does not operate in isolation, but it integrates into a larger vision for sustainable, equitable and future-ready urban and transport systems**. It addresses the urgent need to rethink mobility in a way that balances efficiency with ethics, speed with sustainability and innovation with inclusivity.

One of the most profound contributions of HI-based systems is their ability to **optimise traffic flow while championing shared mobility models**. These capabilities directly address climate action imperatives, such as reducing carbon emissions and energy consumption. Imagine a city where traffic is not just managed but anticipated, where vehicles are utilised efficiently through shared usage models and where the energy footprint of transport is minimised without compromising convenience or accessibility. HI turns these aspirations into achievable goals, embedding environmental responsibility into the core of mobility design.

HI also catalyses urban development. Congestion, which symbolises urban inefficiency, can be alleviated through predictive capabilities and adaptive responses. HI also fosters greater accessibility, ensuring that **mobility systems cater to diverse populations, including vulnerable road users, individuals with disabilities and underserved communities**. This is not just a step forward for transport; it is a leap towards creating cities that are liveable, inclusive and resilient.

Crucially, HI-based systems must be aligned with and strengthen regulatory frameworks like the AI Act (EuropeanCommission) and ISO standards. By embedding principles of **transparency, accountability and fairness into their design**, these systems can help **ensure compliance with both current regulations and emerging ethical guidelines**. This adherence is not merely about ticking boxes; it is about building trust in technologies that will inevitably shape the public's daily lives. Compliant, ethical and trustworthy systems are not just easier to deploy - they are more likely to be embraced by users, stakeholders and policymakers alike.

This alignment positions HI as a **bridge between technological advancement and broader societal goals**. It ensures that these systems deliver measurable benefits across social, economic and environmental dimensions, from improved safety and reduced emissions to enhanced equity and economic productivity. By embedding the values of sustainability, inclusivity and accountability, HI-based smart mobility does more than move people and goods as it moves societies closer to their aspirations for a better, more balanced future.

Table 1 Key HI aspects within a broader picture of mobility

Key Aspect	Description
Broader Vision	Sustainable, equitable, and future-ready urban and transport systems
Balancing Principles	Efficiency vs ethics, speed vs sustainability and innovation vs inclusivity
Traffic Flow Optimisation	Anticipating and efficiently utilising shared mobility models.
Climate Action Alignment	Reducing carbon emissions and energy consumption.
Urban Development	Reduces congestion through predictive capabilities and adaptive responses.
Inclusivity	Cater to vulnerable populations and underserved communities.
Regulatory Compliance	AI Act and ISO standards, embedding transparency, accountability and fairness.
Trust Building	Ethical and compliant systems increasing acceptance.
Economic and Social Benefits	Productivity and equity while supporting economic growth and societal well-being.
End Goal	Bridges technology with societal aspirations.

4 Innovative Approaches and Proposed Solutions

HI transforms smart mobility by merging technological innovation with a deep focus on human-centric design. Its approach combines advanced tools and predictive models to integrate diverse data sources into cohesive, adaptive systems while embedding ethical and fail-safe mechanisms to ensure reliability and trust. HI also prioritises user engagement, leveraging participatory design, explainable AI and inclusive interfaces to address real-world needs and foster acceptance. These innovations redefine mobility as not just efficient and intelligent but also collaborative and empowering, laying the groundwork for the detailed strategies explored in the following sections.

4.1 Integration of Technologies

The foundation of HI in smart mobility lies in its ability to **unify diverse technologies into a seamless and adaptive system**. Sensor fusion remains a pivotal element, integrating data from onboard vehicle sensors, infrastructure and user-provided inputs to generate a **comprehensive and real-time understanding of the transport ecosystem**. These technologies are further enhanced by predictive models that not only interpret current conditions but also **forecast traffic patterns, short-term road-user behaviour and environmental risks**.

To enable this level of foresight, the systems utilise advanced tools such as **digital twins** for simulating and refining decision-making in complex scenarios, as well as **federated learning** to continuously improve models across decentralised data sources without compromising privacy. Adaptive signal controls and V2X (vehicle-to-everything) communication systems synchronise real-time updates between vehicles and infrastructure, creating a network capable of proactive and collective situational awareness. The integration of all V2X networks could be achieved by the end to end model restored by IPv6 especially with new protocols such as SRv6 allowing scaling, P2P and end to end security.

Ethical goal functions ensure that these systems operate in a fair, safe and inclusive manner, while robust fail-safe mechanisms provide resilience in dynamic and unpredictable environments. These safeguards **integrate deterministic safety methods with AI-driven adaptability, ensuring system reliability even in critical situations**. Together, these technologies redefine the potential of smart mobility, creating solutions that are safer, more efficient and deeply aligned with societal values.

4.2 User-Centric Design

For HI-driven systems to thrive, their design must not only meet technical requirements but also align with user expectations and values. **Co-creation and participatory design processes bring users directly into the development lifecycle, ensuring that their preferences and concerns shape the solutions**. These methods extend to gathering data on user behaviour, preferences and real-world scenarios to inform iterative improvements.

User-centricity is further amplified through the **integration of intuitive interfaces and explainable AI, which empower users to understand system decisions and feel confident in the technology**. The systems also leverage human-centric interaction mechanisms, such as **adaptive feedback and multimodal interfaces**, to maintain engagement and build trust. For example, systems might adjust visual, auditory and haptic cues based on user context, ensuring clear and effective communication.

Inclusivity is a core principle, with HI solutions designed to accommodate vulnerable road users, individuals with disabilities and diverse cultural contexts. Safety and its perception are enhanced by **integrating real-time human state monitoring**, such as stress or fatigue detection, to **inform both the system and the user when intervention is needed**. By placing users at the heart of its design, HI transforms mobility systems into trusted allies, fostering widespread acceptance and meaningful societal impact.

5 Expected Outcomes and Transformational Impact

By dismantling barriers to trust and transparency, HI lays the foundation for **systems that inspire meaningful user engagement**. Its versatility is demonstrated in real-world applications, from optimising urban traffic to revolutionising emergency responses and infrastructure planning. Beyond technological advancements, HI delivers **measurable economic, social and environmental benefits**, positioning itself as a critical enabler of sustainable and inclusive urban development. The following sections explore these outcomes in greater detail, highlighting HI's far-reaching potential to redefine mobility as both a service and a societal cornerstone.

5.1 Impact on User Acceptance

HI systems redefine the relationship between users and technology by **tackling the root causes of mistrust and disengagement**. By integrating ethical frameworks and principles of human-like control, these systems **provide transparency, accountability and a sense of shared agency**. Explainable AI ensures users understand the decision-making processes, empowering them to trust and meaningfully interact with the technology. This transparency is not merely a feature but a **foundation for user confidence**, raising a sense of security and reliability that accelerates acceptance. **HI transforms mobility systems from being perceived as cold, distant tools into collaborative partners** designed not just for users but with them. The result is a significant shift toward broader adoption and satisfaction, enabling HI-driven systems to become indispensable in everyday mobility.

5.2 Opportunities and Use Cases

The transformative potential of HI is evident in its **broad range of applications**, each addressing critical challenges in smart mobility. In urban traffic management, predictive systems equipped with advanced sensor fusion and adaptive algorithms optimise traffic flow, reducing congestion and emissions. These systems dynamically anticipate bottlenecks and reroute traffic efficiently, **transforming urban environments into more liveable spaces**.

In emergency response scenarios, HI enables real-time, context-aware adjustments to ensure swift and safe navigation for emergency vehicles. By **leveraging data from digital twins, predictive analytics and situational awareness technologies, these systems can anticipate disruptions and coordinate interventions with precision**. Digital twins further extend the utility of HI by simulating complex collective behaviours, offering a safe environment for testing policies, designing infrastructure and refining mobility strategies. From shared mobility models to personalised user experiences, HI expands its influence across diverse scenarios, ensuring that the solutions are scalable, adaptive and impactful. These use cases highlight how HI turns intricate challenges into opportunities for innovation, fundamentally reshaping the landscape of transport and urban planning.

5.3 Economic and Societal Benefits

HI-driven mobility systems are poised to deliver unparalleled economic and societal value. Economically, they **reduce costs associated with congestion, inefficiency and accidents** while simultaneously driving growth in AI, mobility and related industries. The deployment of **HI fuels innovation, creates jobs and positions regions as leaders in intelligent transport systems**, enhancing competitiveness in a global market. On a societal level, HI **empowers communities by improving road safety and accessibility**. Vulnerable road users, such as pedestrians and individuals with disabilities, benefit from inclusively designed systems that **prioritise equity and fairness**. By reducing traffic incidents and creating intuitive mobility solutions, HI contributes to a **higher quality of life, promoting trust in the broader adoption of smart mobility**. Environmental benefits amplify this impact. Optimised traffic flows and predictive interventions significantly **reduce carbon emissions**, aligning with global climate action goals and urban sustainability initiatives. HI's capacity to combine economic growth, societal equity and environmental stewardship positions it as a cornerstone of transformative urban development. It is not just a tool for smarter mobility; it is a platform for building a more sustainable, inclusive and prosperous future.

6. Future Directions and Strategic Roadmap

Realising the full potential of HI in mobility is ambitious and necessary. It demands a forward-looking vision that integrates evolving technologies with a deep commitment to human-centric principles. The future lies in creating systems that are not only adaptive and predictive but also **deeply tuned to user values, behaviours and expectations**. This chapter outlines a strategic pathway for achieving this future, focusing on a transformative vision for mobility and the research and development efforts needed to bring it to life.

6.1 Vision for the Future

The future of mobility envisions a **seamless, intelligent ecosystem driven by HI, where systems continuously learn, adapt and evolve through decentralised and collaborative innovation**. Federated learning emerges as a foundation of this vision, enabling privacy-preserving data sharing across diverse environments while maintaining system adaptability and integrity. This decentralised approach supports scalable and inclusive solutions that dynamically respond to urban and rural mobility's complexities.

Central to this vision is the **transformation of mobility systems into trusted partners**. HI-powered platforms will integrate human intuition with AI's analytical capabilities, creating **collaborative frameworks that empower users while addressing their concerns**. Predictive capabilities will move beyond traffic management to encompass **proactive risk mitigation and real-time adaptive interventions across diverse scenarios**, from emergencies to personalised travel experiences. This future prioritises systems that are not only **efficient but also equitable, sustainable and aligned with societal goals for accessibility, safety and environmental stewardship**.

6.2 Research and Development Needs

Achieving this ambitious vision requires focused investment in key areas of research and development. **Federated learning** frameworks must be advanced to enable **secure and efficient collaboration across diverse data ecosystems**. This includes addressing challenges such as **data heterogeneity, model generalisation** and ensuring robust **privacy-preserving mechanisms.**

Predictive optimisation models need further refinement to enhance their accuracy and reliability in anticipating complex, real-world scenarios. These models must **integrate real-time data streams** and incorporate diverse environmental, behavioural and infrastructural variables to deliver actionable insights. Additionally, iterative **user feedback loops must be embedded into the development cycle** to ensure that the systems remain **aligned with evolving human needs and societal expectations**.

Ethical AI design will play a critical role, requiring interdisciplinary collaboration to establish frameworks that **balance transparency, fairness and accountability**. Efforts must also focus on creating **intuitive and inclusive interfaces** that cater to diverse populations, including vulnerable road users and underserved communities. These must be developed to ensure machine transparency and, when appropriate, to relay insights in such a manner that empowers humans to take timely and effective actions.

The strategic roadmap for HI in mobility is as much about **cultural transformation** as it is about **technological innovation**. It calls for bold investments, collaborative efforts across sectors and a commitment to aligning cutting-edge advancements with the values and aspirations of a global society. This is the path to ensuring that HI not only transforms mobility but also reshapes the relationship between technology and humanity for a more equitable and sustainable future.

7. Conclusion

7.1 Summary of Vision and Goals

HI represents a transformative paradigm for the future of mobility, addressing not only the technical challenges of transport systems but also the human factors that drive trust, acceptance and inclusivity. By synergising the analytical power of AI with the empathy, intuition and ethical judgment of human intelligence, HI systems promise to deliver mobility solutions that are safer, more efficient and deeply aligned with societal values. This vision extends beyond technological innovation; it reimagines mobility as a collaborative ecosystem where users and systems work in harmony to achieve sustainable and equitable outcomes. From predictive traffic management to inclusive design for vulnerable road users, HI sets the stage for a mobility revolution that resonates with the aspirations of both individuals and communities.

7.2 Call to action

The realisation of this vision demands a collective commitment from policymakers, industry leaders, researchers and communities. Strategic investments in HI technologies, coupled with bold cross-disciplinary collaboration, are critical to unlocking their transformative potential. This is not merely a technical journey but a societal one, where mobility systems must reflect and reinforce human values such as fairness, transparency and sustainability.

Policymakers must create frameworks encouraging innovation while safeguarding ethical principles and public trust. Industry leaders should champion the integration of HI into scalable, user-centric solutions, setting new benchmarks for transparency and accountability. Researchers must push the boundaries of knowledge, addressing the complex intersections of technology, psychology and ethics.

Together, we can redefine mobility, creating systems that not only meet technical benchmarks but also enhance lives, foster trust and drive progress toward a more connected, sustainable and inclusive future. The call is clear: the future of mobility is not just about moving faster or farther—it is about moving better for everyone. Let us act decisively to make this vision a reality.

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Acknowledgements

About AIOTI

AIOTI is the multi-stakeholder platform for stimulating AI, IoT and Edge Continuum Innovation in Europe, bringing together small and large companies, academia, researchers, policy makers, end-users and representatives of society in an end-to-end approach. We strive to leverage, share and promote best practices in the AI, IoT and Edge Continuum ecosystems, be a one-stop point of information to our members while proactively addressing key issues and roadblocks for economic growth, acceptance and adoption of the AI, IoT and Edge Continuum Innovation in society. AIOTI contributions go beyond technology and address horizontal elements across application domains, such as matchmaking and stimulating cooperation by creating joint research roadmaps, defining policies and driving the convergence of standards and interoperability.