Loughborough University

Smart Mobility Living Lab London

Research and Innovation in Safe and Smart Mobility: SEMINAR SERIES
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Digital Road Safety

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NTUA - Dpt of Transportation Planning & Engineering

Department of Transportation Planning & Engineering

- The mission of the NTUA DTPE is to educate scientists engineers and promote science in the field of transportation planning and engineering.
- The NTUA DTPE is a Research and Innovation Center of Excellence with global recognition [Ranked 9th in Europe, 39th worldwide (Shanghai Ranking's 2017), Scientific citations: 3rd in Europe, 19th worldwide (Pulse 2017), Road Safety: 2nd in Europe, 6th worldwide (AAP, 2018)].
- A Team of 60+ Scientists: 7 Internationally recognized Professors, 15 Senior Transportation Engineers and PostDoc, 25 PhD Candidates, 15 Transportation Engineers and other scientists.
- NTUA DTPE Activities in figures (since mid 80s):
  - More than 1.100 Diploma and 30 PhD Theses,
  - More than 330 road safety research projects, mostly through highly competitive procedures,
  - More than 1.100 scientific publications (> 400 in Journals), widely cited worldwide,
  - More than 150 scientific committees,
  - International collaborations: European Commission, UN/ECE, OECD/ITF, WHO, World Bank, EIB, CEDR, FEHRL, ERF, IRF, UITP, ETSC, WCTR, TRB, decades of Universities and Research Centers.

NTUA Road Safety Observatory

- An international reference road safety information system, with most updated data and knowledge, with:
  - more than 3.000 visits per month,
  - tens of items and social media posts/tweets annually

Background

Background

- Road transport is responsible for the majority of transport fatalities, with an annual 1,35 million road traffic deaths worldwide.
- Innovative data-driven solutions could contribute to a proactive approach of addressing road safety problem, which is a core principle of the Safe System.
- The rise of smartphones, sensors and connected objects offers more and more transport data.
- The interpretation of these data can be made possible thanks to progress in computing power, data science and artificial intelligence.

Need for New Data

- Alternative data that could lead to **new road safety analyses** in order to:
  - more efficiently describe the road safety phenomenon
  - address road user behaviour and errors
  - address traffic and infrastructure issues in a proactive manner

- Continuous **driver support** with aim to improve driver behavior and develop better road safety culture at all road users, stakeholders and the Authorities

Digital Road Safety Data

Road Safety Data (1/3)

- **Mobile Phone Data**
  - Sensor Based Data (e.g. Google Maps, Waze)
  - Cellular Network Data (e.g. AT&T)
- **Vehicle On-Board Diagnostics Data** (e.g. BMW, Mercedes-Benz, Volvo)
- **Data from Cameras**
  - Inside and outside on-vehicle
  - Out vehicle
  - On the road (cities, operators)
- **Data from Car Sharing Services** (e.g. Uber, Lyft)
- **Data from Bike Sharing Services** (e.g. 8D Technologies, Mobike)
- **Social Media Data** (e.g. Facebook, Twitter)

Road Safety Data (2/3)

- **Public Authorities Sensor Data**
  (e.g. Ministries, Public Transport Authorities, Cities, Regions)

- **Private Agencies' Sensor Data**
  (e.g. INRIX, Waycare)

- **Travel Cards Data**
  (e.g. Oyster card, Opal card)

- **Weather Data**
  (e.g. AccuWeather, ClimaCell)

- **Census Data**
  (e.g. Eurostat, National Statistics)

Road Safety Data (3/3)

- **GPS traces** of the app users are the main core data elements.
- Data coming from **connected navigation devices** (embedded in cars, applications in smartphones etc.)
- **Various sources may be combined** by some companies: vehicle sensors, smartphones, PNDs, road sensors, connected cars, fleet management companies etc.
- Data related to **road network**, **traffic parameters** and **speed** are the most available.
- **Traffic accidents** may be recorded as a subgroup of recorded incidents mainly through:
  - Crowdsourcing,
  - Partnerships,
  - Algorithmically generated flow-based incidents

Accident Data Collection (1/2)

- Automatic data collection is possible through
  - instrumented floating vehicles and/or
  - smartphones (hard braking, poor road surfaces, speed).

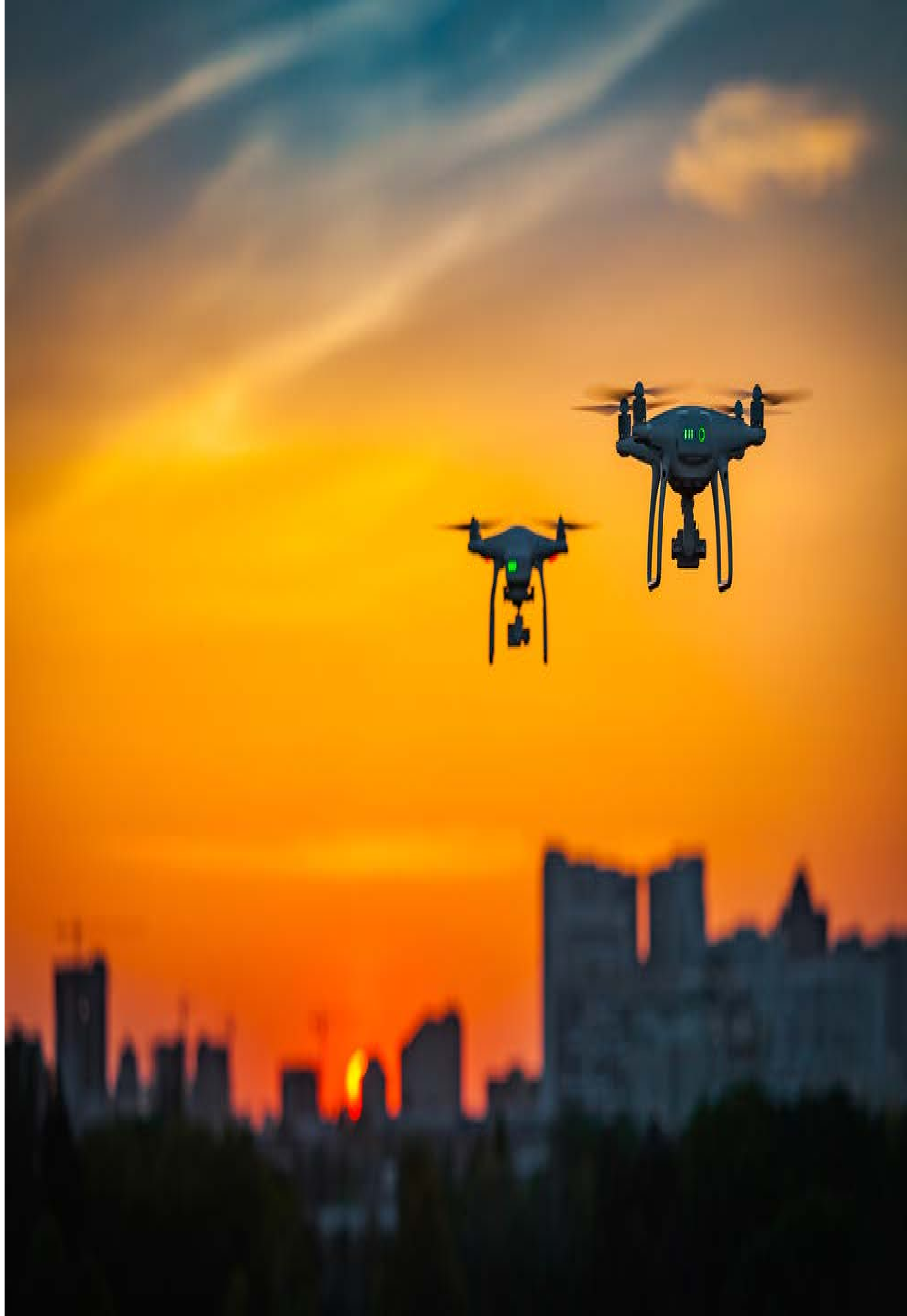
- Active safety systems can also be considered among surrogate safety metrics, such as:
  - ABS for anti-lock braking,
  - ESP for electronic stability control and
  - AEB for autonomous emergency braking

Accident Data Collection (2/2)

- Technologies like **automatic crash notification** and **event data recorders** propose data-driven responses to post-crash problems.

- **Street imagery**, also collected by floating vehicles, supports the assessment of road safety performance (star-rating for roads).

- **Drones and satellites** complement the range of data, capture solutions and play an increasing role.



Cooperative-Intelligent Transport Systems

- Cooperative ITS (C-ITS) technology will enable connected vehicles to openly broadcast not only their position regularly but also warning messages.
  - Talk to each other
  - Report on the system performance in real time
- C-ITS have been developed mainly by and for the automotive industry.
- There is a risk that C-ITS do not contribute to the improvement of VRUs' safety.

On Board Diagnostics (OBD)

- OBD is referring to a vehicle's self-diagnostic and reporting capability
- It provides access to data from the engine control unit (ECU)
- Continuous data collection from the OBD and the smartphone is much easier today
- An OBD device can be easily installed in the vehicle at an affordable price.
- OBD integrates GSM/GPRS technology which records and transmits critical driving behaviour features such as:
  - Mileage driven
  - Road network used (through GPS position)
  - Duration and time of the day driving
  - Harsh braking
  - Harsh acceleration
  - Speed
  - Fuel consumption

Telematics

- A range of telematics solutions already exist for:
  - fleet management,
  - usage-based insurance,
  - eco-driving and
  - safe driving coaching.

- Smartphones are becoming increasingly popular in those applications.

- Current technological advances make data collection and exploitation substantially easier and more accurate through mobile phones.

Feedback on Safety Performance

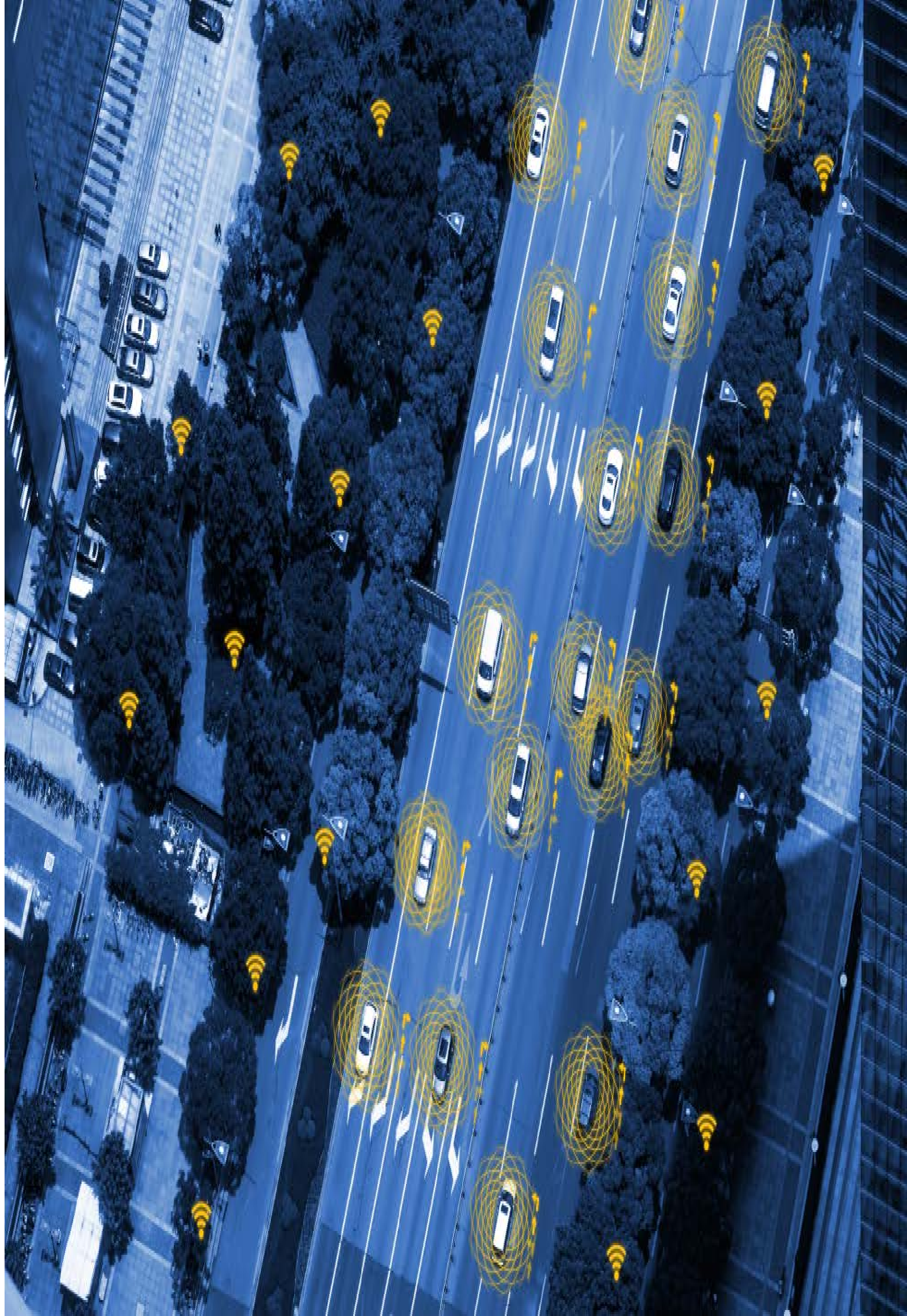
Use of Technology for all Road Users' Support

- **Cooperative ITS technology** will enable every vehicle to openly broadcast its position regularly and to broadcast warning messages when relevant.

- In order to benefit the wider community, including **non-connected vehicles**, smartphones could be integrated in the C-ITS eco-system, so they are used as receivers.

- **Authorities** should also allocate frequency bands for C-ITS safety application.

- **Revision of trigger mechanisms** for automatic crash notification (e.g. e-Call) or event data recorder (EDR) systems, so that VRUs will also benefit from them.



Monitoring Driver Behaviour

- New vehicles can include distraction and drowsiness alerts as standard.
- Crash investigators could have access to eye tracking data through event data recorders.
- Smartphone apps developed by insurers should prevent drivers from using the phone.
- Share data to cap driving hours in the gig economy.
- Ride-sourcing and delivery platforms sharing data on driving and riding time via the licence number for preventing gig economy sector from breaking the driving hours restrictions.

Driver Performance Telematics Feedback

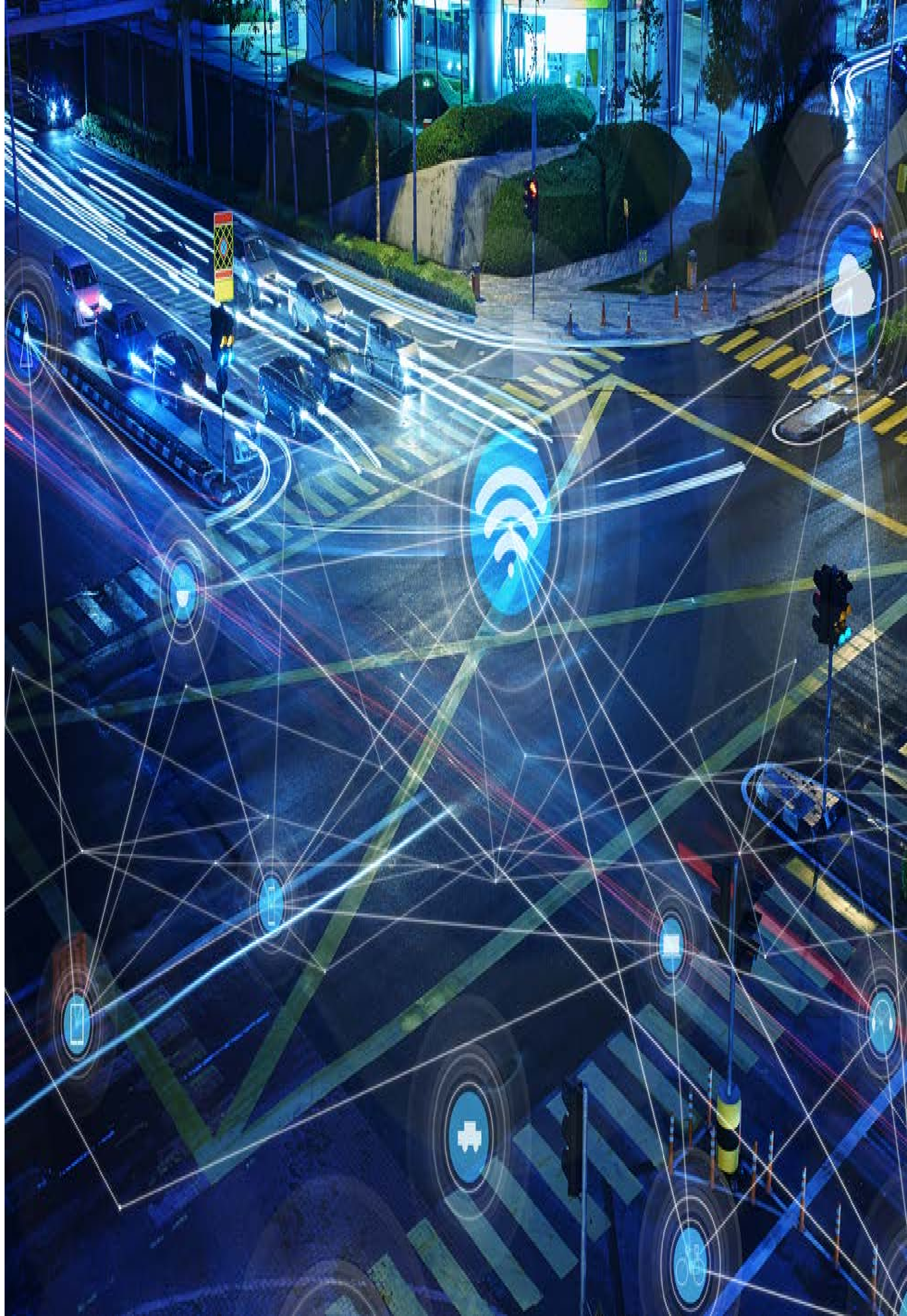
- Feedback to the driver through the Driver Performance Telematics (vehicle or smartphone)
- real time feedback
  + avoid distraction
  - produce distraction
- safety performance star rating
  + engage in the long term
  + great motivation to improve driving behaviour
  + identification of need for re-training
  - demotivation in case of non progress
  - demotivation when non favorable comparison with peers
- The feedback loop should be optimized.

VRU Data Crowdsourcing

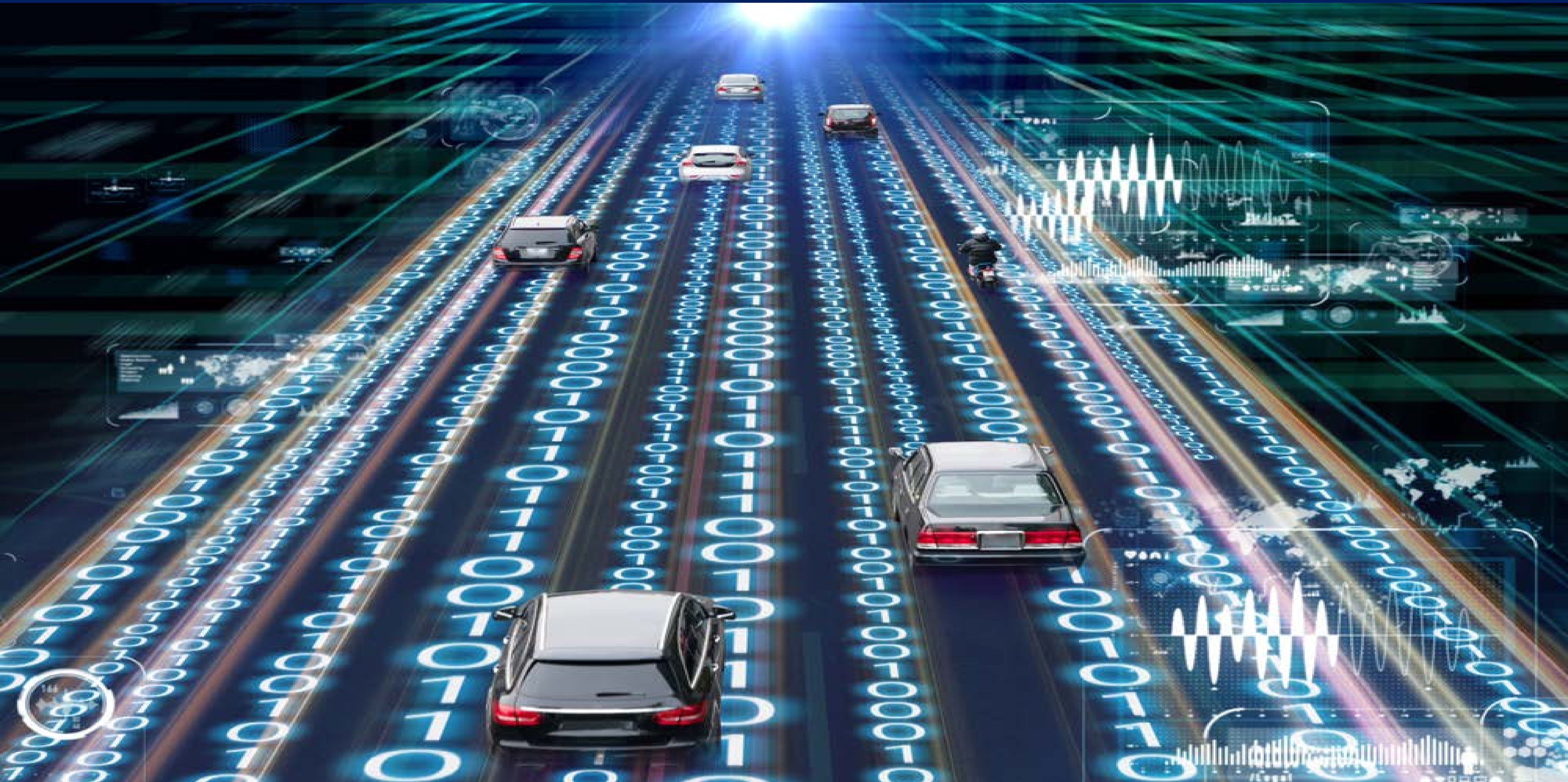
- Cyclists and Pedestrians report:
  - safety problems (roads, behavior)
  - exposure (routes, traffic, etc.)
  - crash data (with injuries, material damage only)
  - star rating

- Not uniform nor systematic reporting practices though

- Feedback on network safety performance
  - useful for the cyclists
  - useful for the decision makers (all levels)
  - useful for business



Open Issues



Critical Issues (1/2)

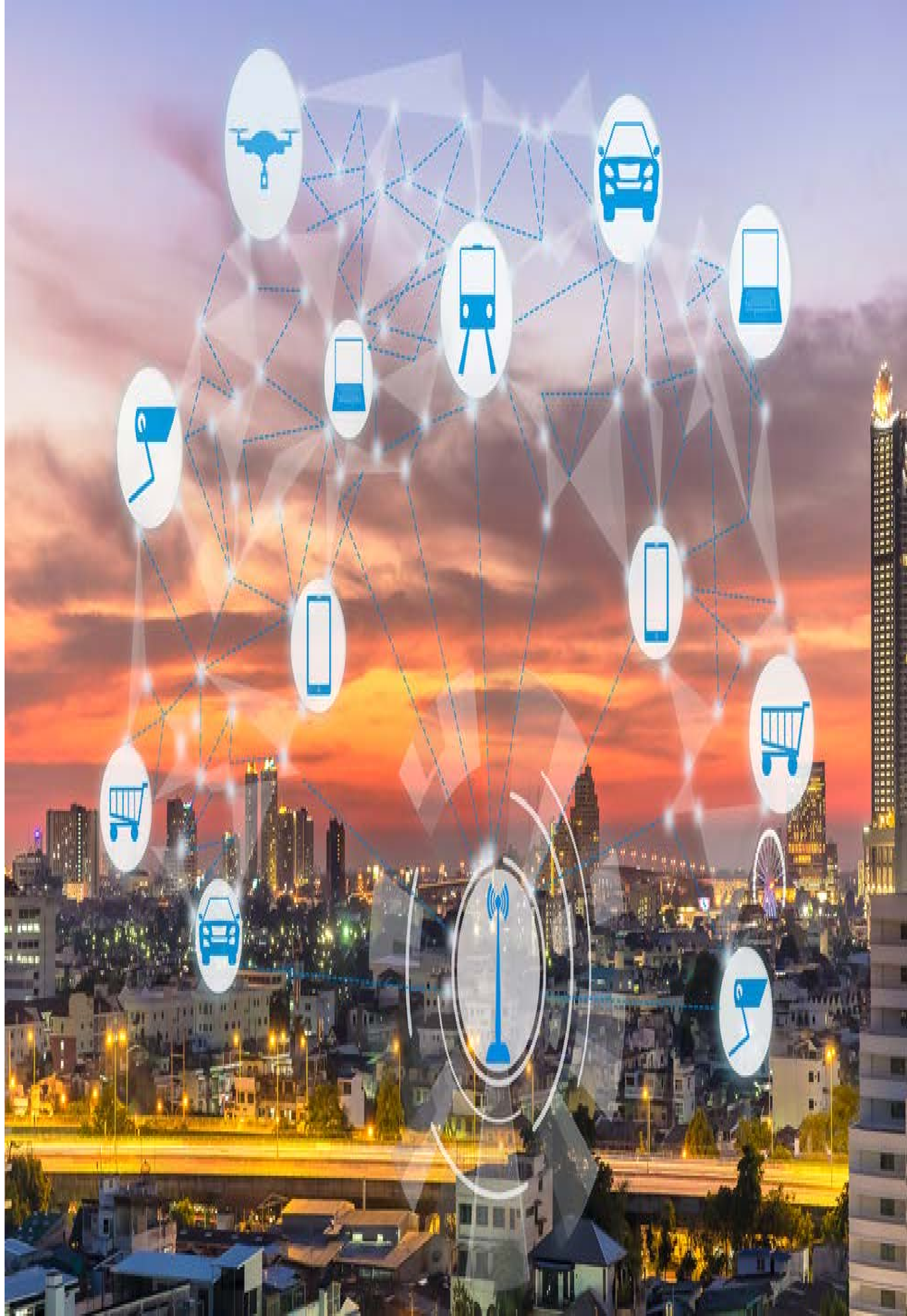
- Punishment Vs Positive Feedback (Incentives)
- Regulatory and Voluntary Data
- Secure anonymisation might increase penetration (e.g. blockchain)
- Ownership of data
- Exploitation of data (charging schemes)
- Sharing of safety data (EU legislation)

Critical Issues (2/2)

- Harmonisation and compatibility of:
  - data
  - metrics
  - data collection methodologies
  - data processing methodologies

- Define proper and properly the KPIs
- Clean properly the data
- Linking KPIs with respective interventions

- Define safety policy focus (behavior, VRUs, infrastructure, traffic)
- Control in-vehicle distraction devices



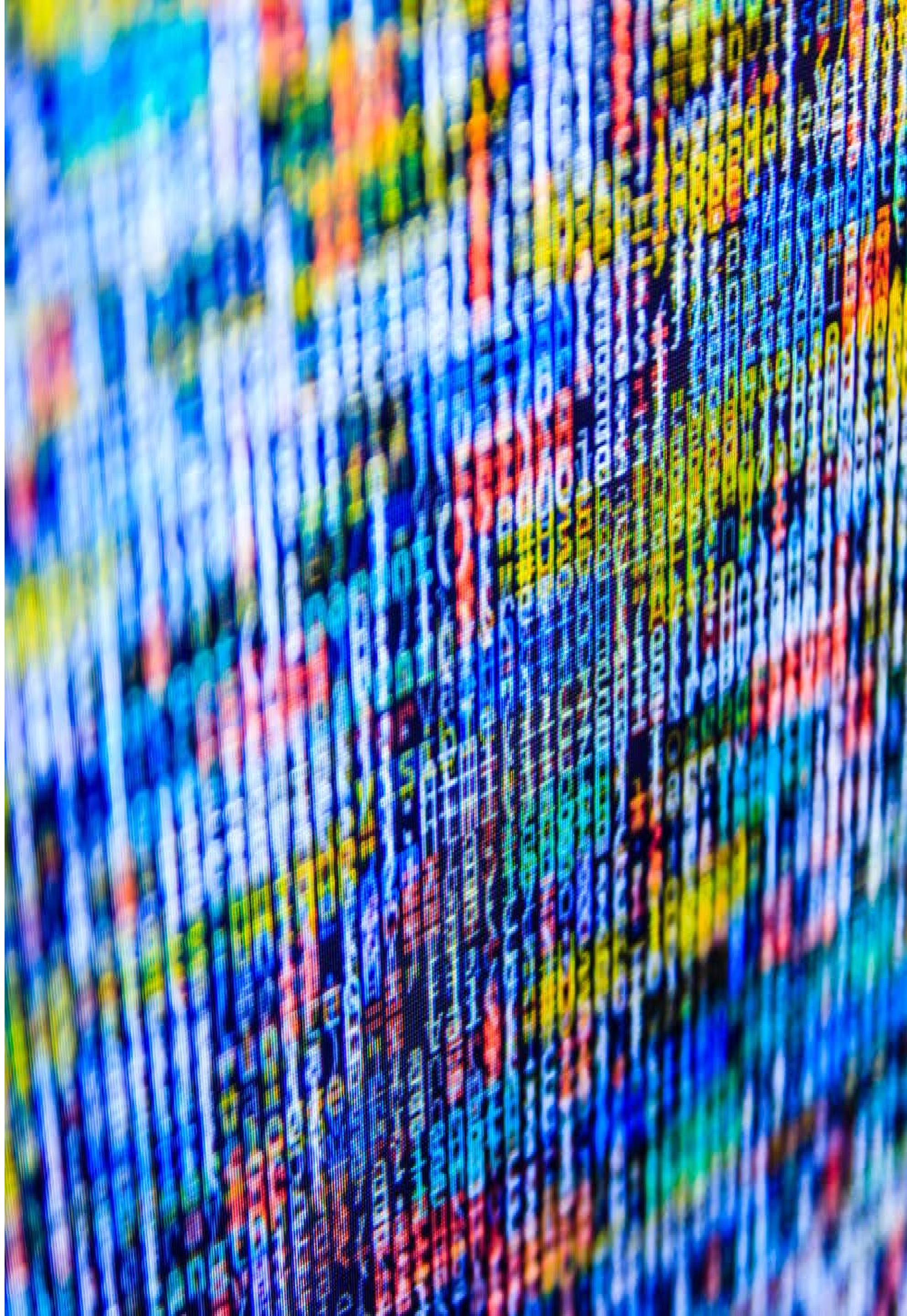
Technology Weaknesses

- Big Data is not only prone to many of the same errors and biases in smaller data sets, it also creates new ones.

- Big data creates privacy threats, especially with the risk of re-identification of individuals in datasets.

- Hacking is an important risk requiring advanced protection measures.

- Drivers using social driving apps may be distracted by new services (navigation, coaching, C-ITS alerts, infotainment, etc.).



Privacy Protection

- Explicit guidelines should be available to stakeholders concerning the protection of personal data, but also to offer reassurance on the legality of data collection and analysis.

- The use of strong de-identification techniques, data aggregation and encryption techniques are critical.

- Issues concerning video images used for close call analysis should be addressed.

Big Data versus Big Biases

- Every data set should be considered biased towards some user groups, trip purposes or in any other dimension.

- The consequences of using data which isn't representative of the whole population should be assessed.

- There is a high risk for decision makers to be misled by the opportunistic analysis of seemingly low-cost data in absence of qualified data scientists and statisticians.

Research Challenges

- Research on the **validation of surrogate safety metrics** is needed in order:
  - to reveal which metrics not only are correlated with reported crashes but also have **predictive capabilities**
  - how surrogate safety metrics should include crash participant **fragility**, **speed**, **mass** and **crash angle**

- The adoption of surrogate safety metrics leads to the **review of statistical training needs**, so that data are not misused.
  - Urgent links should be created between data industry and research and academia partners

- Support research and innovation in the area of **crash reporting**:
  - **Self-reported traffic injury surveys** could play a role in complementing other datasets.

New Data Sharing Partnerships

- New data ownership frameworks will be developed along the lines of "A New Deal on Data".
- Partnerships enabling both the private and public sector can be created.
  - Work is required to define the scope and scale of data collection that is in line with public mandates.
- Open source or commercial solutions are developed to collect, harmonise and aggregate mobility data.
- It is suggested that stakeholders make road safety data freely available through such platforms.

Concluding Remarks

Road Safety Technology Perspectives

- Technology can be the new road safety driver, through:
  - Public private partnerships
  - Clear problem analyses (well defined objectives)
  - Systematic effectiveness monitoring

- Great need for:
  - more data and knowledge
  - better exploitation of current and future data
  - broader geographical coverage

- Data focus on:
  - more accurate road accident data
  - exposure data and performance indicators
  - measures and policies effectiveness evaluation

Road Safety Digitalization Perspectives

- **Digitalization** opens great new data possibilities for:
  - road user support and guidance
  - evidence based public and private road safety decision making at all levels

- New great potential for **seamless data driven procedures** from safety problems identification to selection and implementation of optimal solutions

- New increased **net present value of road safety data**, available for (real-time) early problem detection and prompt and customized decision support

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