Interreg Central Baltic

Course: ITS solutions for traffic and safety management

Intel Trans

Topic 2. ITS Technologies

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ITS technologies

Intelligent Transport Systems include a wide range of user support functions, ranging from simple information alerts on a mobile phone through to highly sophisticated traffic control systems. To achieve its functions, ITS utilises a wide range of enabling technologies.

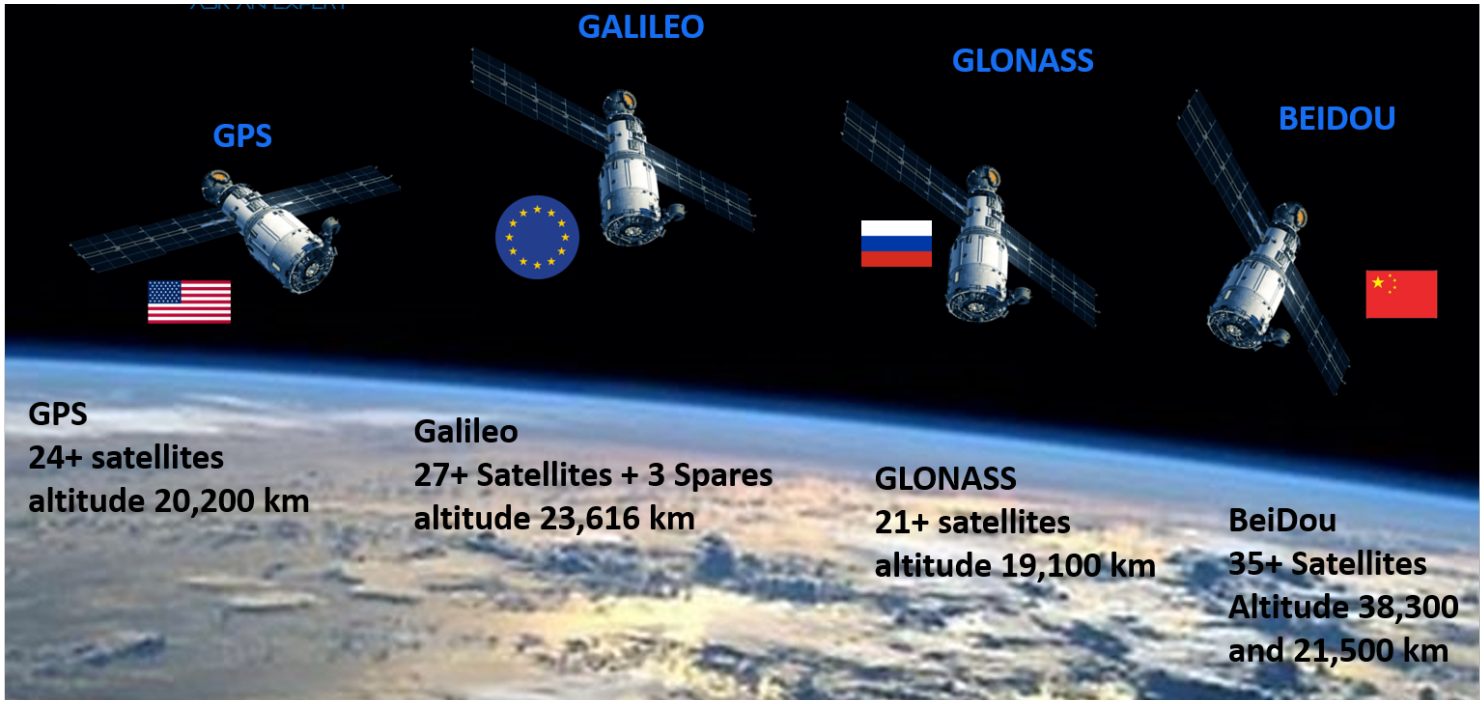
These include:

- data processing, management and archiving technologies;
- detection technologies;
- telecommunication technologies;
- information dissemination technologies;
- location referencing and positioning technologies;
- microwave, infrared, ultrasonic, and acoustic technologies;
- electronic technologies;
- video Image processing;
- surveillance and enforcement technologies and others.

ITS Technologies

ITS Enabling Technologies	Infrastructure Side	Vehicle Side
Location Referencing	• Digital maps • Geographical Information systems • Transport network databases	• Mobile phone location • Global Navigation Satellite Systems • Automatic Vehicle Location
Data Acquisition	• Traffic detectors • Weather monitoring • Automatic Incident Detection	• Automatic Vehicle Identification • Vehicle probes
Data Processing	• Data dictionaries • Data fusion • Data exchange	• On-board computers • Digital map matching
Communications	• Fixed microwave links • Optical fibre networks • Beacons (DSRC) • Cellphone networks	• DAB receiver • Cellphone receivers • Highway Advisory Radio, RDS-TMC receivers • Transponders
Information Distribution	• Dynamic Message Signs • Internet • Kiosks	• Handsets and Personal Digital Assistants • In-vehicle units
Information Utilisation	• Incident detection • Demand management • Congestion monitoring	• Route guidance • Advanced Driver Assistance Systems

GNSS Technologies

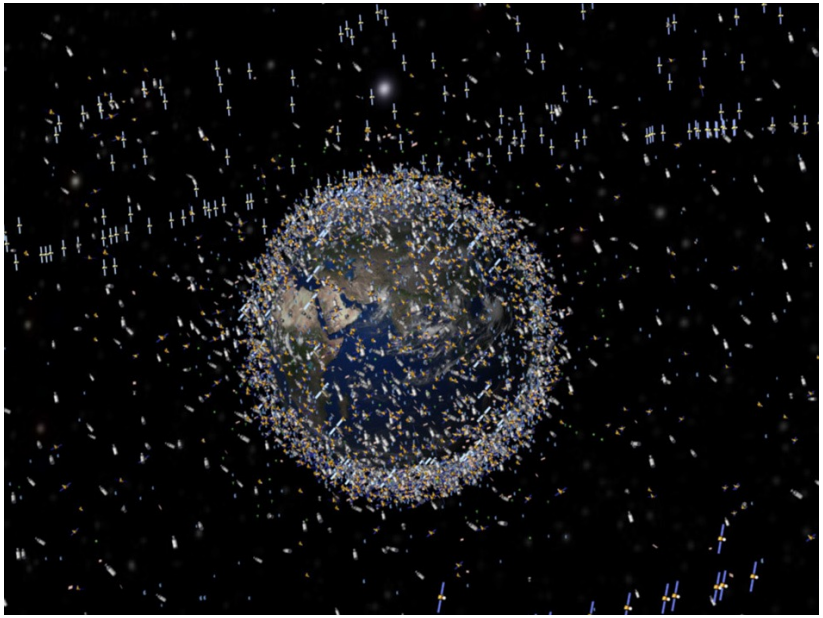


A Global Navigation Satellite System (GNSS) is a group of synchronized satellites working in concert (collectively called constellations) used for Position Navigation and Time (PNT) solutions on a global basis. It consists of many global constellations of satellites transmitting radio signals used for PNT solutions. The main constellations are Global Positioning System (GPS) (USA) - Glonass (Russia) - Galileo (EU) and BeiDou (China).

GNSS Technologies

GNSS is an umbrella term that includes any satellite navigation system. Options include:

- GPS (U.S. | operational since 1994)
- GLONASS (Russian | operational since 1994)
- Galileo (European Union | anticipated operation:2019)
- BeiDou (China | Operational in Asia/Pacific since 2012 / anticipated global operation: 2020)



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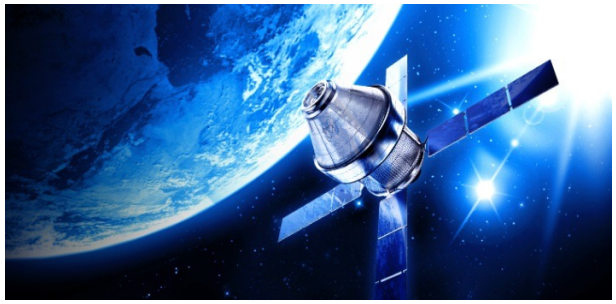
GNSS Technologies

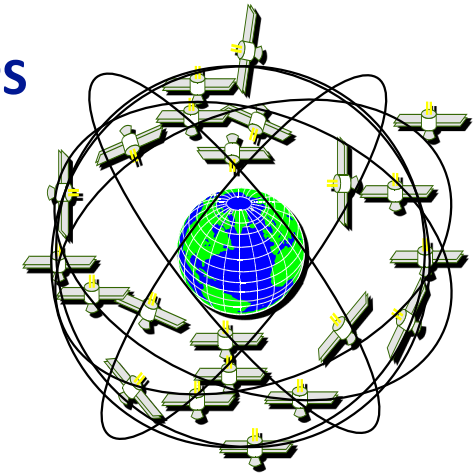
There are three major components in this system:

1. **Satellites**
2. **Ground Control Stations**
3. **GNSS Receivers (or units)**



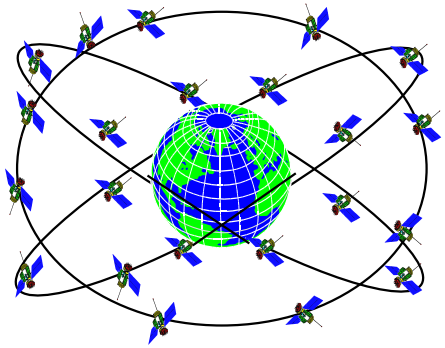
GNSS Technologies

GPS



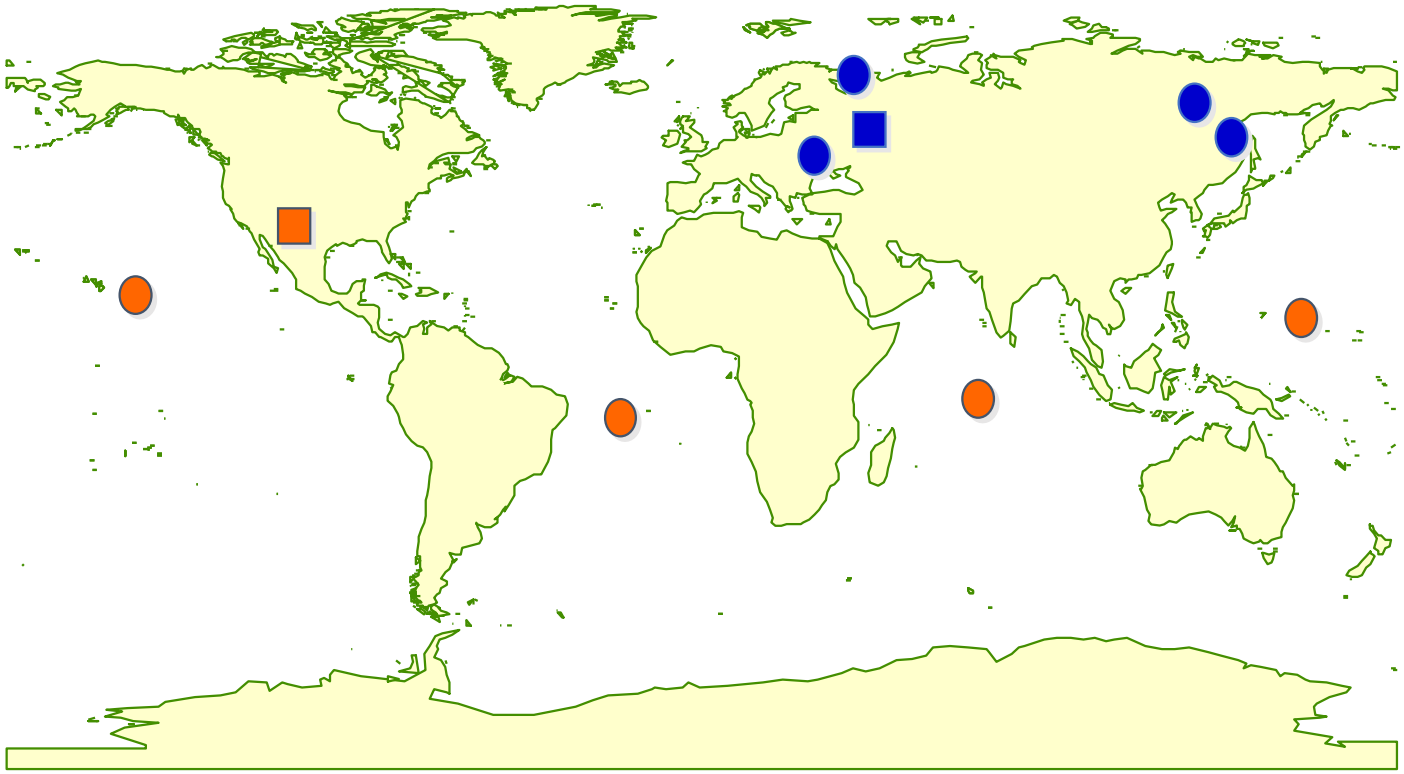
- Code Division Multiple Access
- 21 + 3 Satellites
- 6 Orbital planes
- 55° Inclination
- 20200 km Altitude
- 12 Hour orbits
- 5 Hour satellite visibility

GLONASS

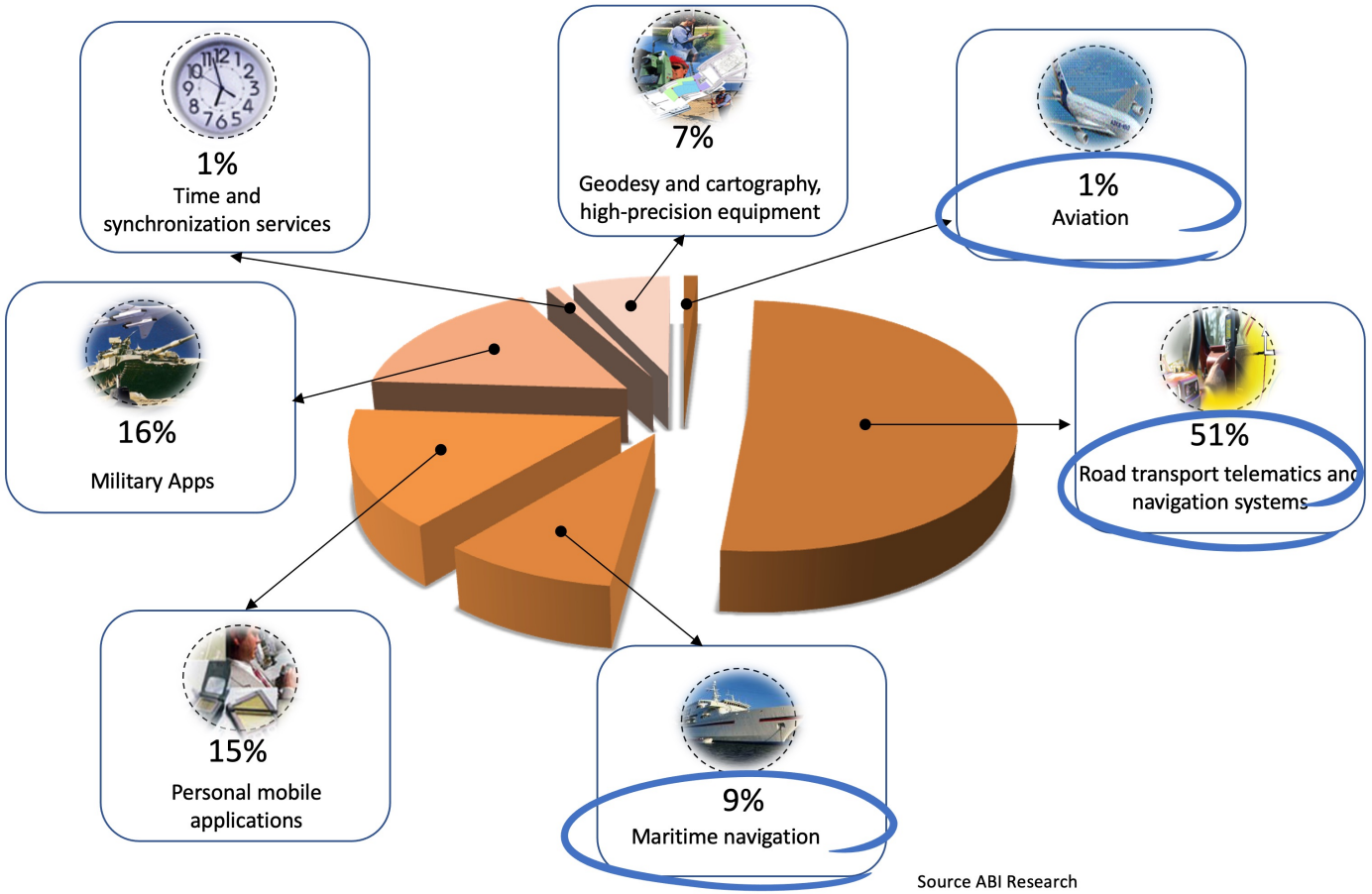


- Frequency Division Multiple Access
- 24 Satellites
- 3 Orbital planes
- 64.9° Inclination
- 19100 km Altitude
- 11 h 16 m Orbit
- Planes separated from each other by 120°

GNSS Technologies



Segmentation of the GNSS global navigation market



Source ABI Research

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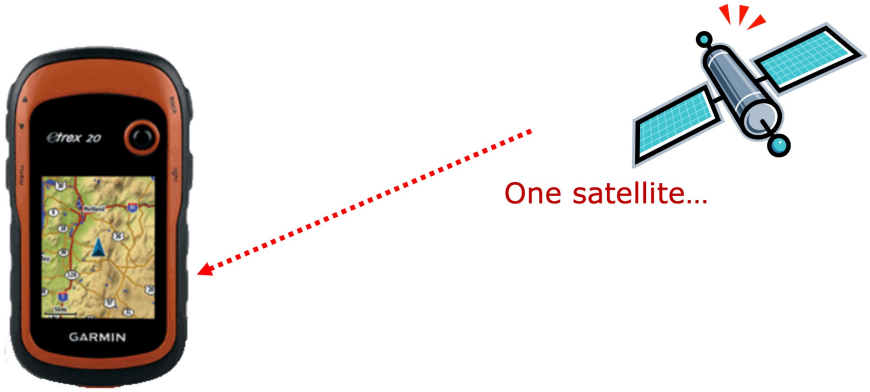
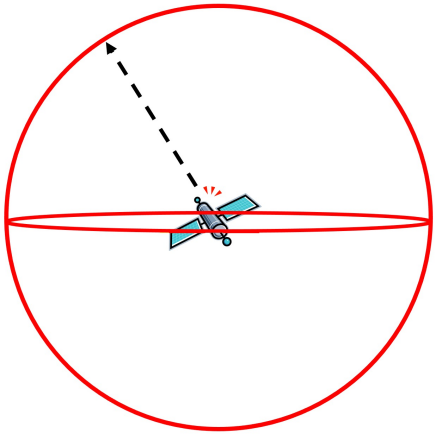
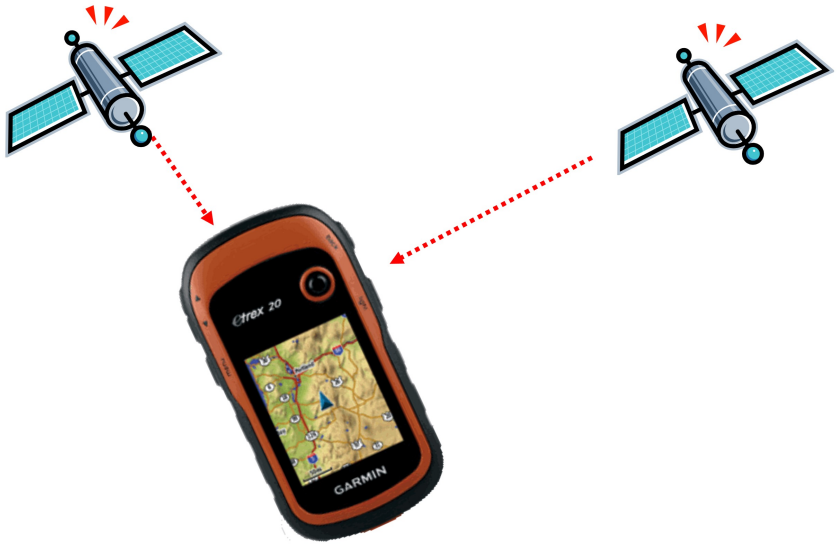
How GNSS Works



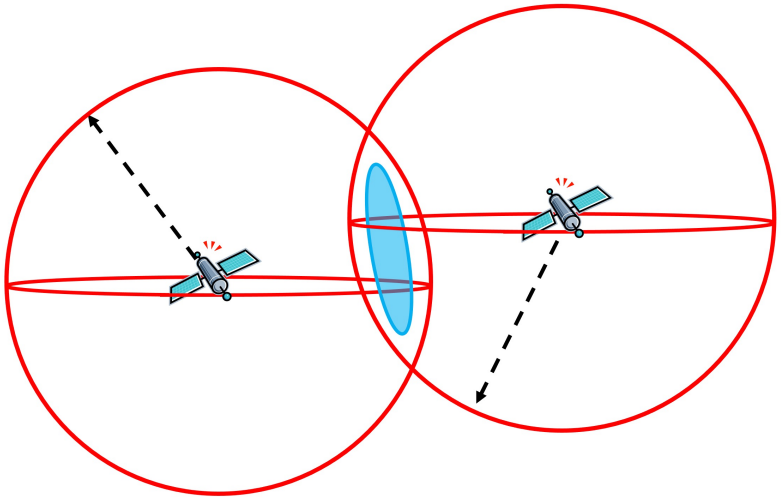
If the GPS receiver only obtains signals from 1 Satellite, then it "knows" that it is located somewhere on this sphere…



How GNSS Works

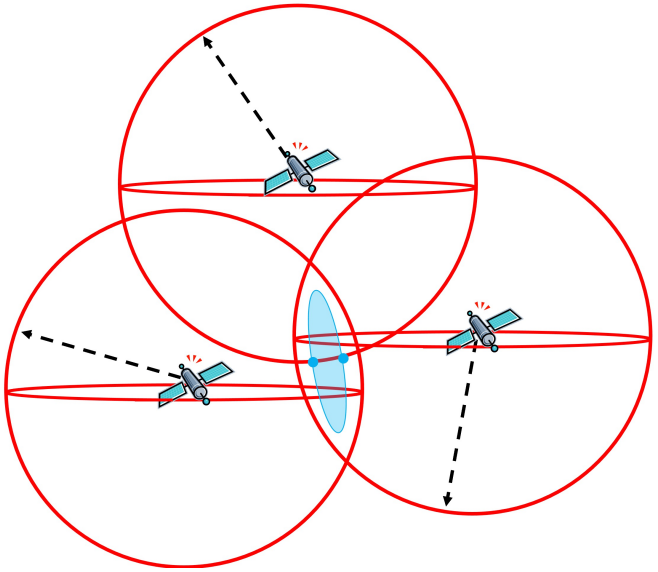


If the GPS receiver only obtains signals from 2 satellites, then it “knows” that it is located somewhere where these 2 spheres intersect

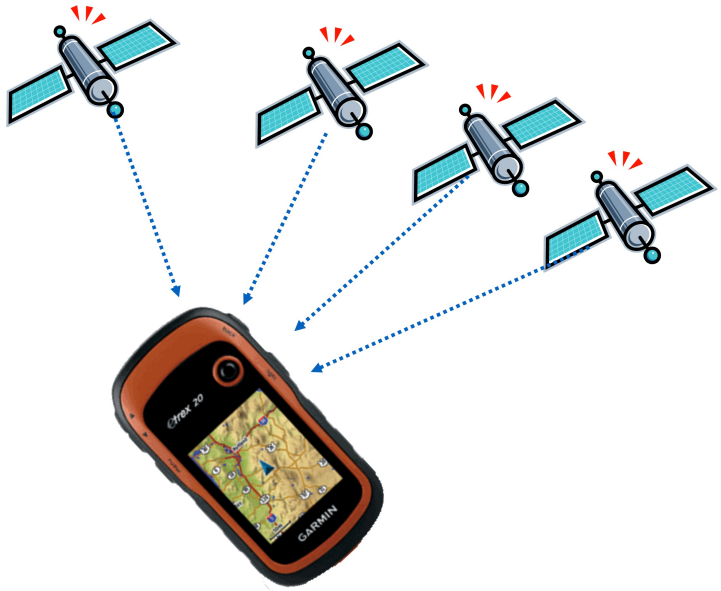


How GNSS Works

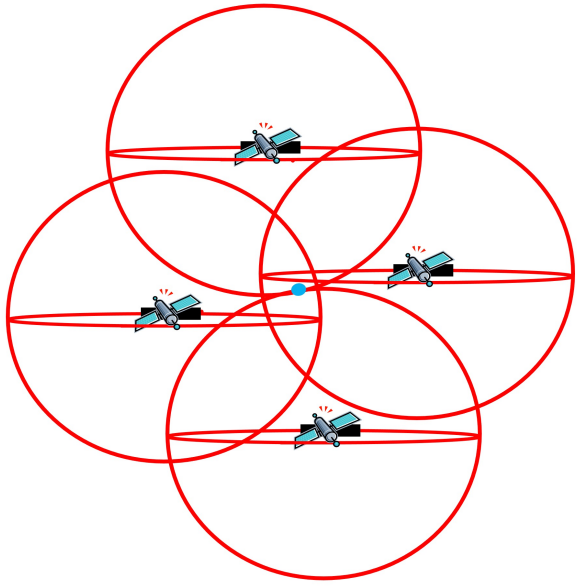
If the GPS receiver obtains signals from 3 satellites, then it “knows” that it is located somewhere where these 3 spheres intersect (2 points)



How GNSS Works



A fourth satellite is required to determine the exact location and elevation.



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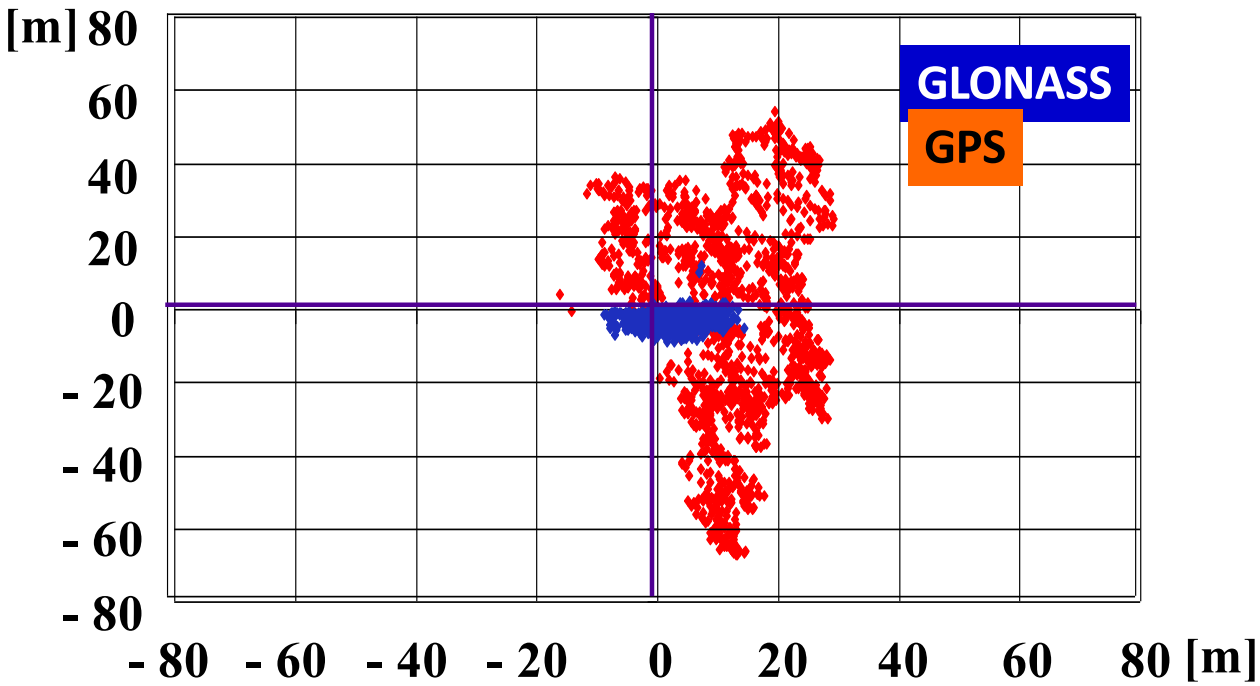
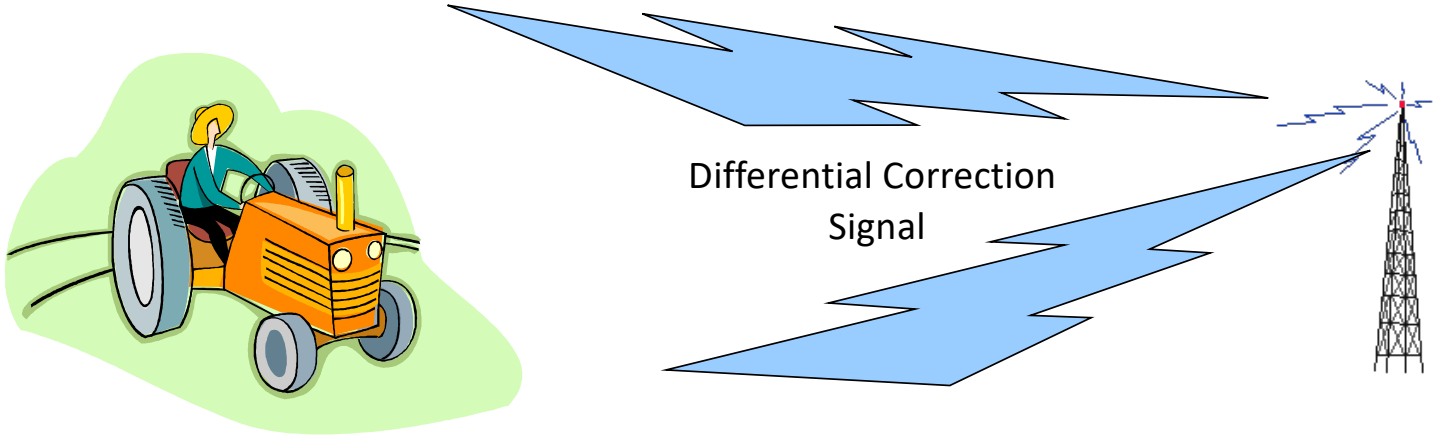
Comparative Accuracy ща GPS and GLONASS



GNSS Differential Correction

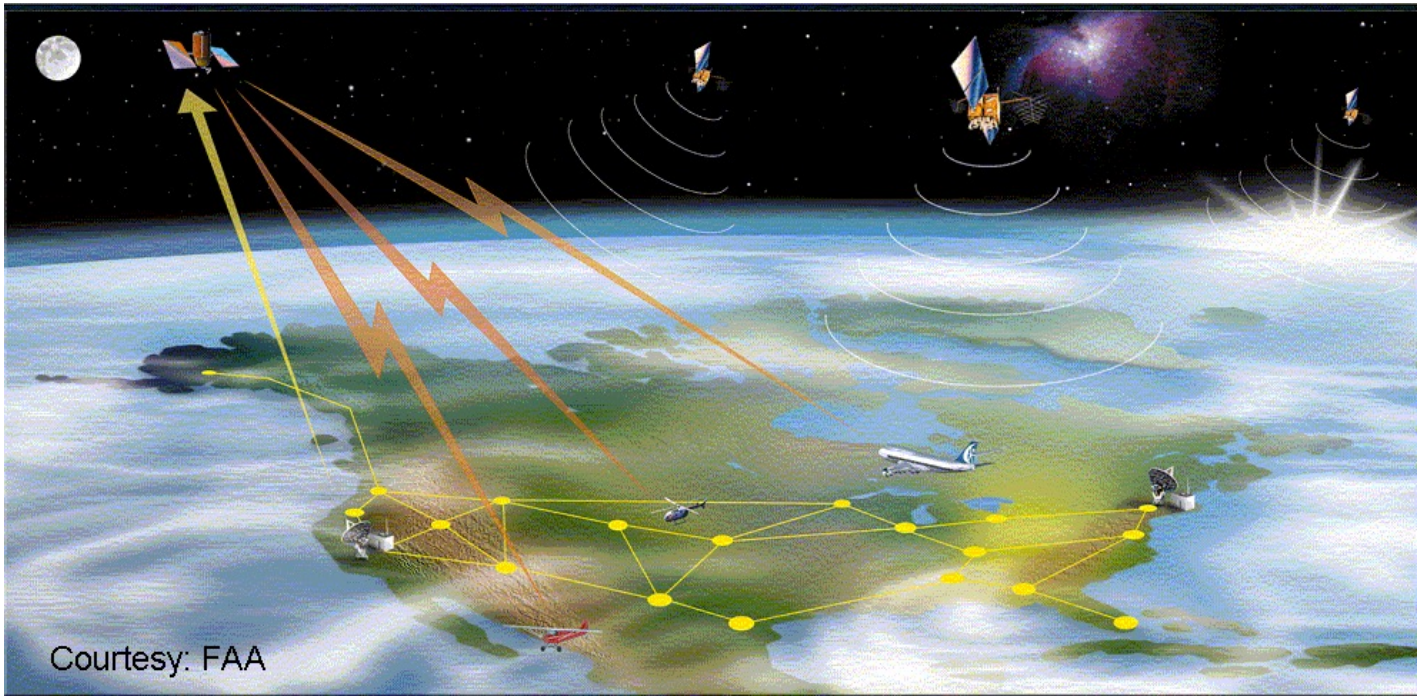
Base station w/ GNSS receiver at known location:



GNSS receiver in the field collecting points, routes, etc.

Exact known (surveyed) coordinates differ from GNSS coordinates at this location = exact amount of error!

GNSS Differential Correction



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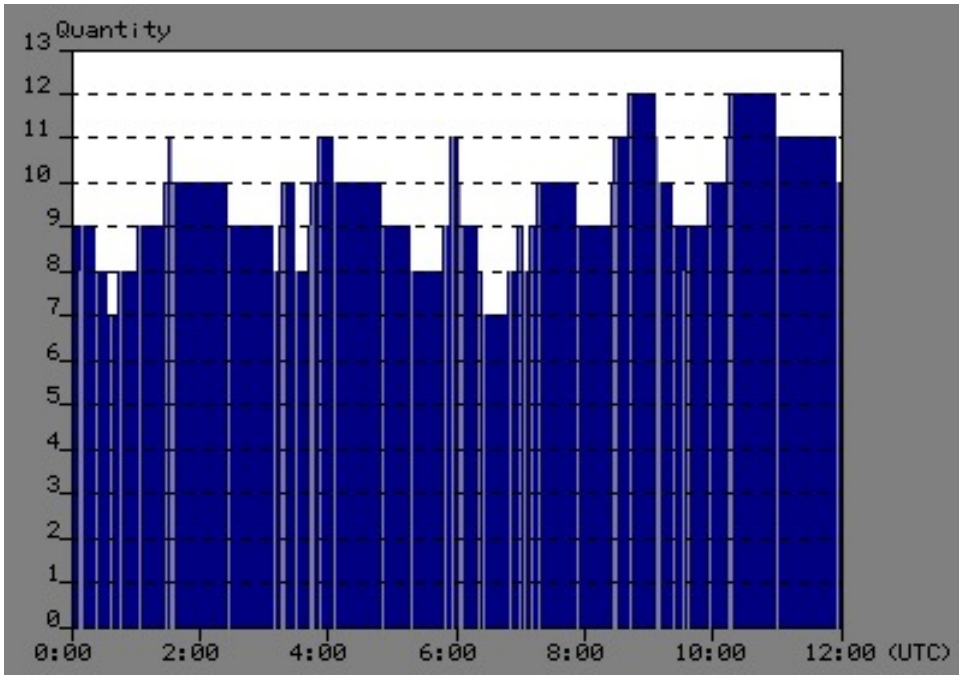
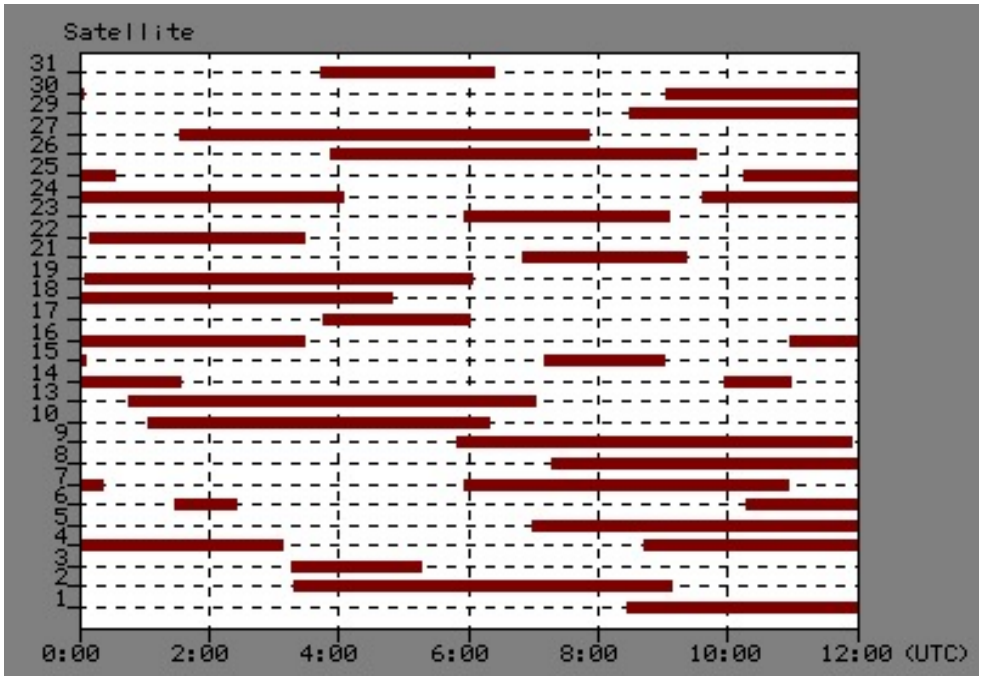
Satellites in View (in Riga)



Satellite Visibility (in Riga)



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Satellite monitoring of transport

Satellite monitoring of transport is a system for monitoring mobile objects built on the basis of satellite navigation systems, equipment and technologies of cellular and / or radio communications, computer technology and digital maps.

Satellite monitoring of transport is used to solve the problems of transport logistics in transportation management systems and automated fleet management systems.

GPS Tracking System

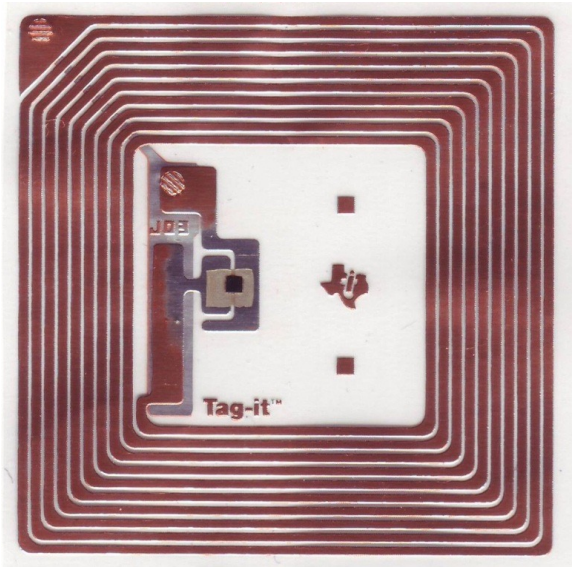
GPS tracking system is well known for tracking the object or person in real-time. But nowadays, it not only tracks but also manages and assures the safety of the object.
The main aim of this system is to make logistics and consignment tracking easier and productive at the same time.

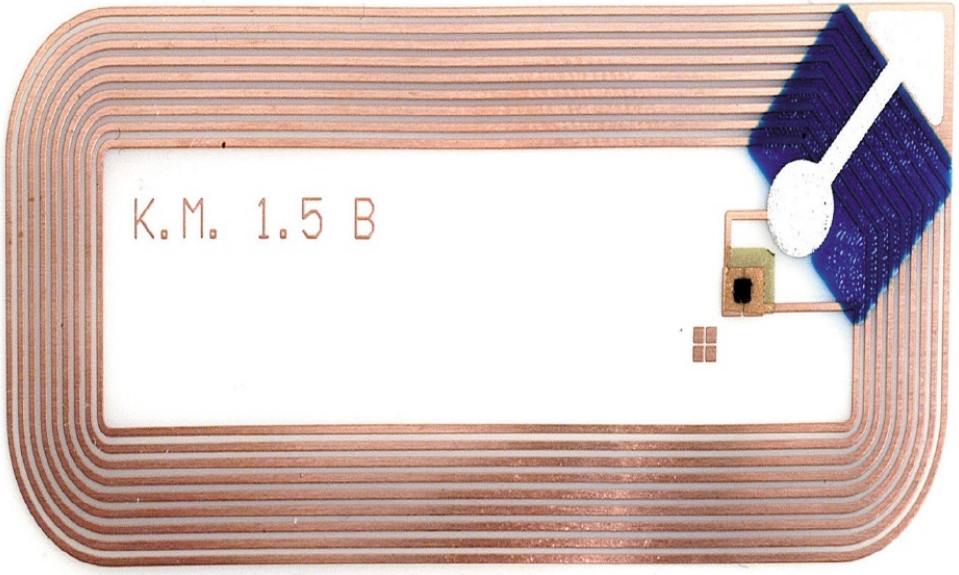
The highlighting features of this are:

- Real-time tracking
- Fuel Monitoring
- Temperature Monitoring
- Fleet maintenance Reminder
- Trip Analysis
- Driving behavior monitoring
- Expense Management
- Tire management
- SOS alert
- Transporter Analysis
- External hardware and device support

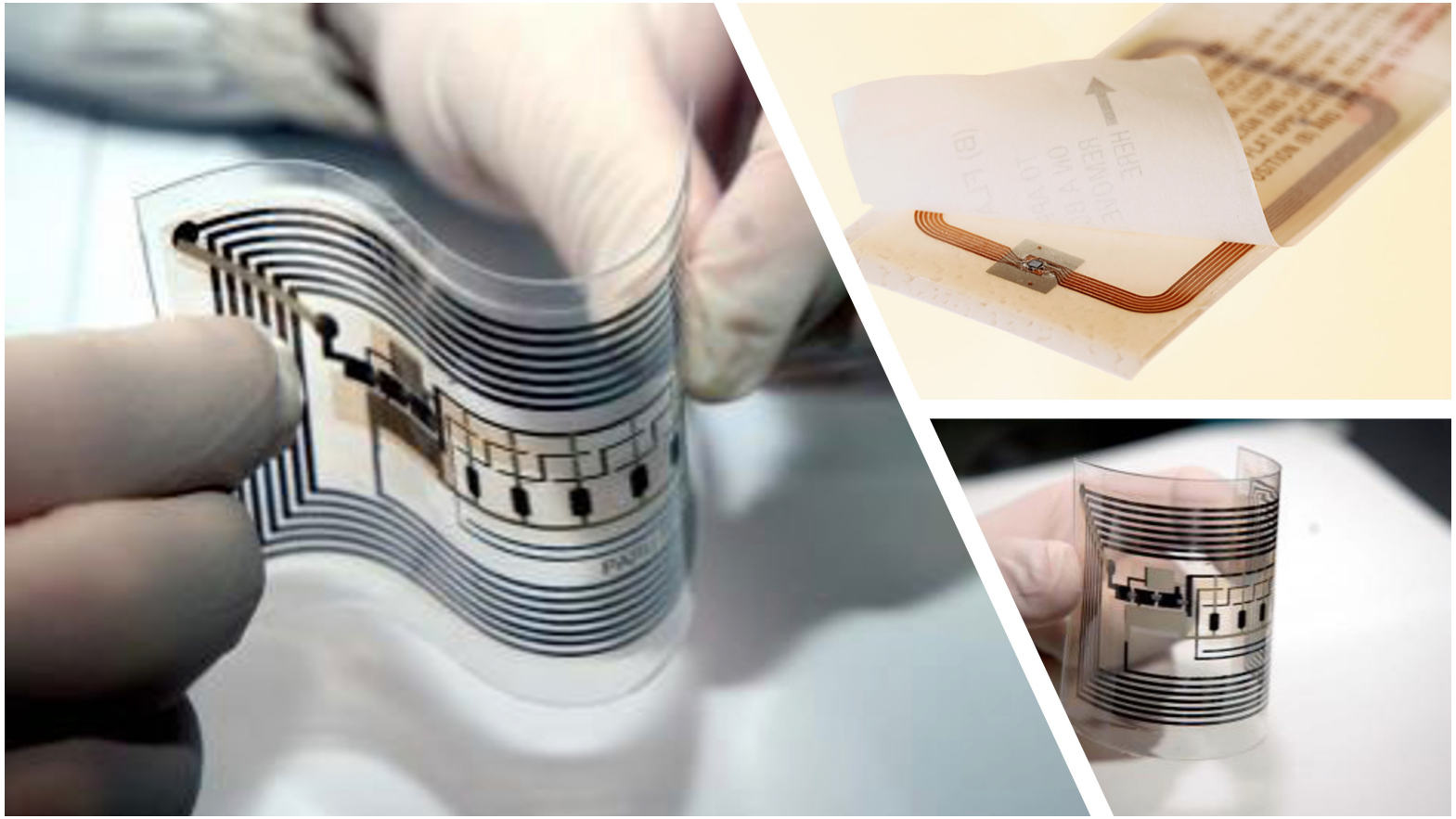
https://www.uffizio.com/resources/blog/post/gps-tracking-system-for-trucks/

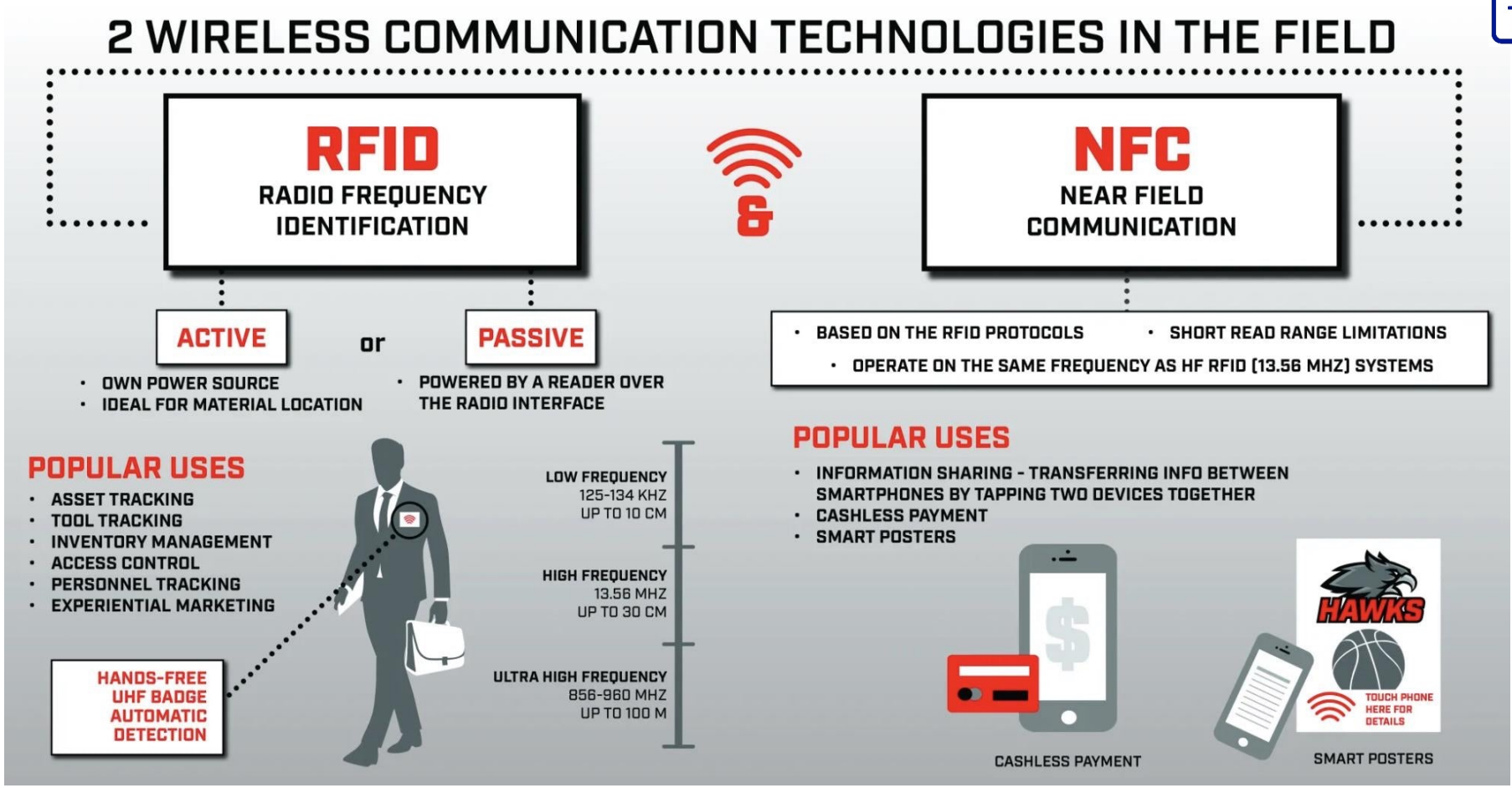
RFID
Radio Frequency Identification



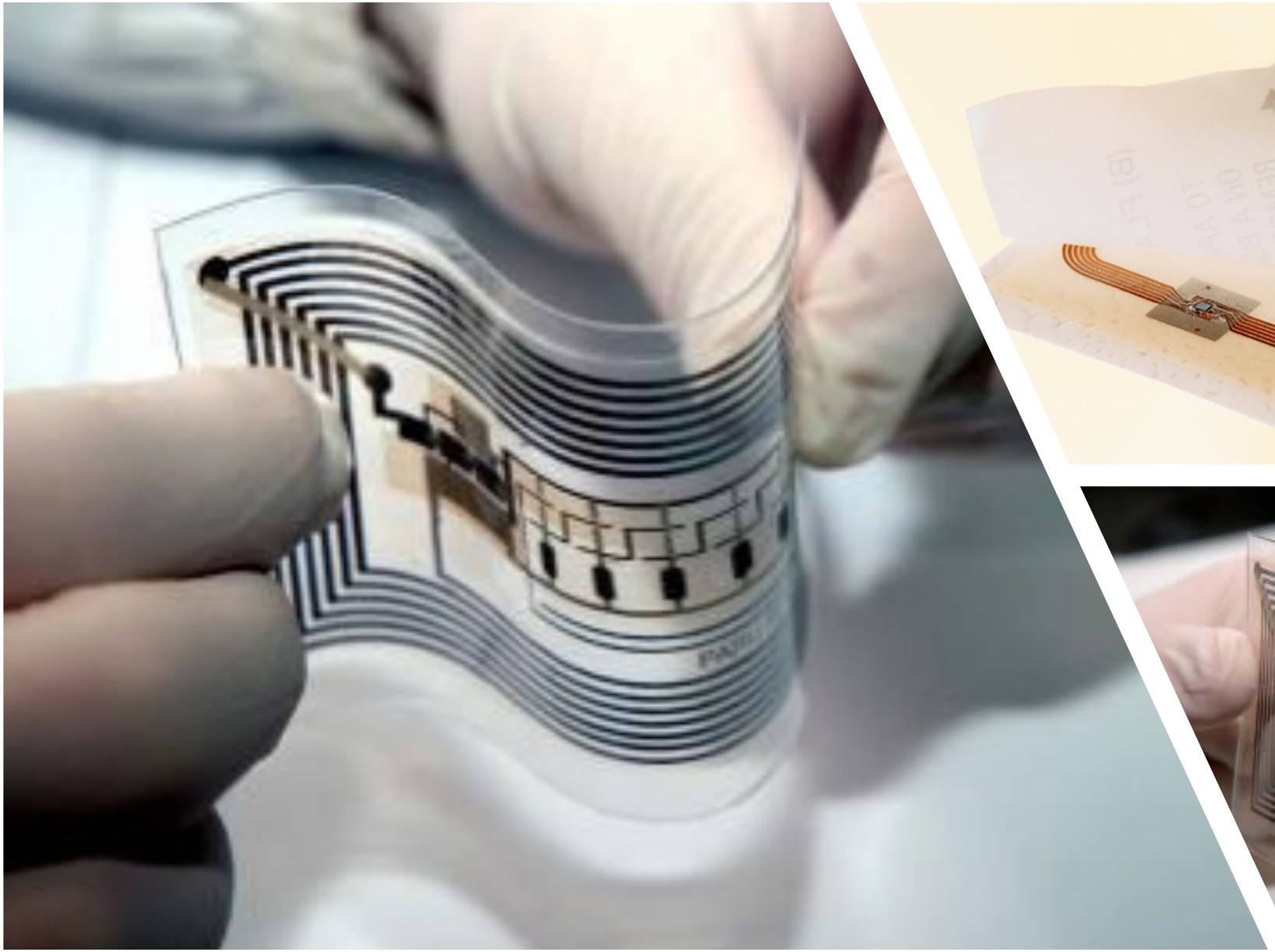


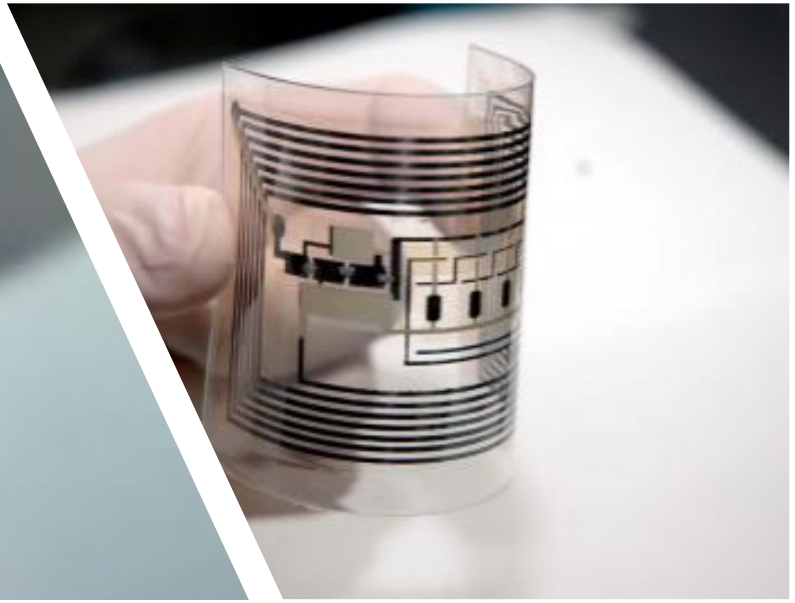
RFID tags





Source: https://www.shopify.ca/retail/rfid-technology





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Active RFID tag tracks:

- Container and Contents
- Location (using bluetooth/ GPS)
- Temperature
- Security

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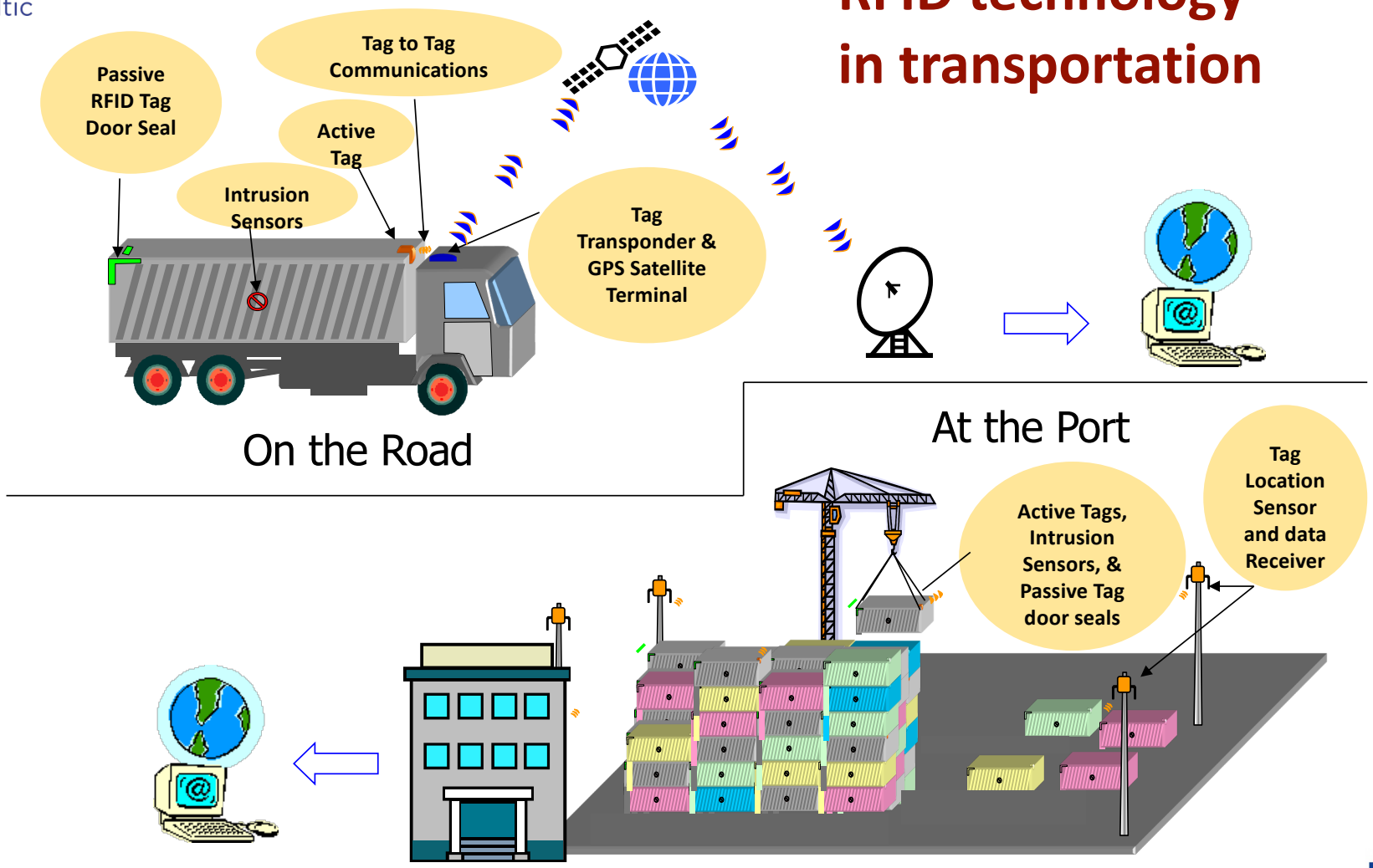
RFID technology in transportation



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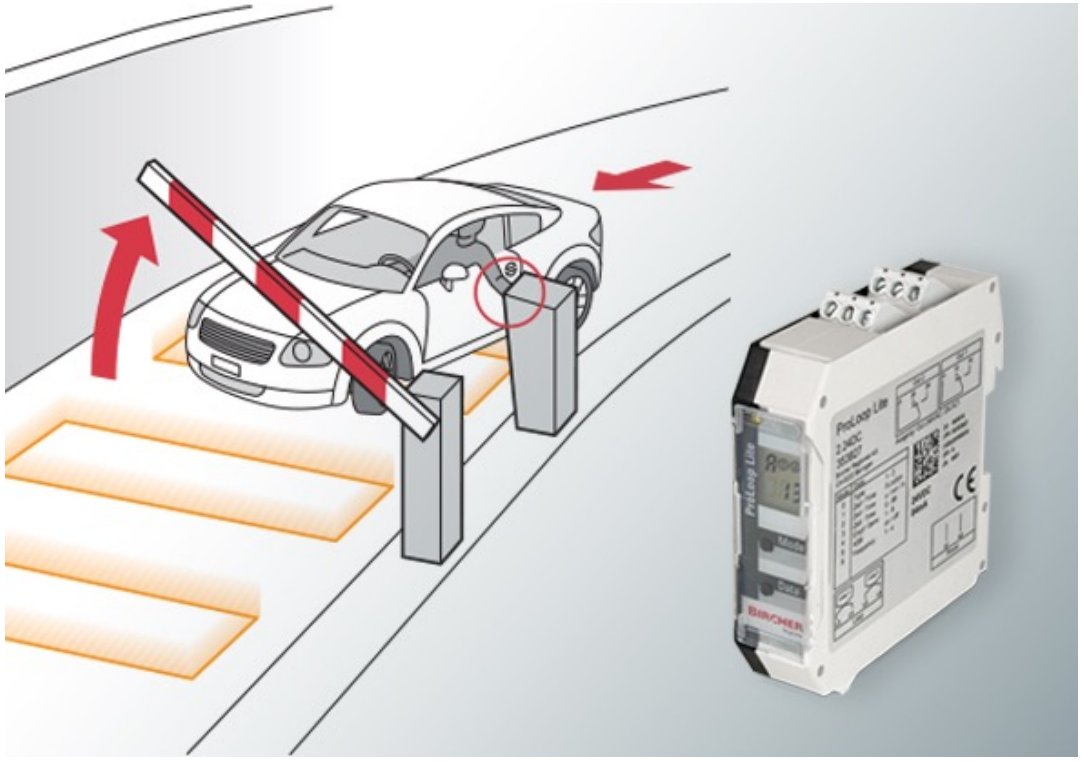
Detection loops and loop detectors

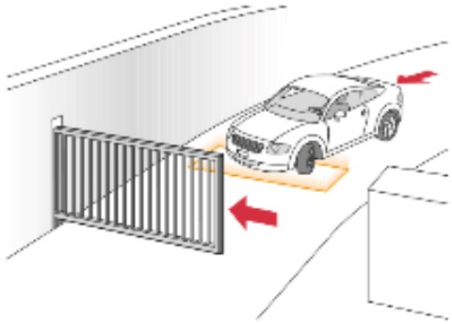
A **detection loop** is an induction loop of copper wire that is located in the surface of the road. By connecting the detection loop to a loop detector, a magnetic field is created (electric coil). A vehicle disturbs the magnetic field and is recognized. A detector for a detection loop provides the signal with which barriers, industrial gates and fences can be opened.



Applications of loop detectors

Situation

Use at sliding gate

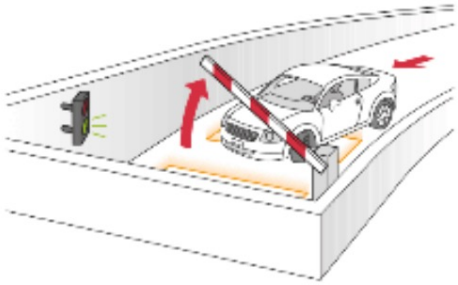


Solution

- Opening and closing site fencing inside and outside

Situation

Use at access barriers

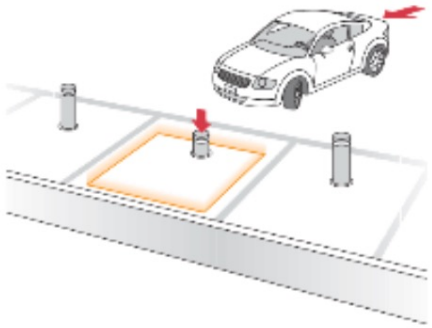


Solution

- Opening and closing access barriers at the entrance and exit of parking zones

Situation

Application at bollards

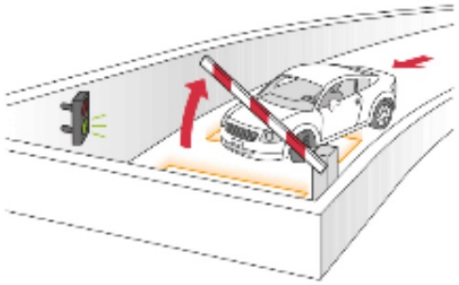


Solution

- Activation of retractable bollards at entrances, parking places, roads and pedestrian zones
- If the bollard is in use, it prevents improper activation

Situation

Access at gates with traffic lights



Solution

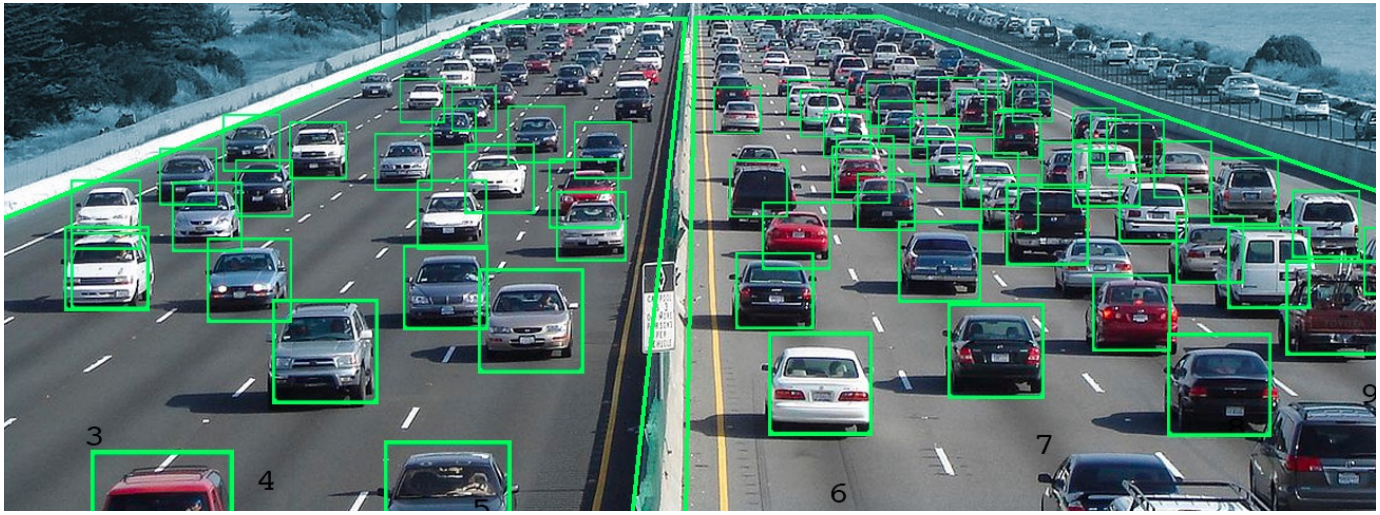
- Operating gates and light signals at confusing entrances and narrow passageways

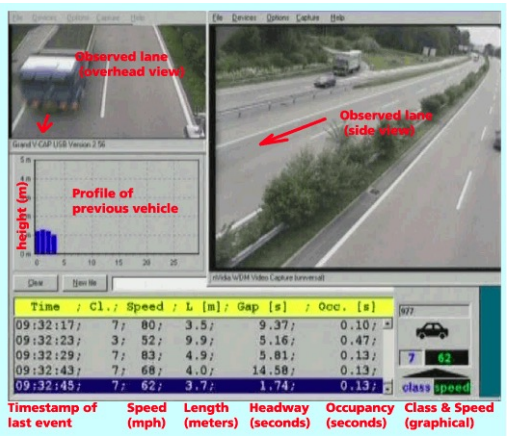
Video detection

TrafficVision software turns any traffic monitoring camera into an intelligent sensor. Specifically built for Intelligent Transportation Systems (ITS), TrafficVision monitors digitally encoded video streams of traffic cameras on highways to immediately detect incidents and continuously collect real-time traffic data.

Using existing camera infrastructure, TrafficVision helps traffic managers make proactive decisions based on immediate incident alerts that are visually verifiable, providing more information about what is happening on highways, bridges and tunnels.

TrafficVision helps organizations get more use out of their ITS investment, leveraging both existing and new video assets. By providing the information needed to reduce the impact of incidents and recurring congestion on highways, TrafficVision helps traffic managers provide safer and more efficient travel for the public.





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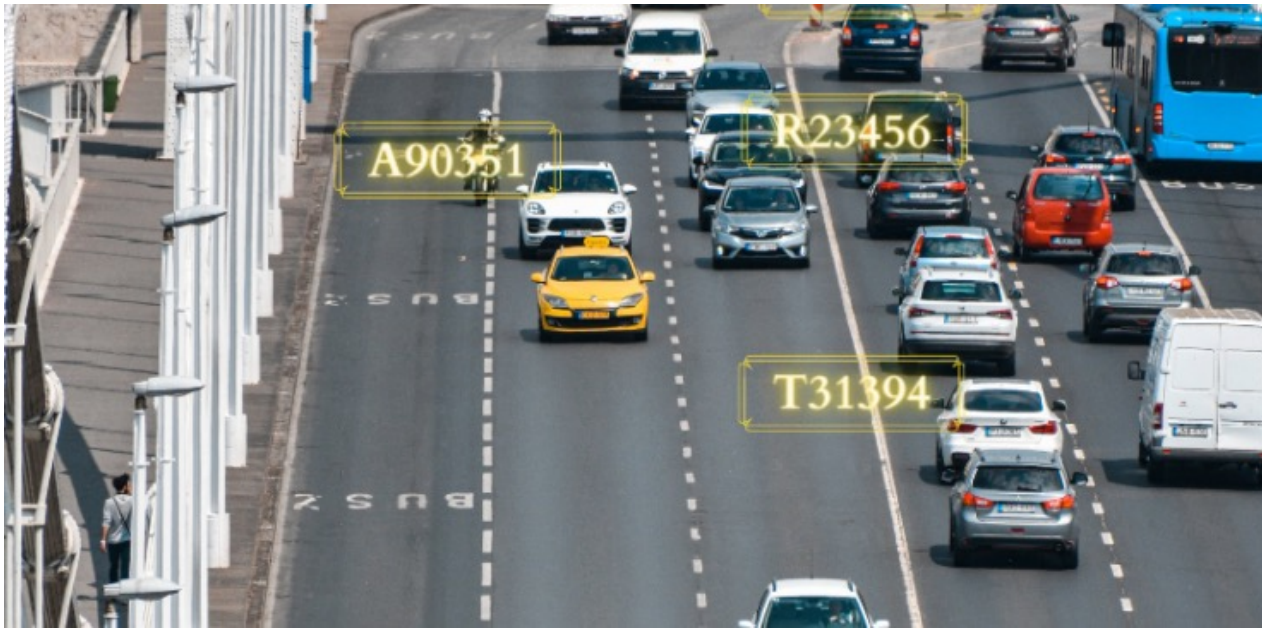
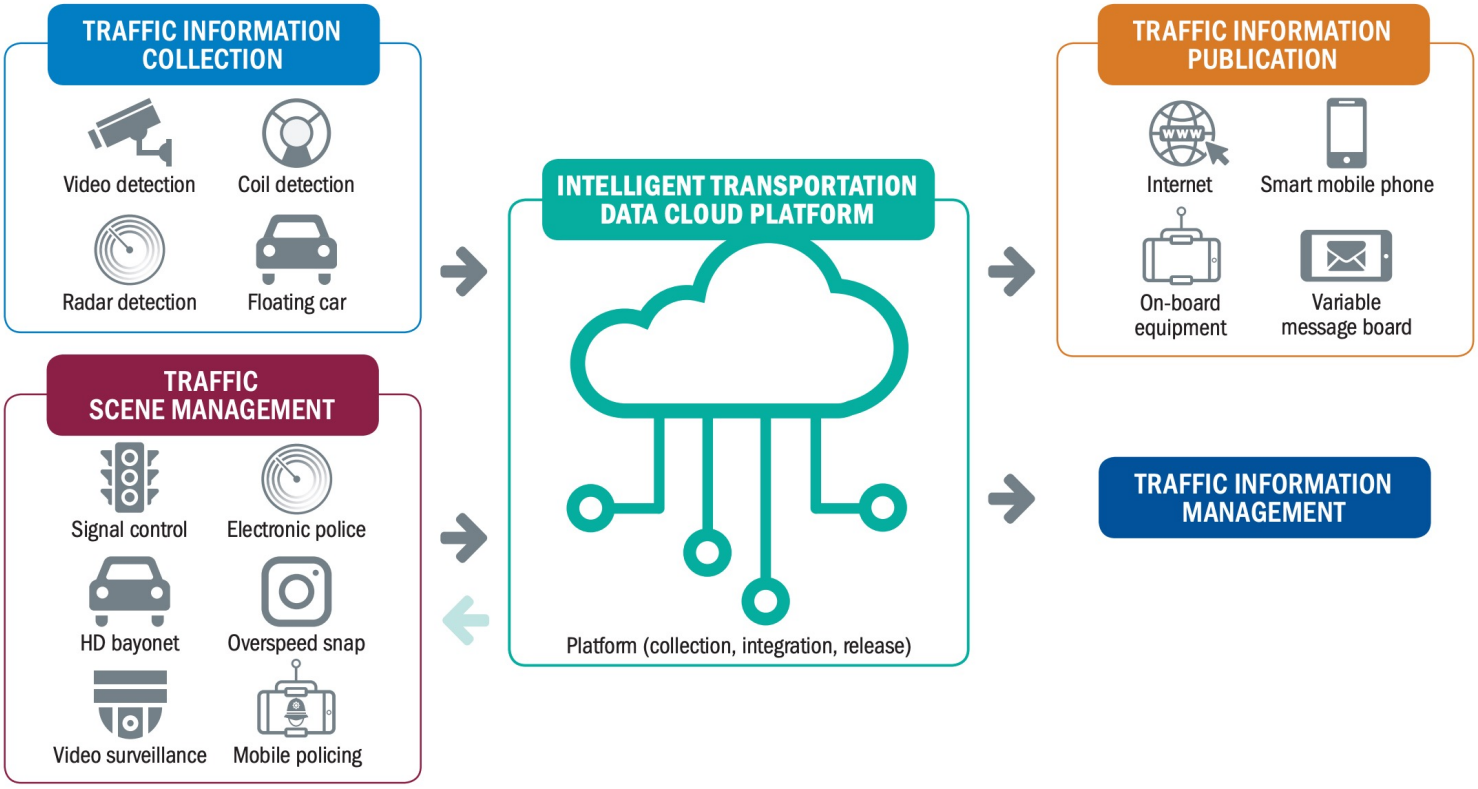
Optical Character Recognition

The number of vehicles is increasing significantly. This increase has invoked the necessity of an automatic surveillance system. The License Plate Recognition and detection is a key technique in most applications related to vehicle movement.

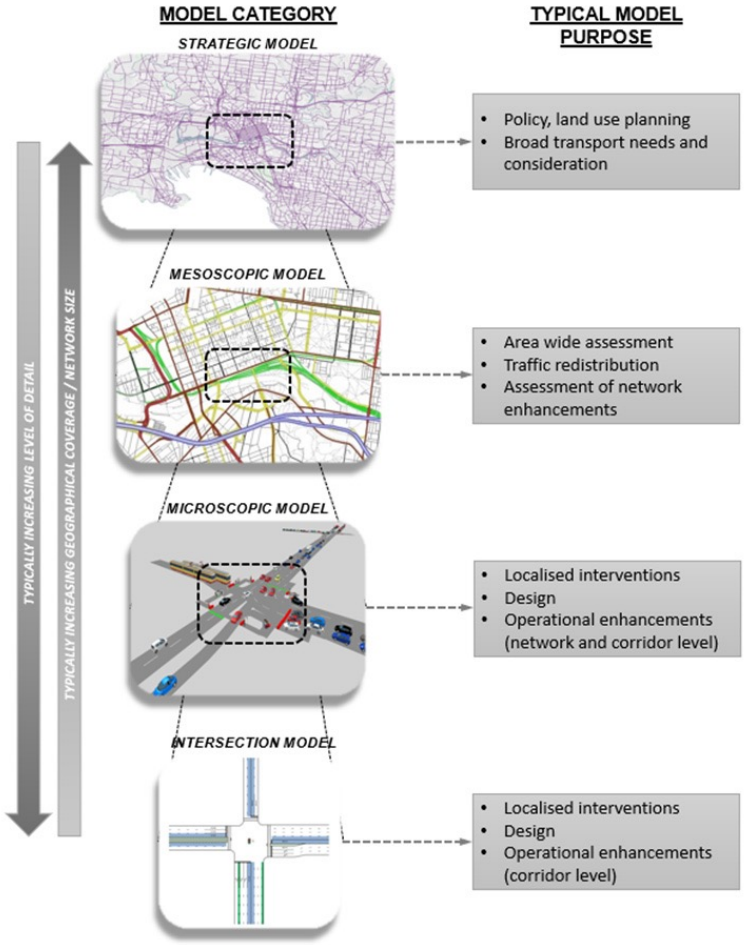


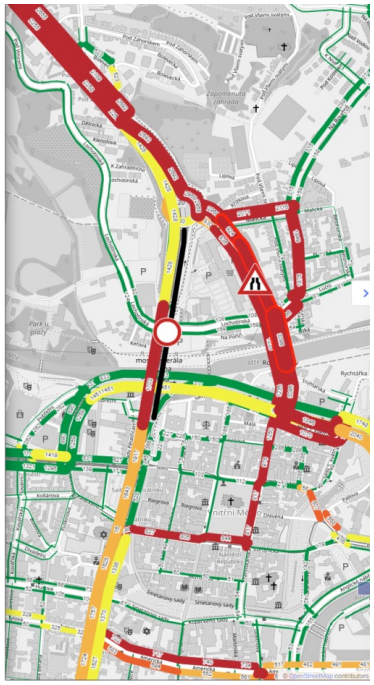
Disruptive technology and innovation in transport

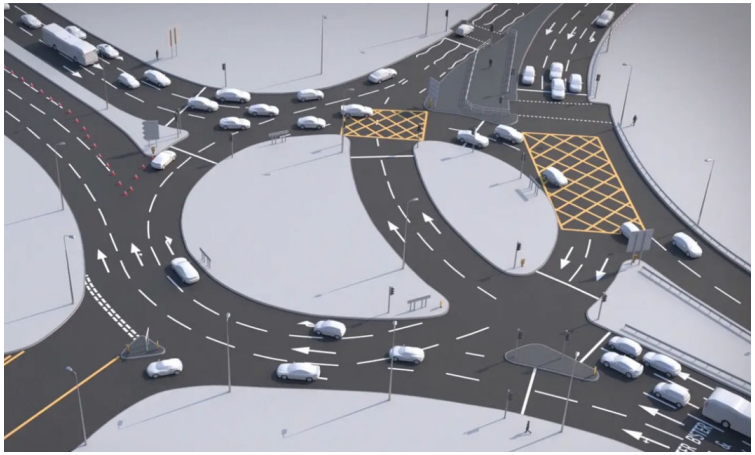


Source: Market analysis (Support study for Impact Assessment of Cooperative Intelligent Transport Systems, European Commission (2016) and Hu et al. (2017)).

Traffic modelling

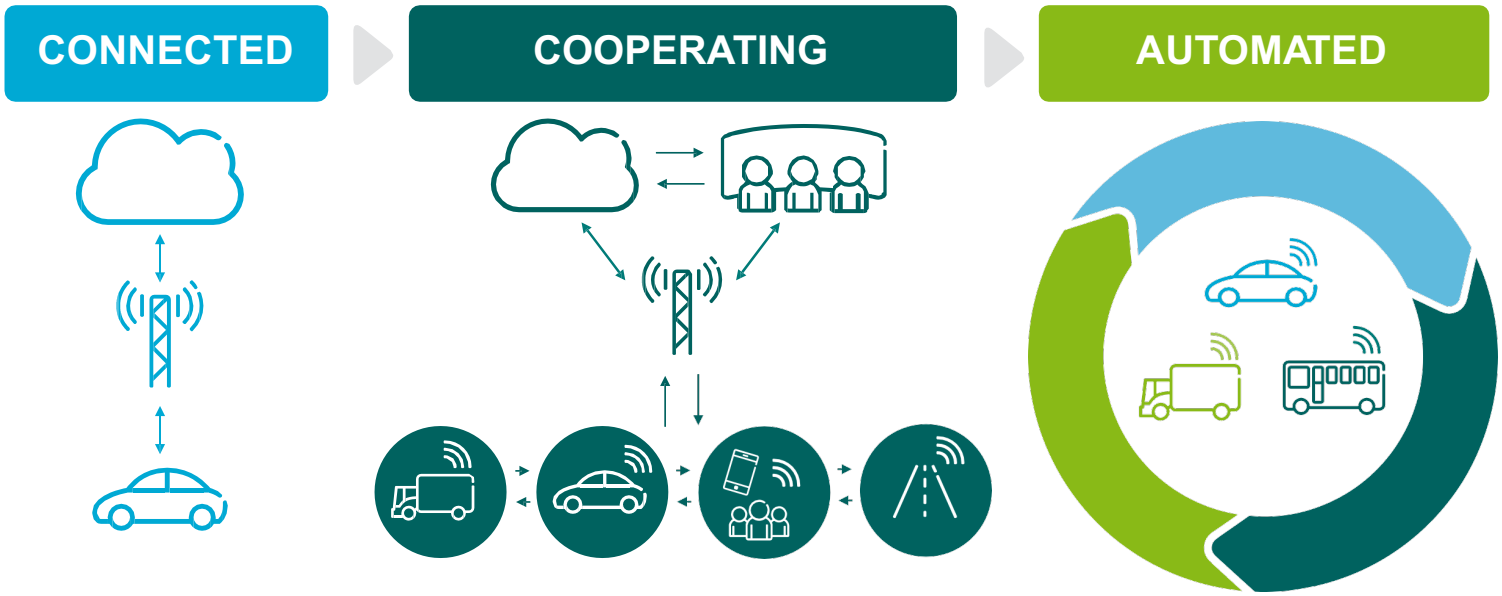






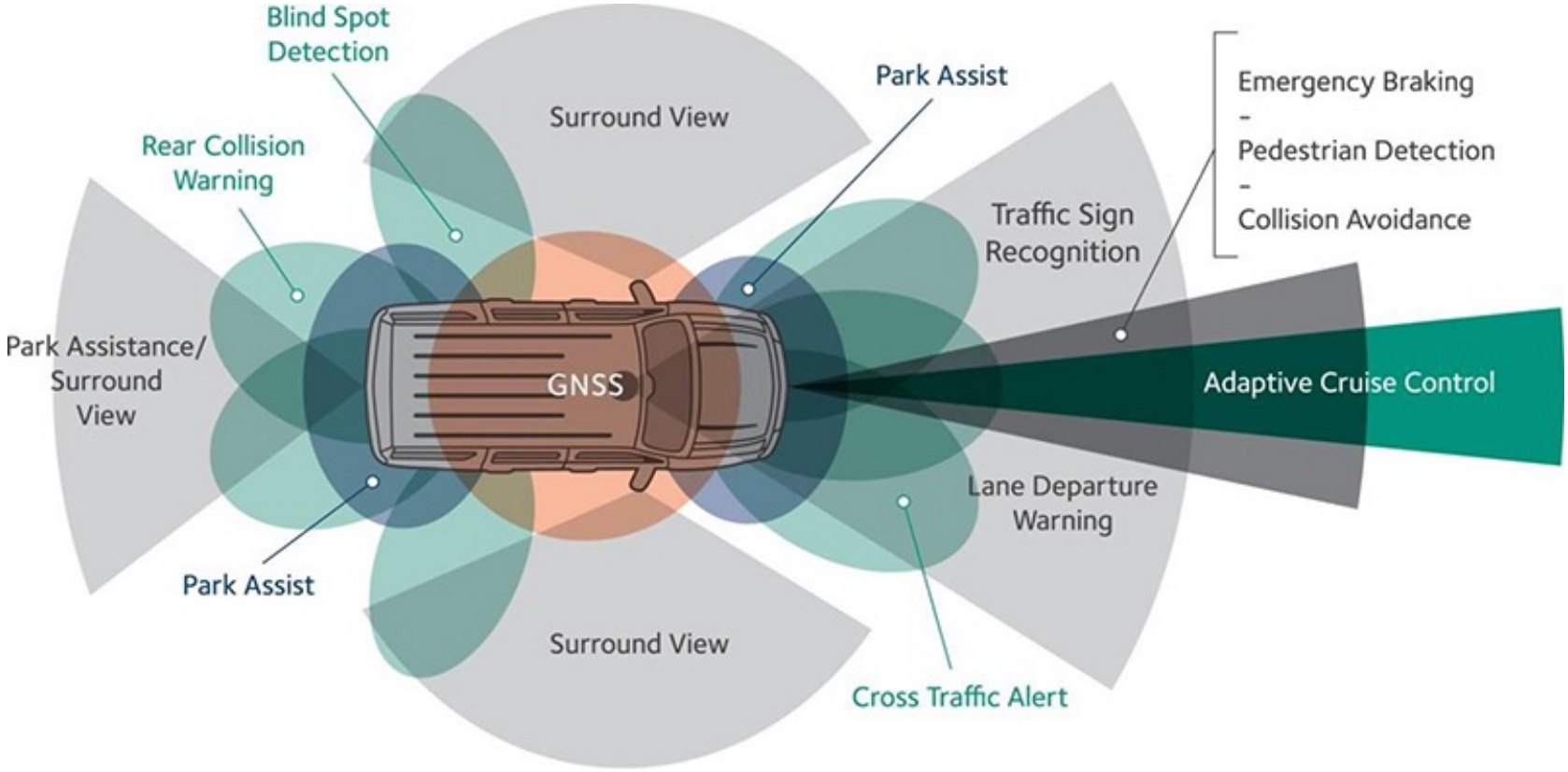
Future trends of ITS

TOMORROW STARTS NOW

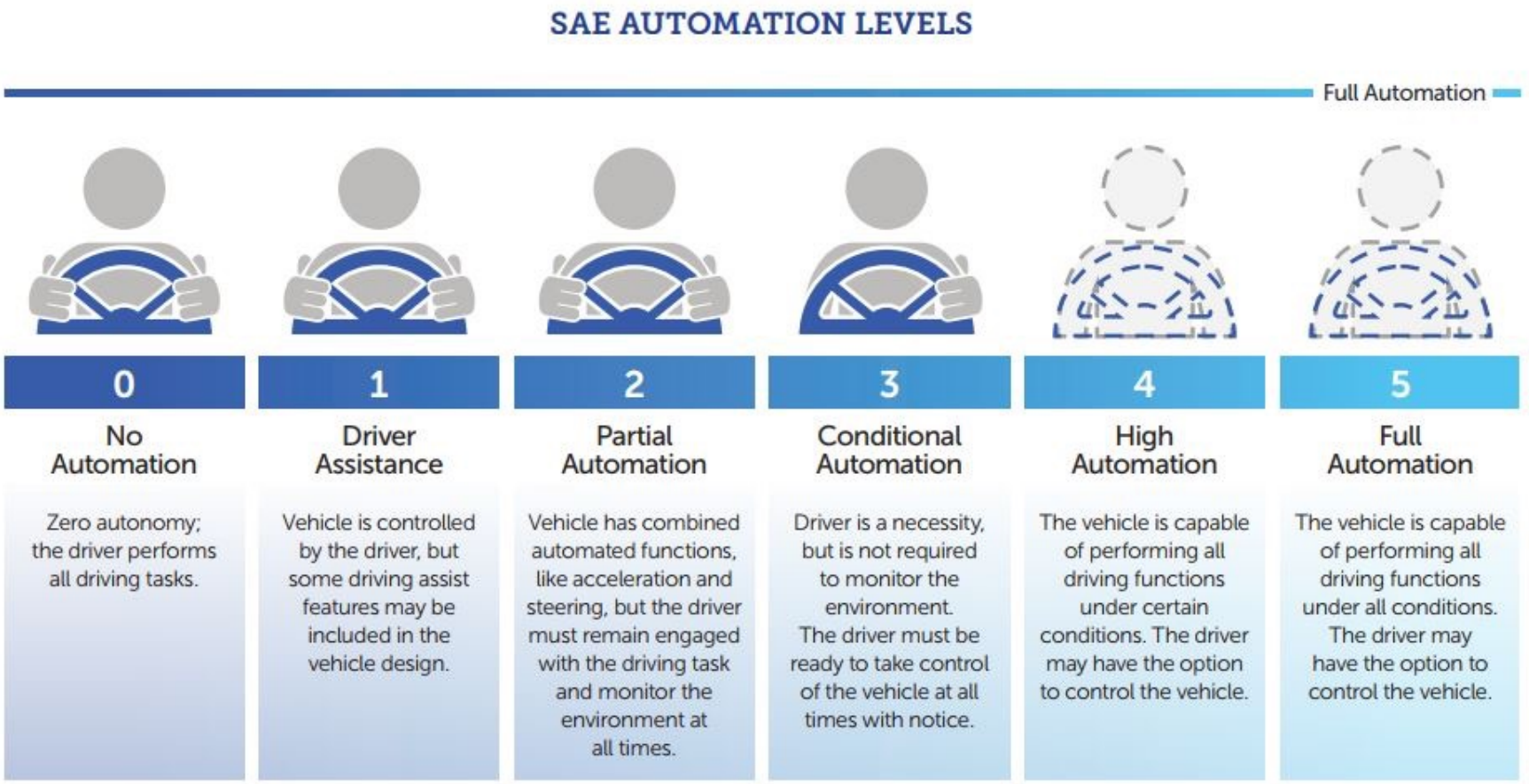


Source: Ericsson, 2014

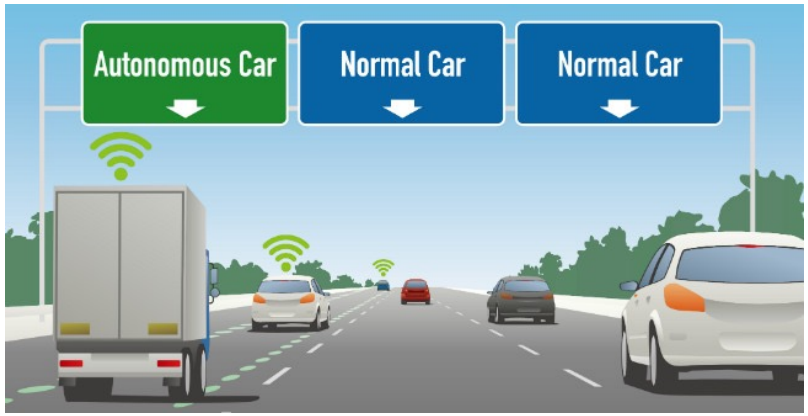
Sensor technologies

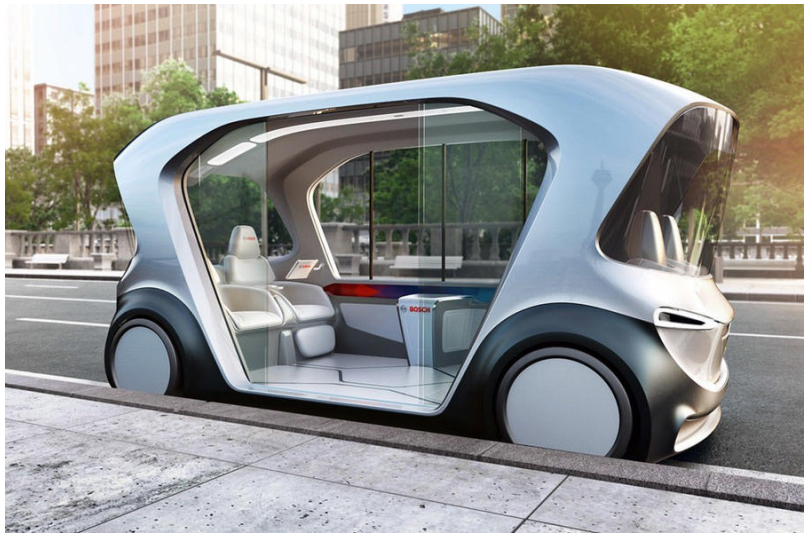


The vehicle automation development paths



Autonomous cars





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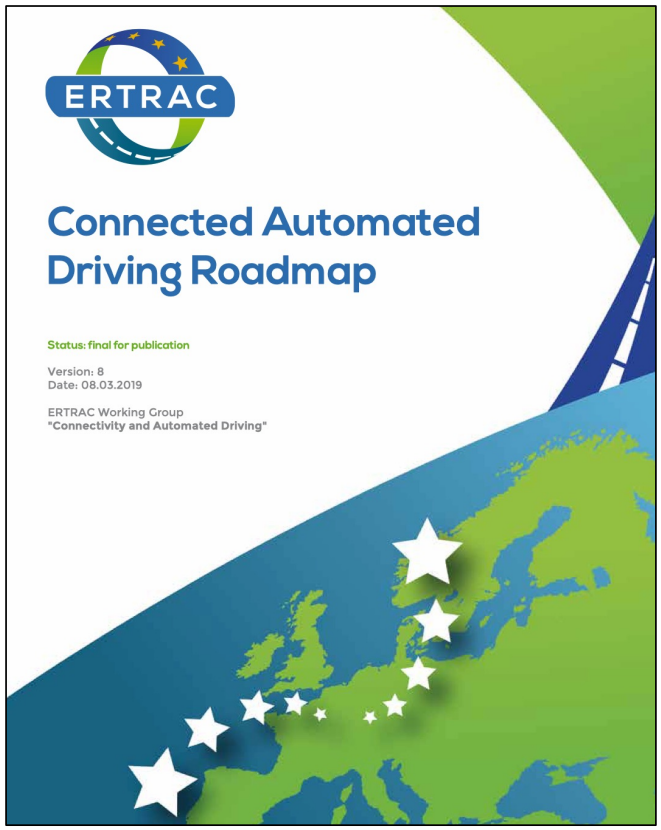
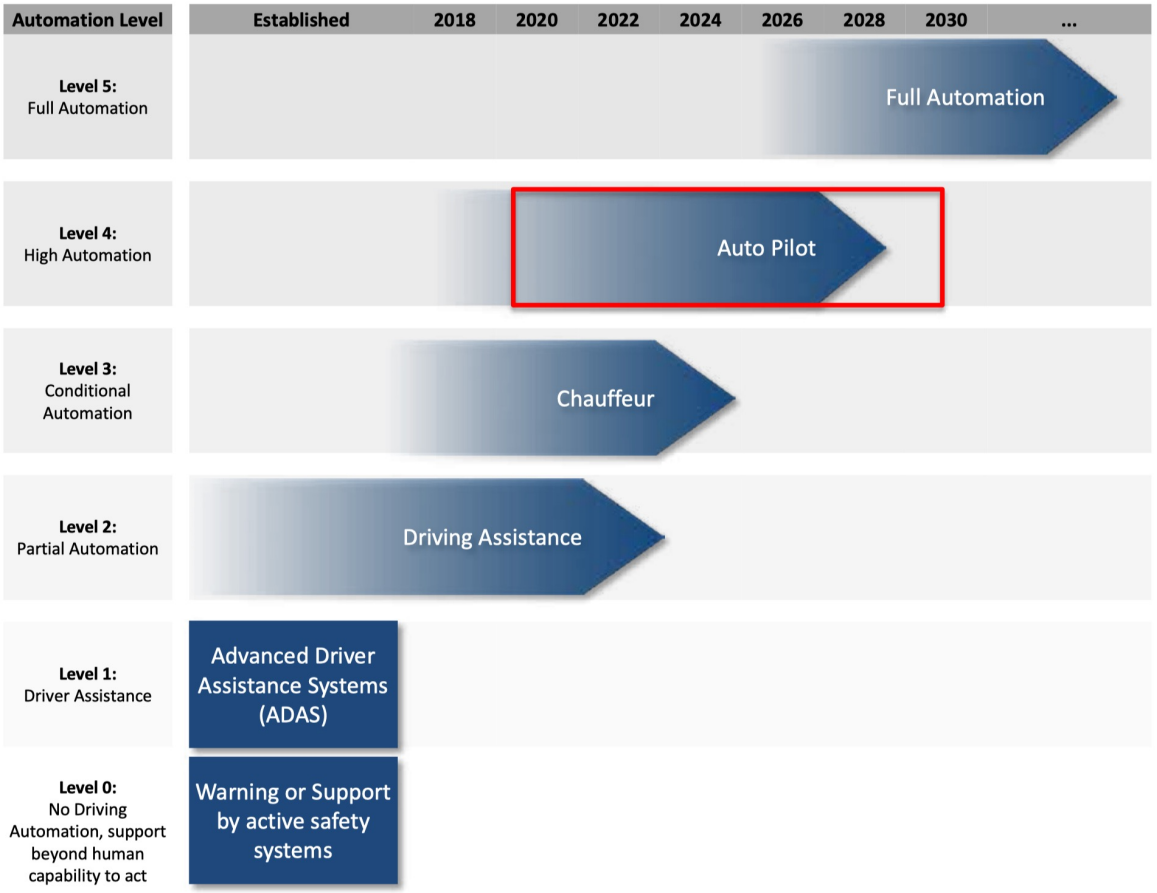
EUROPEAN UNION EUROPEAN REGIONAL DEVELOPMENT FUND

The vehicle automation development paths





Topic 2. ITS Technologies

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