

Unmanned Aerial Vehicles as an Enabler for Next Generation Mobility

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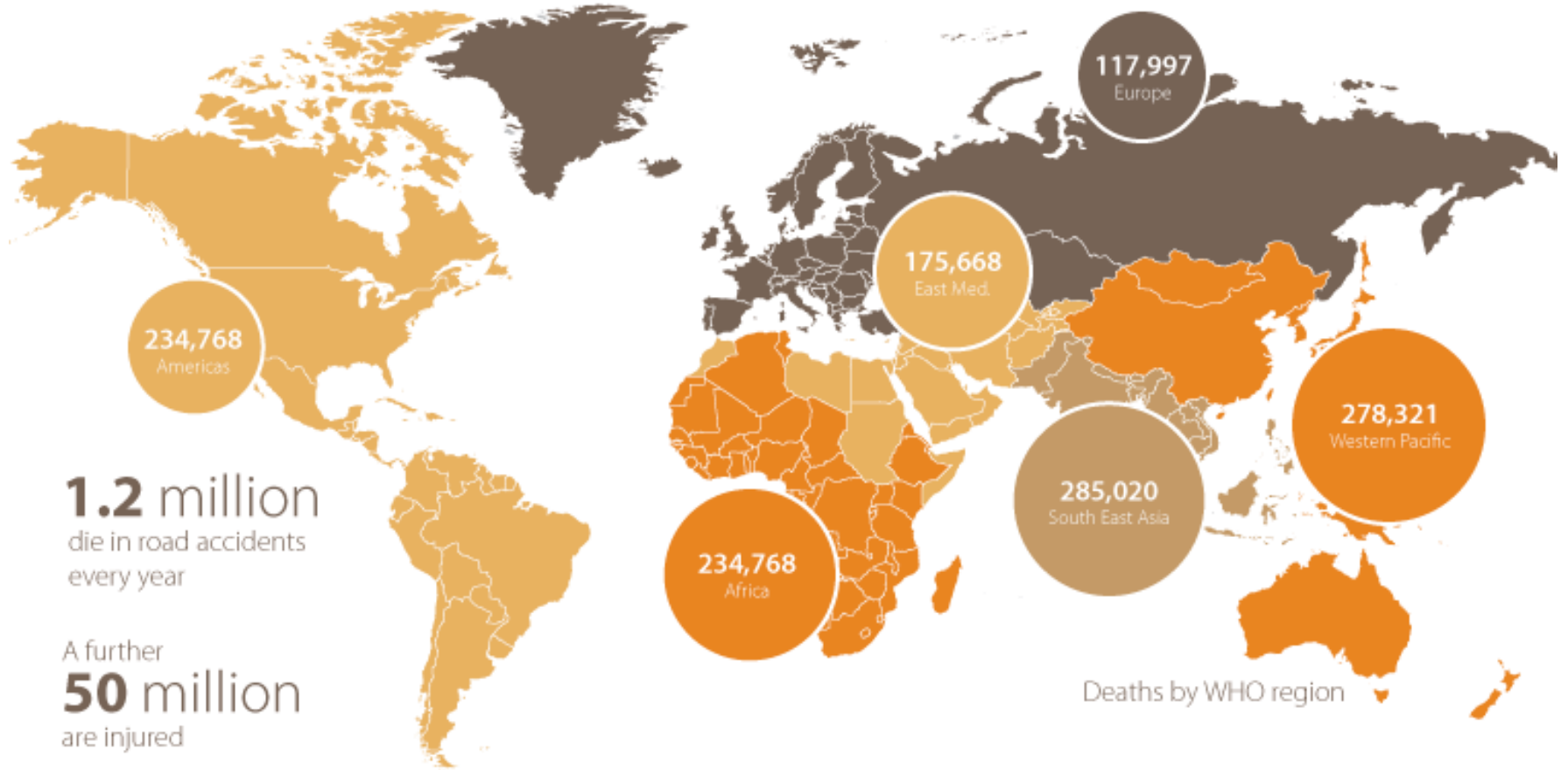
Qatar Mobility Innovations Center

First Independent Innovations Center in Region
Founded in 2009

Innovations Model Optimized for the Region
System Innovations
Idea to Market
User-Centric

Leadership in Key Emerging Market Domains
Intelligent Mobility
Smart Living (IoT)

Road Safety a Worldwide Problem



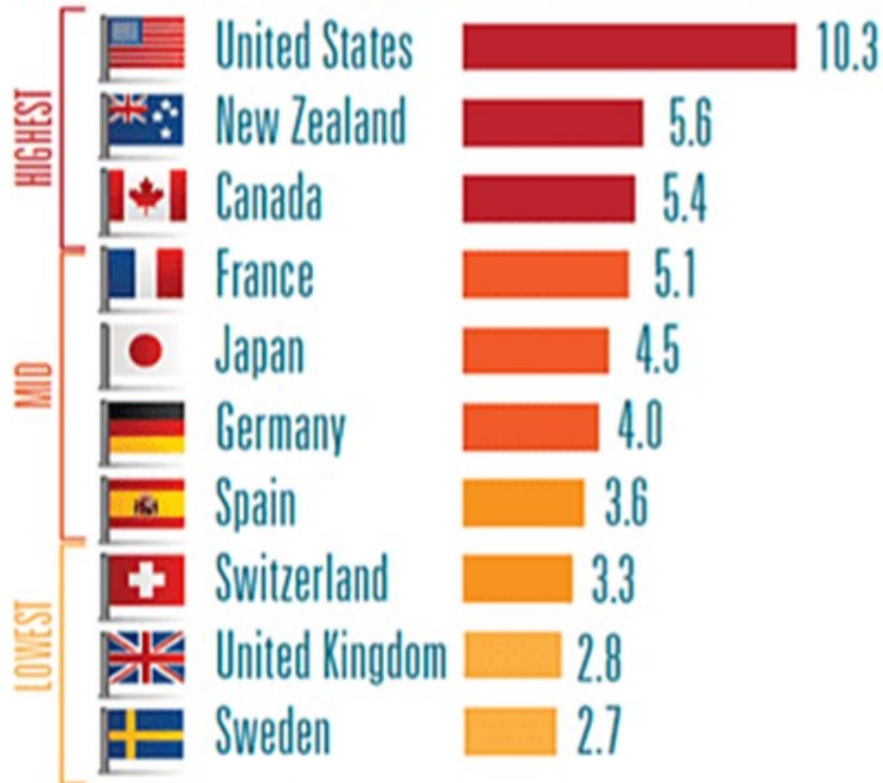
Source: WHO this year - 2013

And Old Problem...



Considerable Improvements

Motor vehicle crash deaths in 10 comparison high-income countries, 2013



Deaths per 100,000 people

SOURCE: WHO Global Status Report on Road Safety, 2015.

Countries with the highest and lowest reductions in crash deaths, 2000-2013

Spain (highest)

↘ 75%



AVERAGE

of 19 high-income countries ↘ 56%



United States (lowest)

↘ 31%



Deaths per 100,000 people

SOURCE: International Road Traffic and Accident Database (IRTAD) Road Safety Annual Report, 2015.

Roads Are Safer Than They've Ever Been



And Cars Are Safer Than They've Ever Been

Built to Crash...



Park Assist



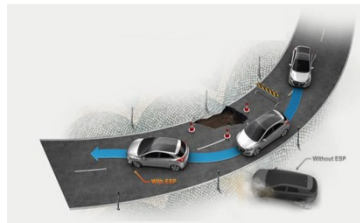
Driver & Passenger Centric ...



Adaptive Cruise Control



Driver Assisted...



Lane Assist



APPROX **90%**

of all crashes are due to minor mistakes such as **distraction, fatigue or being slightly above the speed limit**

Source: www.carrsq.qut.edu.au



Automated Driving to Eliminate Human Error!

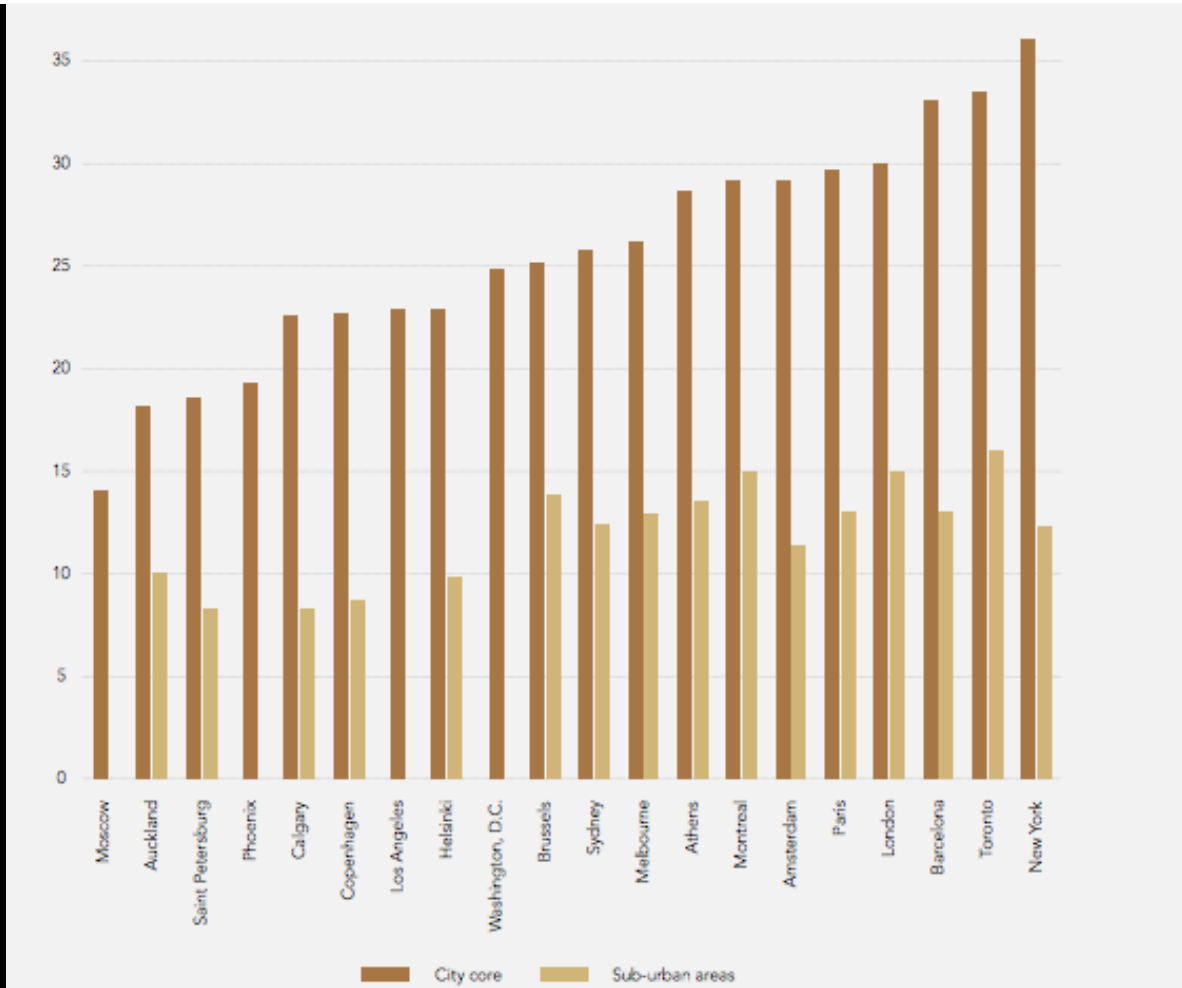
Cut Road
Accidents
by 90%

McKinsey & Co.



CITIES ARE DESIGNED FOR CARS

30-35%
Land used
for streets



**Parked
95%
of the time**



↓
**WASTED
SPACE & MONEY**

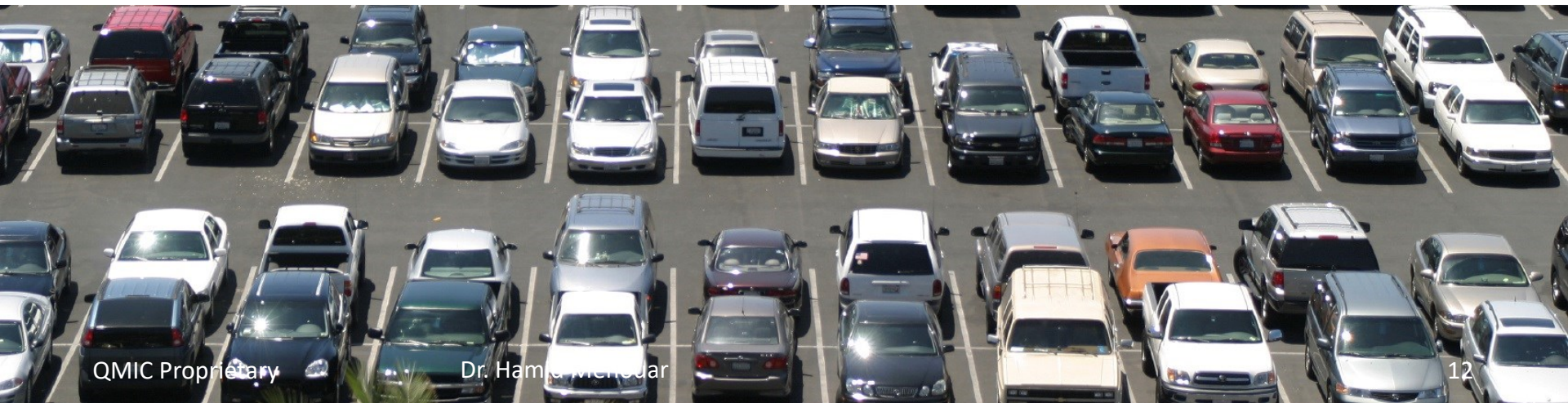
There are
4
times as
many parking
spaces as
cars in
America.

31%
of our
downtown
commercial
cores are
devoted to
parking.



Source: <http://www.motherjones.com/environment/2016/01/future-parking-self-driving-cars>

WASTED SPACE & MONEY



PAST



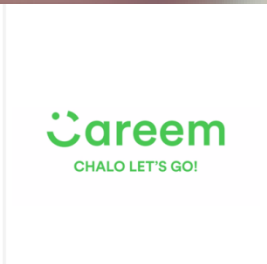
FUTURE



DIFFERENT EXPECTATIONS

THERE IS ONE trend of mobility that young people have embraced, though:

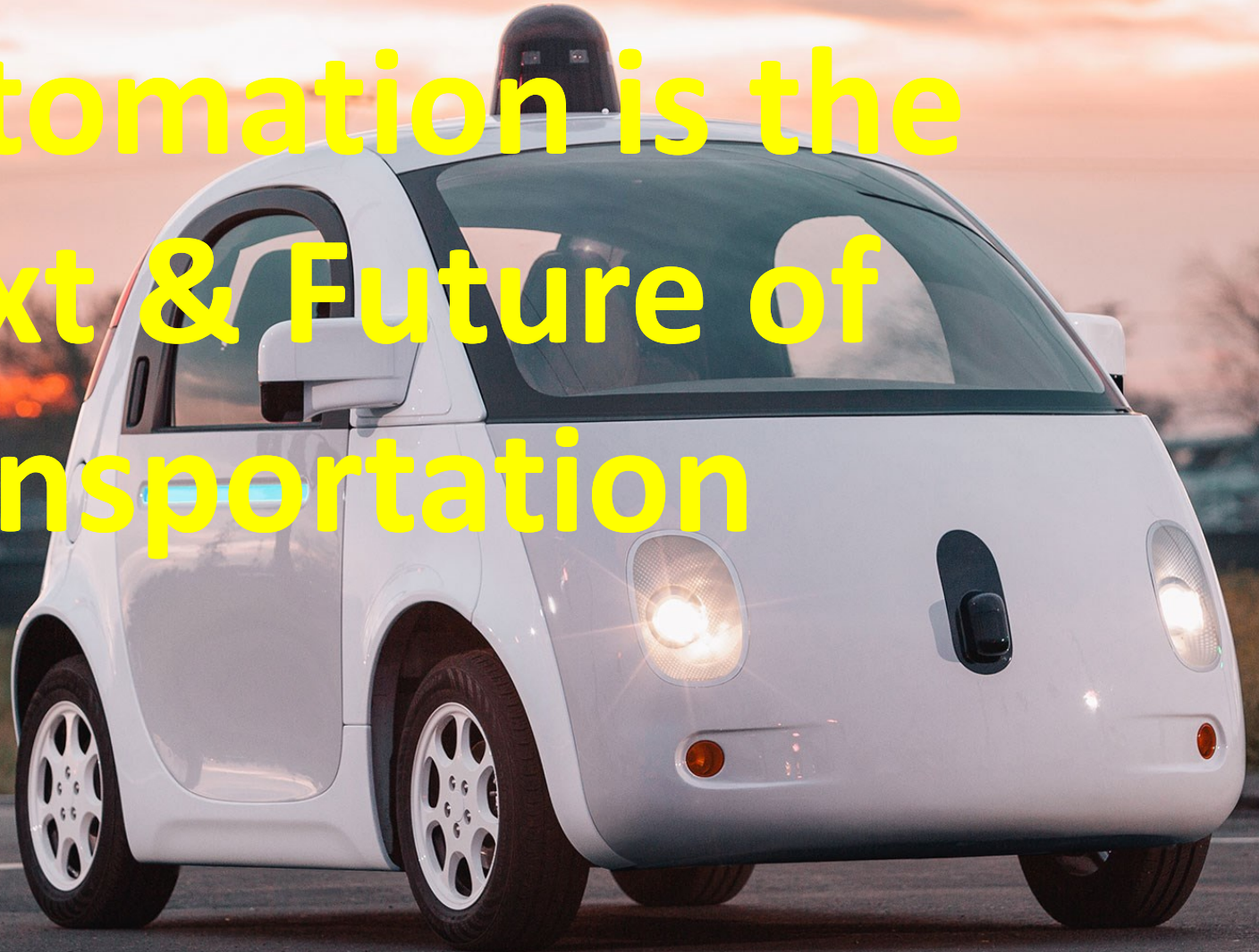
MOBILITY AS A SERVICE



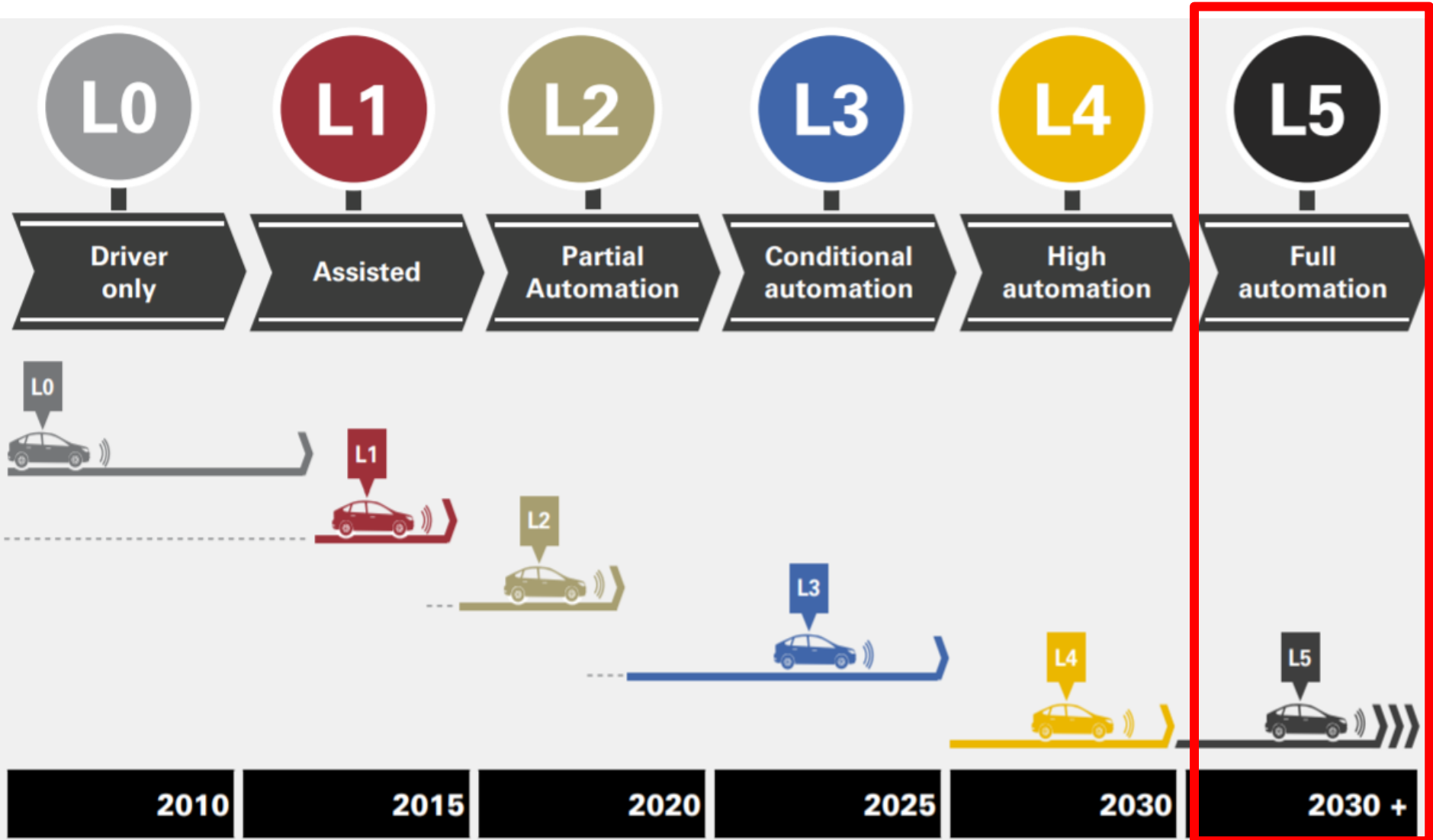
Fleet of Taxi ROBOTS



Automation is the Next & Future of Transportation



Levels of Automation



Source: KPMG: CAV – the UK Economic Opportunity, March 2015

What about road maintenance?



What about road assistance?



What about road surveillance?



What about road assistance?



Drone-aided Platform for Enabling Next Generation ITS

NPRP9-257-1-056 | www.DroneITS.com



UAVs Applications ... A Reality!



Flying cameras



Delivery



**Public safety /
Disaster recovery**



Precision Agriculture



**Inspection in Oil,
Wind, Construction,
electrical industry**



Defense

ENABLING MOBILE AND WIRELESS TECHNOLOGIES FOR SMART CITIES

UAV-Enabled Intelligent Transportation Systems for the Smart City: Applications and Challenges

Hamid Menouar, Ismail Güvenc, Kemal Akkaya, A. Selcuk Uluagac, Abdullah Kadri, and Adem Tuncer

Due to their mobility, autonomous operation, and communication/processing capabilities, UAVs are envisaged in many ITS application domains. The authors describe the possible ITS applications that can use UAVs and highlight the

ABSTRACT

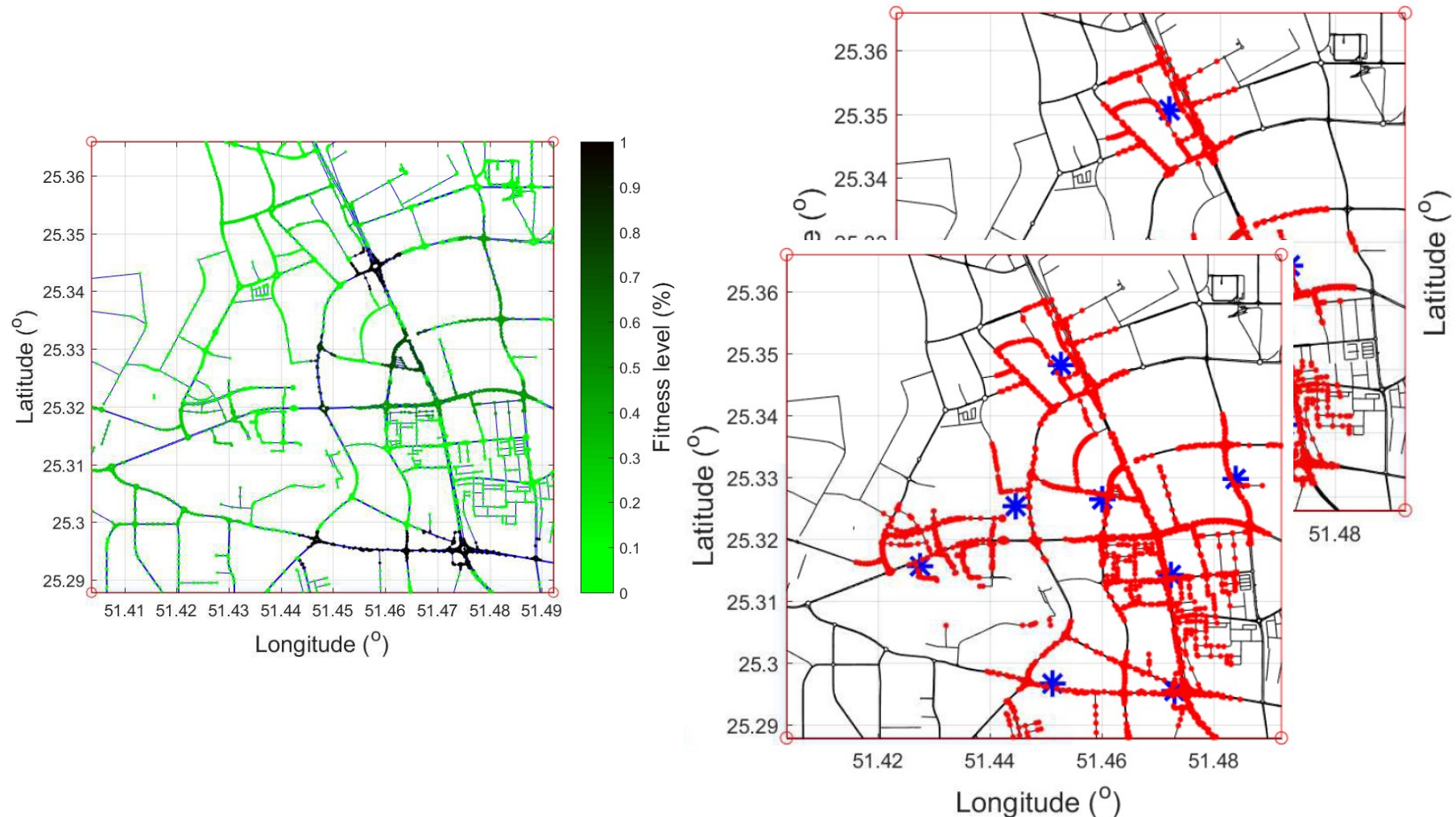
There could be no smart city without a reliable and efficient transportation system. This necessity makes the ITS a key component of any smart city concept. While legacy ITS technologies are deployed worldwide in smart cities, enabling the next generation of ITS relies on effective integration of connected and autonomous vehicles, the two technologies that are under wide field testing in many cities around the world. Even though

com/b?node=8037720011). Similarly, DHL of Germany and China's largest mailing company have started their experiments with a fleet of UAVs that could deliver around 500 parcels every day. Use of UAVs for daily consumer-oriented services is expanding and becoming a reality.

Automation of the overall transportation system cannot be achieved through only automating the vehicles. Indeed, other components of the road and the end-to-end transportation system, such as the field support team, traffic police, road

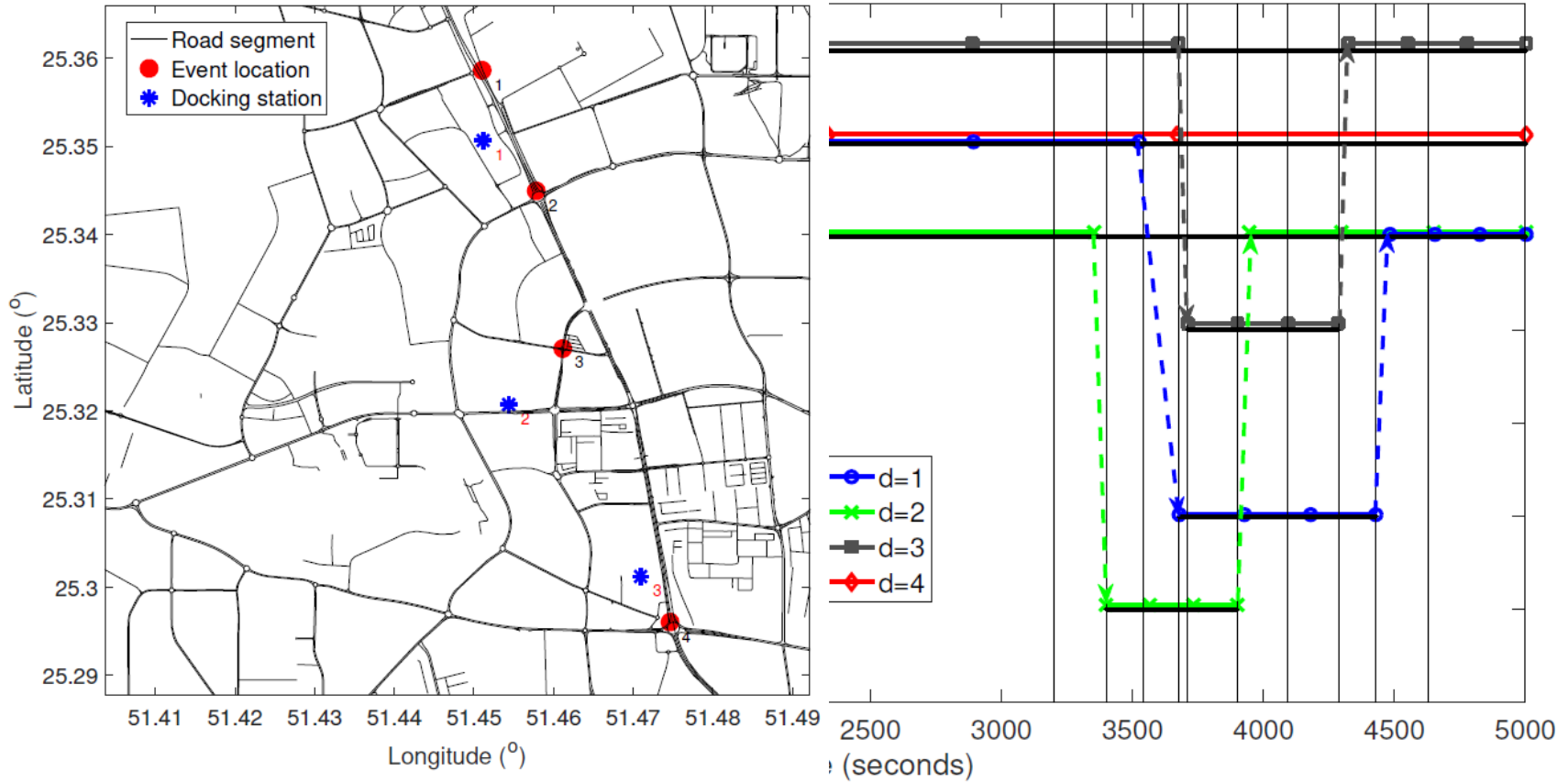
Hamid Menouar, Ismail Guven, Kemal Akkaya, A. Selcuk Uluagac, Abdullah Kadri, Adem Tuncer, "[*UAV-Enabled Intelligent Transportation Systems for the Smart City: Applications and Challenges*](#)", [*IEEE Communication Magazine*](#) – Special Issue "Enabling Mobile and Wireless Technologies for Smart Cities, March 2017.

Placement of the UAV Docking Stations



Hakim Ghazzai, Hamid Menouar, Abdullah Kadri, "[On the Placement of UAV Docking Stations for Future Intelligent Transportation Systems](#)", the 2017 IEEE 85th Vehicular Technology Conference (VTC), 4–7 June 2017 in Sydney, Australia.

UAV Missions Scheduling



Hakim Ghazzai, Hamid Menouar, Abdullah Kadri, Yehia Massoud, “[Future UAV-based ITS: A Comprehensive Scheduling Framework](#)”, to appear in IEEE Access. June 2019, pages 1-18, Print ISSN: 2169-3536, Online ISSN: 2169-3536, DOI: 10.1109/ACCESS.2019.2921269.

Flying IoT Gateway



Video link:

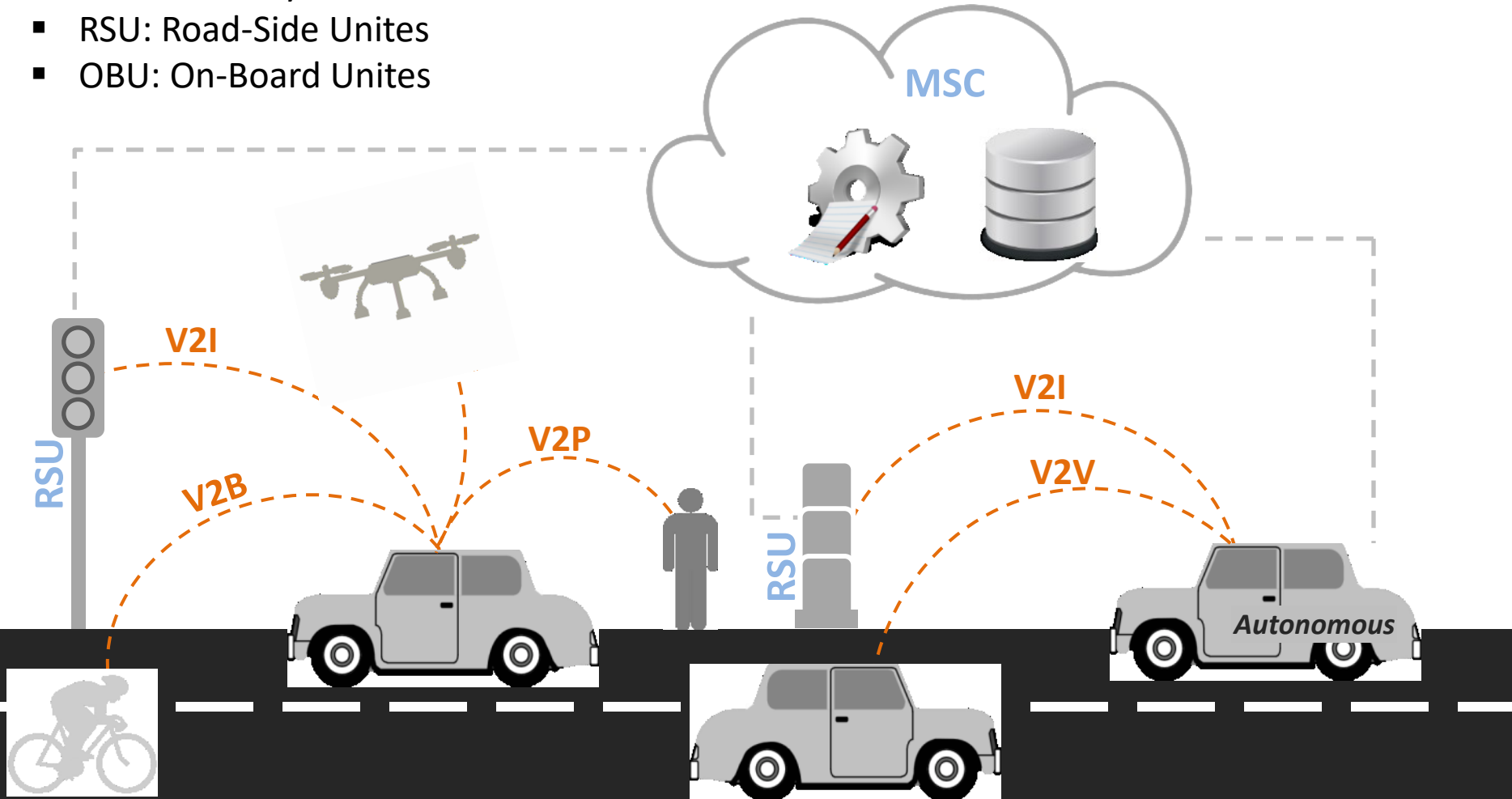
<https://www.youtube.com/watch?v=jmxxL9Gzo-M>

Hamidullah Binol, Eyuphan Bulut, Kemal Akkaya, Ismail Guvenc, "[Time Optimal Multi-UAV Path Planning for Gathering ITS Data from Roadside Units](#)", In Proc of 2018 IEEE 88th Vehicular Technology Conference: VTC2018-Full, 27–30 August 2018, Chicago, USA.

Qatar V2X Pilot - Architecture

The pilot includes:

- MSC: Mobility Services Center
- RSU: Road-Side Unites
- OBU: On-Board Unites





Unmanned Aerial Vehicles (UAVs) Drones for ITS

Flaying V2X Road-Side Unit



Video link:

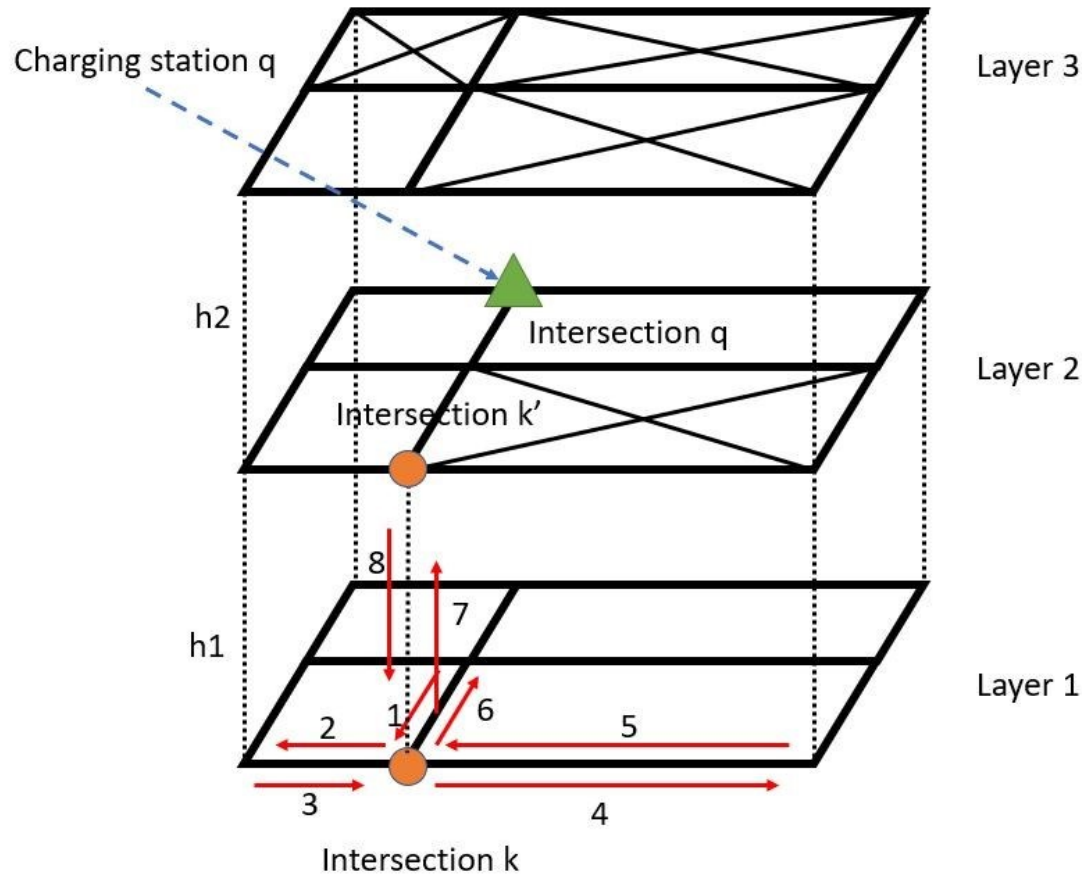
https://www.youtube.com/watch?v=eJ_JUjmgLOQ

Nico Saputro, Kemal Akkaya, Ramazan Algin, and Selcuk Uluagac, “[Drone-assisted Multi-purpose Roadside Units for Intelligent Transportation Systems](#)”, In Proc of 2018 IEEE 88th Vehicular Technology Conference: VTC2018-Full, 27–30 August 2018, Chicago, USA.

3D Space Navigation

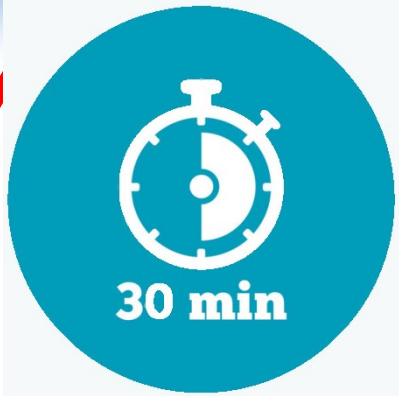


3D Space Navigation



Xiangpeng Wan, Hakim Ghazzai, Yehia Massoud, Hamid Menouar, “**Optimal Collision-free Navigation for Multi-Rotor UAV Swarms in Urban Areas**”, In Proc of 2019 IEEE 89th Vehicular Technology Conference: VTC2019-Spring, 28 April – 1 May 2019, Kuala Lumpur, Malaysia.

UAVs Applications ... A Reality!



**Limited Flight
Lifetime!**

An Example



16 km max

What if we let the UAV ride the bus?



Nouredine Lasla, Hakim Ghazzai, Hamid Menouar, Yehia Massoud, “**Exploiting Land Transport to Improve the UAV’s Performances for Longer Mission Coverage in Smart Cities**”, In Proc of 2019 IEEE 89th Vehicular Technology Conference: VTC2019-Spring, 28 April – 1 May 2019, Kuala Lumpur, Malaysia.

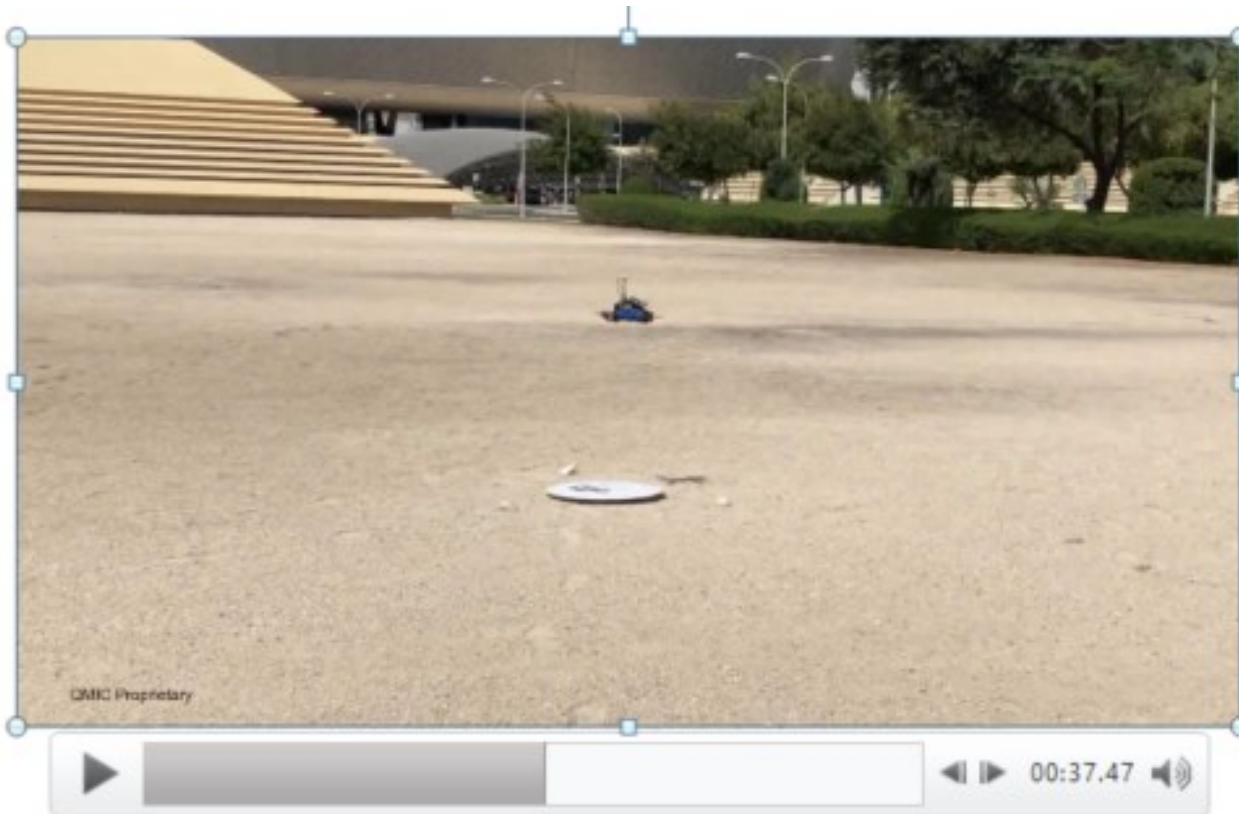
Exploiting the Existing Land Transport!



Others already doing it...

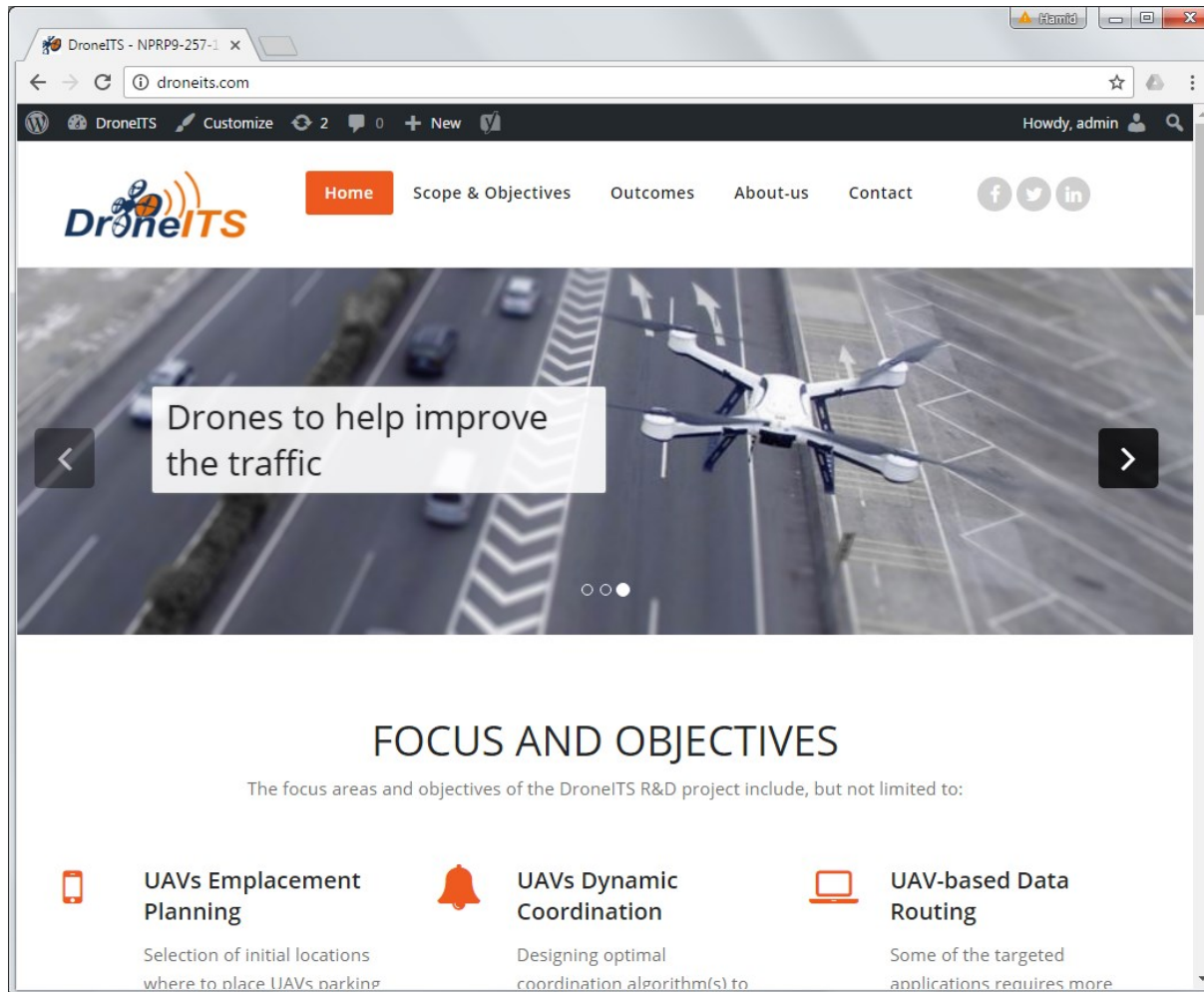


Automated Landing



Video link:

<https://www.youtube.com/watch?v=iUO39s-Zj08>



An aerial photograph of a multi-lane highway with several cars driving. A white quadcopter drone is flying in the upper right portion of the frame, positioned over the road. The drone has four propellers and a central body. The road below has white lane markings and arrows pointing forward.

Thank You!

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