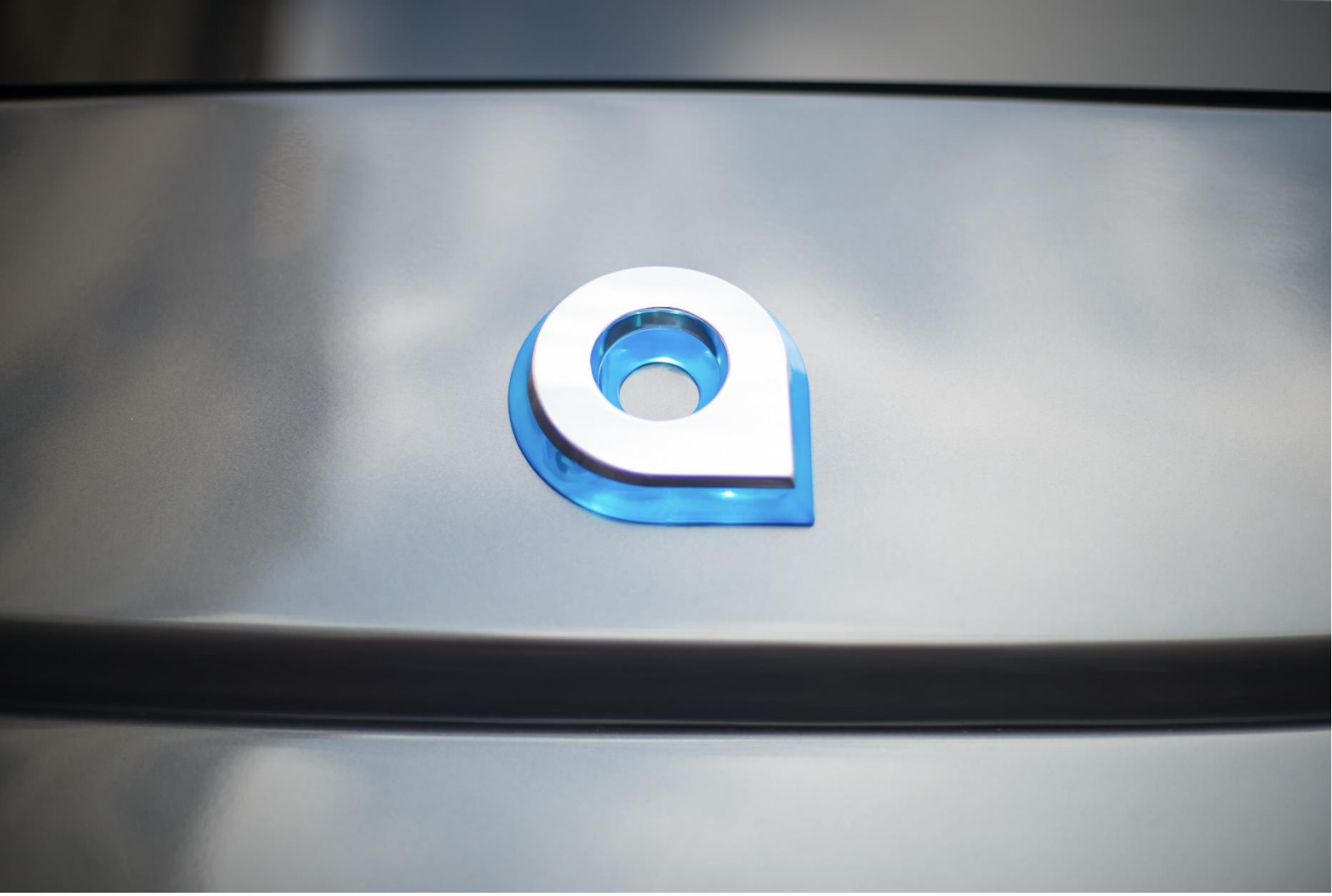


NAVYA SAFETY REPORT

THE AUTONOM ERA

navya
be fluid

Our team of more than 250 engineers, designers, and automotive technology experts are dedicated to working on the safest, most sustainable and advanced vehicles available anywhere. Each day, members of the NAVYA team deliver amazing work to make this more than a mission, but a reality.

As pioneers in the Automated Vehicles (AV) sector, we recognize that the status of individual cars is rapidly changing, especially among younger generations, many of whom do not have their driver's license and are less attached to the concept of owning a car. The industry has already begun shifting in ways that will revolutionize both habits and technology, giving many people access to brand-new mobility options.

We view this as an opportunity to deliver safer transportation through highly engineered, intelligent vehicles such as the NAVYA AUTONOM SHUTTLE and CAB. Smart AV solutions give people their autonomy back by allowing them to do something productive or simply relax during their travel time, while also reducing emissions with electric powered vehicles. In turn, transportation will be smarter, more comfortable, more efficient and cleaner with AVs as part of the transportation matrix.

As an industry and a society, we need to create a bridge to the future, taking steps towards establishing a comprehensive benchmark for the coming Autonomous Vehicle Era, ultimately improving our quality of life while continuing to raise safety standards for a world in constant motion.

Since its inception, NAVYA has focused on the safety and reliability aspects of our vehicles with a laser focus. Passenger safety must always remain the main concern of autonomous vehicle makers. Not only is it the most important priority, it is also the key to obtain the public's trust in this new concept in automotive transport.

Our Mission

NAVYA's mission is to fluidify cities, offering all residents at the heart of the urban scene the opportunity to experience a type of connected mobility that is seamless, safe, and clean.

Table of Contents

Introduction

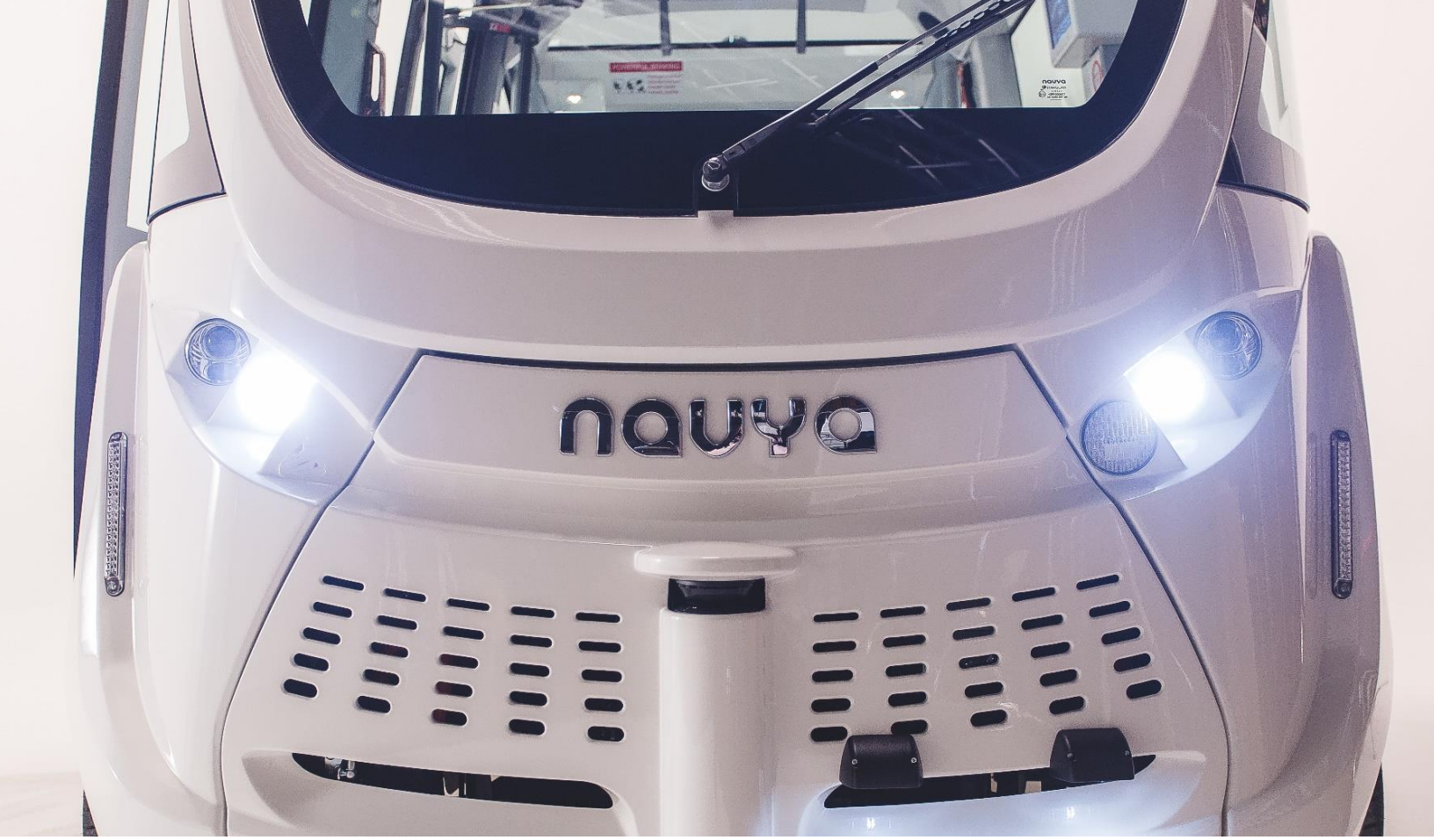
This report will address the recently updated framework entitled

Automated Vehicles 3.0: Preparing for the future of Transportation.

The guidelines, published by the United States Department Of Transportation (USDOT), outline elements involved with the development, testing, safety, and deployment of Automated Vehicles.

NAVYA is continuously improving its technology and expects to update this regularly. Please ensure this version is the most recently published for the most accurate and up-to-date information.

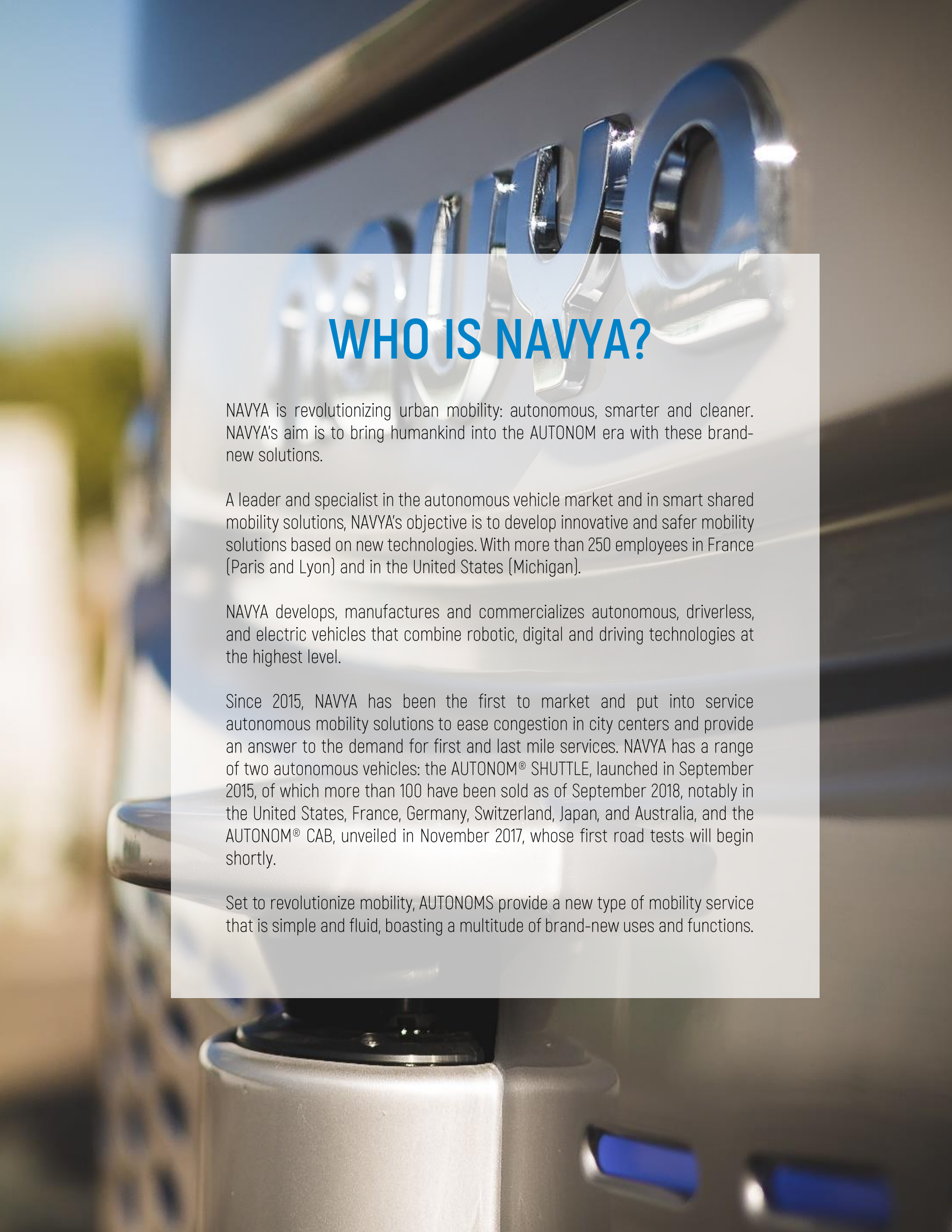
Version 1.1, January 2019



THE AUTONOM ERA:

Working towards a safer and more fluid world

Today, with more than a billion automobiles on the roads around the world and a growing population, our cities are reaching a saturation point. Traffic jams are an enormous waste of time and money, costing U.S. drivers $305 billion dollars in 2017 averaging $1,400 per driver according to the most recent INRIX Global Traffic Study. It also found America to be the most congested developed country in the world, having a disastrous impact on the environment. Traditional solutions are no longer enough to slow down the saturation levels in our cities and it is essential to change the way in which we move around. NAVYA strives to design, build and deploy AUTONOM solutions that instill citizens with the utmost confidence in the safety and reliability of autonomous vehicles. Opening the way to liberated cities where space and time are given back to residents at the heart of the urban scene and enhancing cities where everyone can move according to their needs or desires, fluidly!



WHO IS NAVYA?

NAVYA is revolutionizing urban mobility: autonomous, smarter and cleaner. NAVYA's aim is to bring humankind into the AUTONOM era with these brand-new solutions.

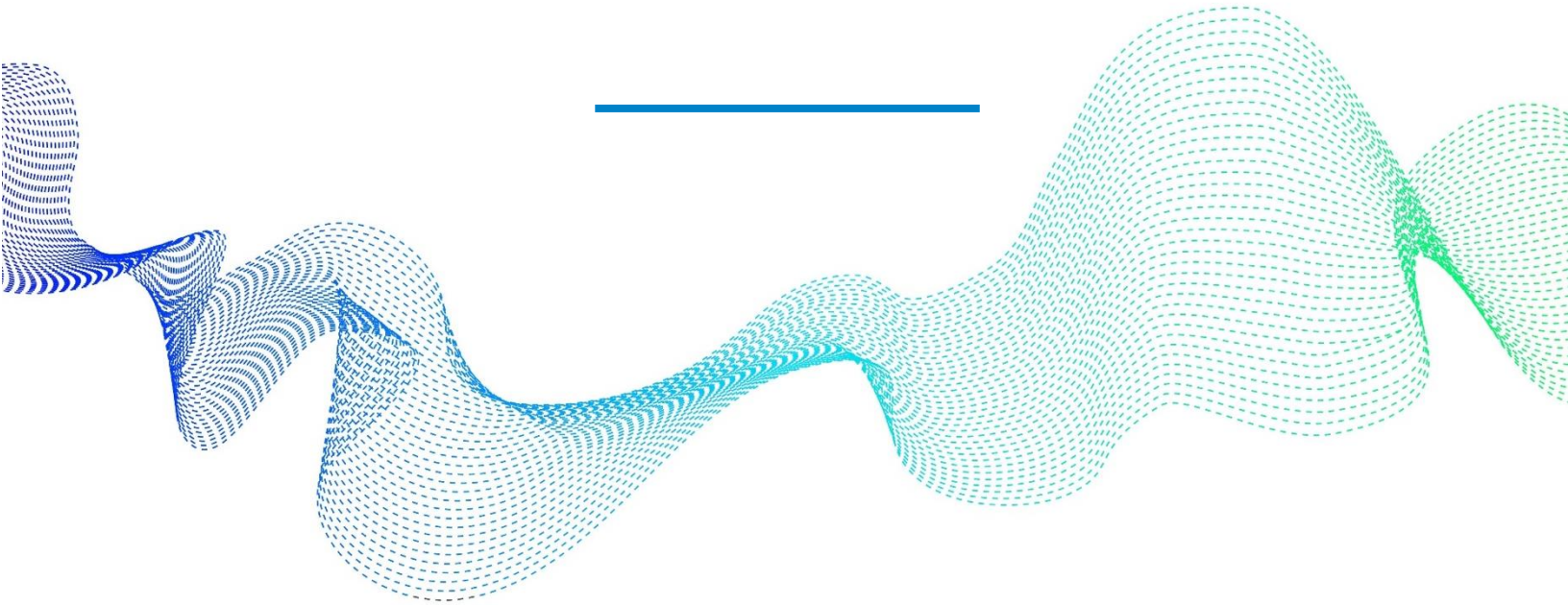
A leader and specialist in the autonomous vehicle market and in smart shared mobility solutions, NAVYA's objective is to develop innovative and safer mobility solutions based on new technologies. With more than 250 employees in France (Paris and Lyon) and in the United States (Michigan).

NAVYA develops, manufactures and commercializes autonomous, driverless, and electric vehicles that combine robotic, digital and driving technologies at the highest level.

Since 2015, NAVYA has been the first to market and put into service autonomous mobility solutions to ease congestion in city centers and provide an answer to the demand for first and last mile services. NAVYA has a range of two autonomous vehicles: the AUTONOM® SHUTTLE, launched in September 2015, of which more than 100 have been sold as of September 2018, notably in the United States, France, Germany, Switzerland, Japan, and Australia, and the AUTONOM® CAB, unveiled in November 2017, whose first road tests will begin shortly.

Set to revolutionize mobility, AUTONOMS provide a new type of mobility service that is simple and fluid, boasting a multitude of brand-new uses and functions.

NAVYA FACTS & FIGURES



100+ vehicles sold worldwide *(September 2018)*

NAVYA LEAD is the platform which monitors, manages and optimizes operations of on-duty shuttles. Reactive and available, our 24/7 Supervision Service ensures continuous fleet management, if so desired, guaranteeing optimal operations.

Operations in 20 countries including the United States, France, Australia, Austria, Denmark, Germany, Japan, Singapore, Switzerland.

Public road approvals by ASTRA (Switzerland), DRSA (Denmark), LTA (Singapore), MDDI (Luxembourg), MFK (Liechtenstein), MTES (France), RDW (Netherlands), SAAQ (Canada), SPF M&T (Belgium), STA (Sweden), TÜV Austria (Austria), TÜV Rheinland & TÜV Hessen (Germany) *(September 2018)*

300,000+ passengers transported *(since April 2016)*

THE AUTONOM RANGE

Autonom® Shuttle

First and last mile transportation on private sites and open roads

Capacity

- 15 passengers: 11 sitting and 4 standing

Engine

- Drive wheels: 2 or 4
- Engine: Electric
- Operating speed: up to 16 mph

Energy

- Theoretical autonomy: 9 hours
- Charge duration up to 90%: 5-9 hours

Autonom® Cab

The first robocab of the market in cities

Capacity

- 6 sitting passengers

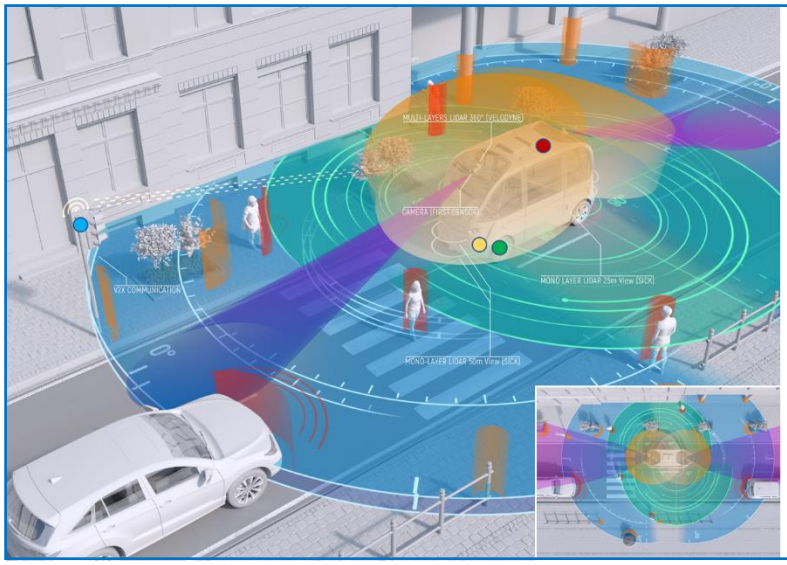
Engine

- Drive wheels: 2
- Engine: Electric
- Operating speed: 30 to 55 mph

Energy

- Theoretical autonomy: 10 hours
- Charge duration up to 90%: 5-9 hours

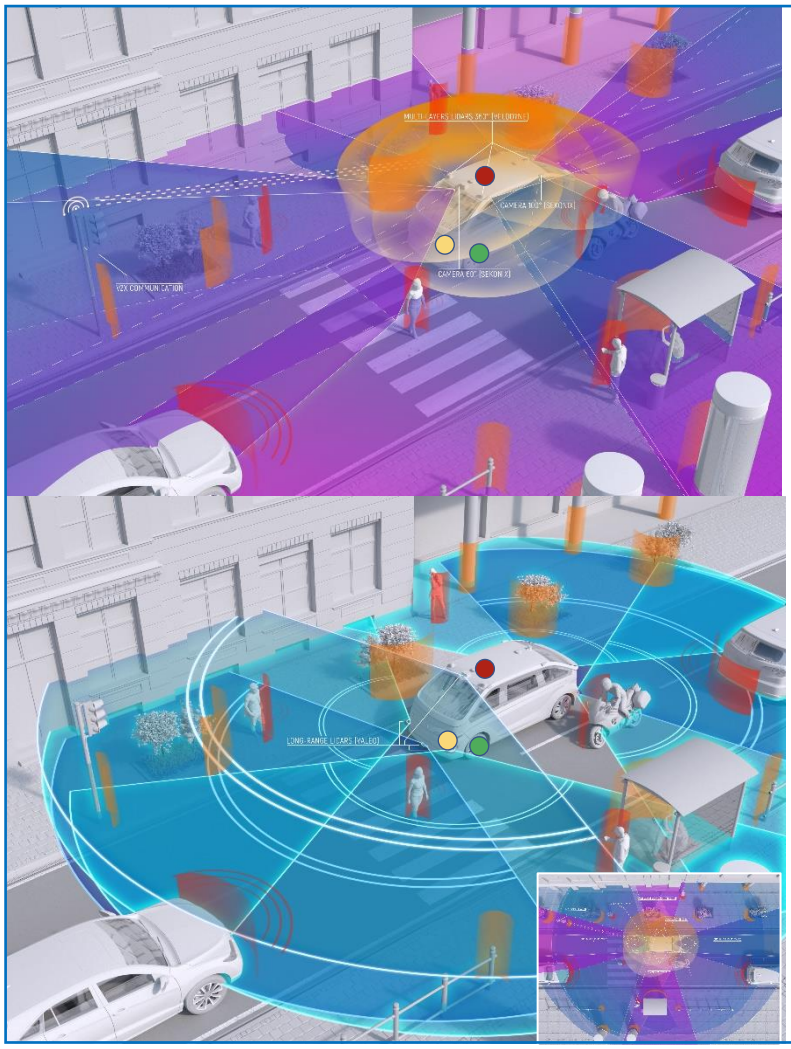
Cutting edge multi-sensor technology



IN-HOUSE ADVANCED
INTELLIGENCE SOFTWARE

COMBINED WITH OUR SPECIFIC
SENSORS ARCHITECTURE

- MULTI-LAYER LIDAR SENSOR
- MONO-LAYER LIDAR SENSOR
- CAMERAS
- ANTENNAE GNSS
- ODOMETRY SENSORS
- IMU UNIT
- V2X COMMUNICATION



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- V2X COMMUNICATION

There are various systems which allow our vehicles to operate without a human driver. To be driverless, the vehicle must “see, think, and act” like a human. Therefore, systems such as localization, obstacle detection, trajectory decision and actuating conventional vehicle dynamic functions (powertrain, braking, steering), have been implemented.

Proprietary software in our decision making and action, the Automated Driving Systems (ADS) utilize sensors and actuators to enable driverless functionality. Additionally, software updates provide continuous improvement of the vehicles’ safety, functionality, and features. All modifications to software are tested first in a virtual environment, followed by an offline test fleet in France, before finally being sent to the fleet as an update. Using this workflow allows us to improve the software quickly while giving us the opportunity to validate the improvements prior to updating the entire fleet.

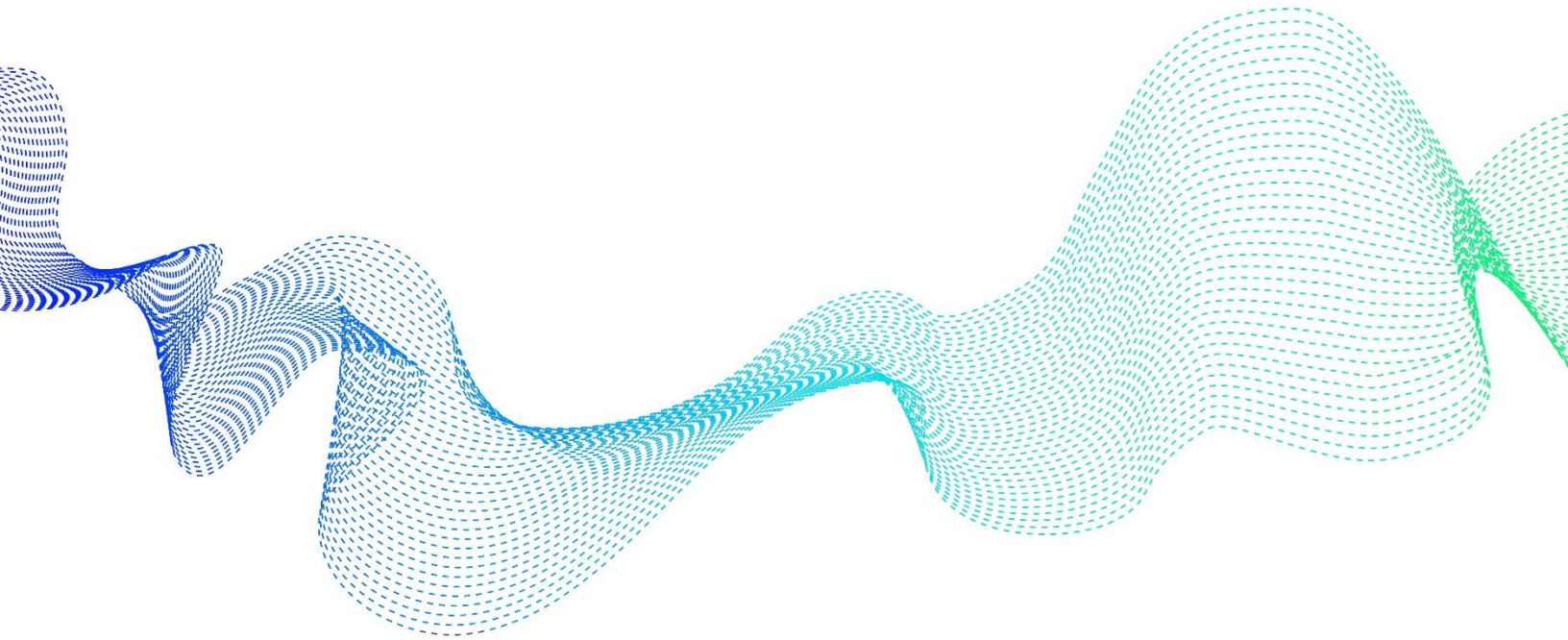
Mitigating risks is a top priority at NAVYA. For all hazardous events identified during a Hazard Analysis and Risk Assessment (HARA) all operational measures have been implemented with the idea to detect those hazards and transition into a safe state, in case of a system failure.

In the most extreme example, if power is lost and all systems go offline, our shuttle is brought to a halt using a spring-loaded mechanical brake. Similar systems have been used on commercial trucks, trains and transit busses equipped with pneumatic brakes.

A trained operator can also assume manual control of our vehicles if they encounter a scenario where power has not been lost, but the vehicle has experienced an unexpected behavior. By switching from autonomous mode to manual mode, the operator can use the remote inside the vehicle and then, drive the vehicle manually.

NAVYA ADSs are tested and improved using a variety of environments including:

- NAVYA manufacturing and test facilities in Villeurbanne, Lyon, France and in Saline, Michigan, USA
- MCity AV proving ground in Ann Arbor, Michigan, USA
- Virtual environments at R&D headquarters in Paris, France
- Data generated by 100+ vehicles operating in real world environments

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SYSTEM SAFETY

Safety through all the product life cycle

NAVYA's safety process is based on state-of-the-art standards. It addresses topics such as Functional Safety (FuSa), but also Safety of the Intended Function (SOTIF), among others. The process manages the safety activities during the entire life cycle of the products.

During development, we cover the concept phase, at the system level, the hardware and software level, and during the verification and validation phase. Several requirements from the development activities are exported to mitigate the risks during production, operation, service and decommissioning.

During operation, a field monitoring is performed by a safety operator as well as our 24/7 supervision center to monitor and report any unexpected behavior.

FuSa - Functional Safety

Due to the increasing technology complexity of current mechatronic systems, handling systematic failures and random hardware failures is a priority to achieve functional safety for road vehicles. The ISO 26262 standard addresses possible hazards caused by malfunctioning behavior of safety related E/E systems, including the interaction of these systems. The goal is to mitigate the risk according to ASIL (Automotive Safety Integrity Level). This means that any safety related E/E system shall work properly in critical situations during at least the fault tolerance time in order to achieve transition to the safe state mode. Unless directly caused by malfunctioning behavior of safety related E/E systems, FuSa does not address hazards related to electric shock, fire, smoke, heat, flammability, corrosion, release of energy and similar hazards as they are already addressed by other safety regulations such as FMVSS or EU 2007/46/EC.

During the development phases, the NAVYA FuSa team identifies all hazardous events during Hazard Analysis and Risk Assessment (HARA) to establish safety goals with the appropriate ASIL. NAVYA FuSa team then specifies the correct safety mechanisms during Safety Concept, perform Safety Analysis on the systems architecture using method such as FTA (fault tree analysis) & FMEAs (Failure Mode and Effects Analysis) and validate the correct implementation during Safety Validation (confirmation through tests and analysis). All relevant information is gathered in a safety case report that provides evidence of FuSa achievement at the vehicle level.

Aware that independence is an important aspect for safety, NAVYA conducts frequent verification and confirmation reviews ensuring that there is an appropriate level of independence on the required products.

SOTIF - Safety Of the Intended Function

Achieving a high level of driving automation, especially from LEVEL 4, according to SAE J3016, requires more than only mitigating unreasonable risks due to the E/E system failures. Other than malfunctioning, E/E systems can lead to hazardous events such as foreseeable misuse of the function by the safety operator, performance limitations of sensors or systems and unexpected changes in the road environment. Mitigating risks in the absence of the malfunctions of the E/E system in vehicles shall be performed. Recently, a safety standard "ISO PAS 21448" was newly developed to provide a guidance on how to address these issues, complementing with ISO 26262 functional safety standards.

OPERATIONAL DESIGN DOMAIN

In order to operate safely, our operations must remain in the specific conditions under which the AV is intended to function. Therefore, Operational Design Domain (ODD) must be known precisely to transit to a safe state when boundaries are reached. Conditions and environments are determined theoretically during System Safety activities and according to the limits of the embedded system and sensors. These conditions are validated during testing and validation, as well as checked operationally during the first step of the commissioning process.

The AUTONOM SHUTTLE operating at night in Nevada, USA

The AUTONOM SHUTTLE under rain testing in Singapore

The AUTONOM SHUTTLE under warm weather in Perth, Australia

The AUTONOM SHUTTLE with in snowy conditions in Michigan, USA

Some environments and conditions where testing can take place include:

- Roadways - road types, road signals, road speed limitations, lane widths, road surfaces, etc.
- Geographical Areas - climate, slope, transversal inclination.
- Environment - lighting, weather events (e.g. fog, rain or snow), temperature (during operation, charging, storage).
- Others - operational safety measure, infrastructure, localization.

The first step of commissioning activities is the site feasibility. This activity is conducted by a dedicated team, according to the ODD, to ensure that all the conditions are gathered for a safe operation. If needed, adjustments of the path will be made (e.g. using an alternative road due to a GNSS poor reception).

The second step requires a dedicated programming of the operation path by NAVYA Engineers. This will allow the vehicle to only drive on the pre-defined path and fulfill the traffic laws. The vehicle is designed to detect going outside of its pre-defined path, and transition, to a minimal risk condition which will be, in this case, a safe stop.
The safety operator is also a part of the safety chain to prevent going out of the ODD according to its role in the fallback strategy. For this reason, the manual mode will always have the priority over the automatic mode and the emergency stop buttons, available on board, are made fully mechanical.

Before public operation, the commissioning team always tests the expected behavior of the shuttle in the path without passengers. This step helps the operation technician to make path adjustments in real condition, if needed.

During all operations, the vehicles will constantly communicate with our fleet management system NAVYALEAD and be in contact with our supervision team to make sure the specific conditions are met, and boundaries are never violated. If required, adjustment to the ODD will be made to guarantee safe operation in a specific area.

OBJECT AND EVENT DETECTION AND RESPONSE

Our vehicles are designed and programmed to manage Dynamic Driving Tasks applicable in the Operational Design Domain.

Automated functions are implemented to detect events and objects in order to respond safely in normal driving conditions or in pre-crash scenario to avoid a crash. This includes:

- Obstacles on the road
- Other road user's behavior
- Priority management
- Road traffic rules

The safety operator supervises the good behavior of the vehicle and can manage, at any time, any particular conditions if needed by manual recovery of the driving control, which have priority on automated driving.

Perception features

The detection is ensured by perception features that include environment perception sensors and data processing.

Localization

Our operations are based on a predefined path, programmed during the commissioning phase. The known objects (as road signs, traffic lights…) and events (as priorities, speed limits, intersections…) are localized in the path and the vehicles localize themselves in the path thanks to the fusion of three (3) different sensor technologies:

- GNSS: the position is determined by a Global Navigation Satellite System (GNSS) according to satellite reception from an embedded GNSS receiver board, and support by Real Time Kinematic technologies (RTK) with the correction from a fixed base, deployed by NAVYA or, Networked Transport of RTCM via Internet Protocol (NTRIP).
- LiDAR: the current measurement of the environment done by the lidars is compared to recognize fixed obstacles that were defined during the commissioning phase.
- Odometry: the odometry of our vehicles is defined with Inertial Measurement Unit data and four wheel-speed sensors to measure longitudinal and lateral movements.

Object detection

The vehicles perceive obstacles and objects on the road and can identify pedestrians, other vehicles, bicycles and any other static road obstacles.
Lidars and camera sensors are installed on our vehicles to detect and track obstacles, as well as objects present in the environment. Our AUTONOM Shuttle is equipped with two (2) cameras and eight (8) LiDAR and our AUTONOM cab with six (6) cameras and ten (10) LiDAR.

V2X

To respect the road traffic rules, our vehicles can be installed with an On-Board Unit (OBU) system that is used to receive the state of traffic lights by communicating with the Road Side Units (RSU).

Decision features

The response is ensured by several decision features, including Trajectory and Mission Management:

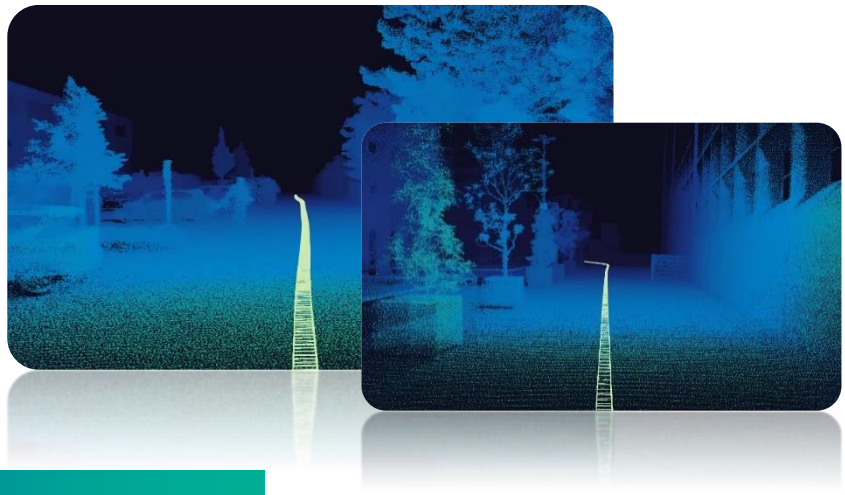
Decision

According to the detected information, transmitted by the perception features, the decision features define the required trajectory. Our AUTONOM vehicles can take the appropriate decision based on the event or object detected.

The vehicle regulates the speed to a safe stop according to:
- The road traffic rules, such as priorities, speed limits, traffic lights
- Any other activities such as pedestrian crossings, shared zones

These objects or events are programmed on the path, with an identified position, according to the vehicle localization or the V2X communication.

This obstacle detection information is used to manage priorities, and merge the vehicle into road traffic, via a programmed zone of control, before continuing motion.
Speed is regulated to safely manage the detected obstacles on the path by prediction. The vehicles will decelerate according to the position, the trajectory and the speed of the obstacles. This function allows our vehicle to interact with shared road users, preventing crash avoidance and regulating the vehicle speed.



Action

The Decision features communicate with the Action features, in order to actuate the vehicle dynamic functions (braking, steering, powertrain), and to reach the best behavior of the vehicle according to any object or event.

FALLBACK minimal risk condition

To ensure minimal risk conditions and avoid any hazardous events in case of a failure or malfunction, the NAVYA safety process is designed to maintain safety mechanisms and lead to a safe state mode by implementing detection and reaction faults within a specify timeframe.

The safe state mode of our vehicles is made to create a safe stop in case of a fault or a malfunction, as it can have an impact on road users or passengers in the vehicle. This safe stop is applied by taking in consideration the Operational Design Domain (low speed of operation in an urban environment), the presence of the on-board operator to manually drive the shuttle to a safe place, and by mitigating the risk of harm.

Safety mechanisms are applied at different levels:

- At the system level: The vehicle will be led to a safe stop if a failure has been detected and communicated, such as losing sensor reception.

- At the interaction system level: The detected failure will come from a loss of communication and will force the vehicle to stop, such as loss of communication in the automated driving chain.

- At the vehicle level: The level will prevent, for example, the vehicle to run out of its pre-defined path. The vehicle will be forced to stop, as a result of a malfunction of the embedded sensors.

In addition, a failsafe brake function is activated in case power supply is lost.

Support functions

In order to maintain minimal risk conditions, and before transitioning to safe state mode leading the vehicle to a safe stop, some other back-up functions will mitigate the risks in case of failure of one of the primary functions. For example, the fusion of localization data, via GNSS, Lidars and odometry, all ensure operation in case of temporary loss or disturbance of the GNSS.

Human control

The events of malfunction are communicated to the safety operator on board. The agent on-board can switch to manual mode, secure the vehicle and the passengers, and will be assisted by our 24/7 supervision team.
The safety operators are trained to monitor operations, to detect malfunction behavior, and drive the vehicle manually if needed.
Our vehicles have an emergency stop button, which allows the operator, as well as the passengers, to transit to a safe state mode. The activation of the emergency stop will override any other automated functions and will manually stop the vehicle by a mechanical action.
With our own fleet management system, NAVYALEAD, the supervision team is informed immediately and can assist any safety operator when operational issues occur. They can also remotely stop the vehicle in case of inappropriate behavior or operator misuse.

VALIDATION METHODS

The main goal of NAVYA testing activities is to ensure that the vehicle is safe for passengers, road users, and pedestrians in all conditions.

A dedicated team has the responsibility to determine all possible scenarios that could happen to our vehicles and verify that the vehicle's reaction is always safe.

For every new feature, the testing process is the same starting by simulating the new features in a virtual environment, followed by a closed test track with dedicated test vehicles, and finally in an on-road validation before being deployed to our worldwide fleet.

Software testing unit

The development of any new features is separately tested to make sure they are in accordance with the safety requirements and the architectural design.

Then, these features are tested in a virtual environment. This simulation is based and built from data that we have collected from our fleets already deployed, as well as from closed-loop scenarios.

By using our own simulation environment, our engineers can not only evaluate the performance, but also the compliancy of algorithms with the specifications.

Item integration and testing

The integration of the software and the hardware is tested within a Hardware In the Loop (HIL) setup using our AUTONOM SHUTTLE or AUTONOM CAB tables.

Functional and dysfunctional tests are conducted to verify that the new feature is well designed and robust. To ensure that all systems are working well together, the new item is tested for its compatibility with the other systems already in place and validated to ensure that the expected behavior is reached.

Vehicle Validation

The vehicle validation is the final phase of testing, once the software, hardware and subsystems have been separately passed through the unit and integration tests.

By designing our own vehicles and managing all the processes from conception to production, NAVYA can validate the global behavior of its products. The automation of our vehicles is included in our vehicle validation process.

Our vehicle testers ensure the vehicle is compliant with its specifications and with a complete quality control process covering mechanical, software and electrical aspects, including motorization, braking, steering, comfort, material resistance and load resistance.

The tests are performed both on test sites and on open roads:

- **Regression testing**
  According to a specific plan, dedicated to the impacted control unit, a regression testing campaign is conducted for all new software versions. These campaigns prevent any regression that a new feature could bring to the vehicle's behavior.

- **Injection fault testing**
  During the driving tests, including regression testing, several voluntary faults are performed such as sensor losses, or hardware failures to ensure the safe behavior of our vehicles in case of faults.

- **Endurance testing**
  Our vehicles are continuously tested in dedicated test sites with severe road conditions, such as paved roads, speed bumps and severe localization conditions such as forest areas or wireless communication interferences.

  A new software version is tested in at least two (2) weeks of endurance tests before being validated.

- **Vehicle performance testing**
  As it is important to ensure the limits of our vehicles are compliant with the given specifications and vehicle regulations,

NAVYA conducts performance testing such as obstacle detections or braking performance.
These performance tests are also performed by independent homologation organizations such as APAVE, TÜV, IDIADA or RDW.

- **Environmental testing**
  Our vehicles are exposed to various environmental situations in climate chambers or in one of our test sites located in four different continents.

Production validation

For any vehicle, multiple tests are performed by the NAVYA Quality Control department after two (2) different phases:

- **After production**
  Our Quality department goes through a list of quality points to determine the correct construction of the vehicle.

- **Once the vehicle is delivered to the client**
  Once the vehicle is on the customer site, a member of our commissioning team is on site to deploy our autonomous vehicles properly and assure its proper function.

  Those tests cover mechanical, electrical and software aspects of the vehicle, and are performed based on test procedures designed by NAVYA engineers.

HUMAN MACHINE INTERFACE

NAVYA has designed its Human Machine Interface (HMI) to provide the best compromise between ease of use and level of functionality.
Our HMIs have multiple goals as they are used to communicate with passengers, onboard operators and the supervision and maintenance team.

During product development, NAVYA has programmed the ability for our HMI to display information that can inform the operator if the ADS is functioning improperly.

Visual cues are also used to represent if the vehicle is in automated or manual mode, is available for use, or if they are experiencing any ADS malfunction. If the operator needs to assume manual control, due to an emergency or ADS malfunction, the HMI would provide visual cues to do so.

Passenger

This is the most basic access level. A passenger can see the vehicle's location on a map and, depending on the service mode defined by the service provider, can request a specific stop at a station along the route.
In metro mode, the user cannot change the route/stops defined on the line by the service provider.
We also inform the passenger on the vehicle behavior vocally (text to speech) and through sound notifications.

Operator

This Operator mode contains additional data to the previous functionalities. The main view displays driving information such as speed, wheel angle and important notifications such as light status, engine temperature, access ramp.

This level contains legal information required to operate the vehicle manually. Other auxiliary views allow a quick diagnostic of the vehicle and display software status, error messages, serial number, software version.

Maintenance

This mode is the highest level of access. This level gives access to the exact value of data such as the engine temperature, the battery's state, etc.

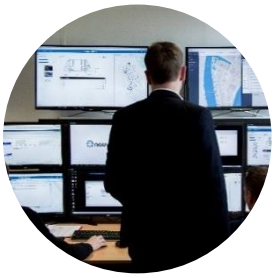
VEHICLE CYBERSECURITY

Autonomous vehicles mean smart and, in most cases connected. As for Internet of Things (IoT), vehicles can be considered as Internet of Vehicles (IoV).

In term of cybersecurity, two mains factors shall be considered:

- The vehicle makes decisions based on its current environment
- In most cases, only passengers are physically present inside the vehicle

Because of these two factors, everything must be monitored in real time. In addition, the potential safety impact of any incident, causes restricted remote manual safety functions like being able to stop the vehicle.



Our vehicles are connected to our 24/7 supervision center through a secure Virtual Private Network (VPN). The access is restricted, and all communications are properly encrypted.
In addition, all communications inside the VPN are also segregated to prevent any unusual network communications. Even if a vehicle is corrupted, propagation and data exfiltration through this network would be prevented.

Each point of connection is a threat vector. For this reason, the cybersecurity activity at NAVYA is mandatory to avoid any unwanted side effect for our vehicles. Our first concern is to ensure passenger's safety but also all road users' safety.

Therefore, at NAVYA, a dedicated cybersecurity team exists. This team is responsible for the entire vehicle lifecycle, from the design phase to after SOP until the decommissioning, on subjects such as:

- Identify vulnerabilities
- Determine a risk level
- Threat modeling (e.g. Craig Smith approach)
- Risk mitigation
- Awareness by improving cybersecurity knowledge of all employees
- Be compliant with governments regulations like the French National Cybersecurity Agency
- Carrying out internal intrusive audits

With NAVYA cybersecurity experts, we have tailored our own "state of the art" cybersecurity strategy. Three main complementary pillars are implemented:

- Risk Management
  Implement and maintain a risk analysis approach, based on the cybersecurity state of the art standards on all new projects.

- Intrusive audits
  Perform frequently intrusive audits, both internally by the cybersecurity team and externally by independent assessors as well.

- Operational response to incident
  Implement detection mechanism and being able to react properly when needed.

Risk Management

Several standards exist, but none of them apply to the autonomous vehicles with enough maturity. Because of this fact, we tailored our own risk analysis method based on a classical IT cybersecurity, the "state of art" standards, as well as some guidelines such as the industrial or the vehicle guideline.

The goal is to be able to assess a risk and mitigate it during the design phase considering criteria such as:

- Threat vector
- Vulnerability
- Attacker profile
- Ease of exploitation
- Consequence

Depending on those factors, we deduct the risk level. Once this risk level has been identified, a cybersecurity board, composed of all stakeholders, decides to treat the risk according to what is best for our vehicles and final users through a risk treatment plan.

Intrusive audits

Challenging our products by performing frequent intrusive audits is one of the best ways to identify vulnerabilities or threat vectors that have not been identified previously. These audits are also ideal to assess technical impacts.

At NAVYA, the cybersecurity team performs intrusive audits frequently on various scopes concerning the vehicle and its environment. In addition, audits lead by independent companies are also performed in order to challenge our cybersecurity team.

In the near future, a "red team" will be created. Their members could be any cybersecurity employee from the company (developers, researchers, supervisors, managers). The goal of this team would be to mix knowledge from other teams, through different sessions, in order to be more efficient on threat and vulnerability detection.

Operational response to incident

Because cybersecurity is not only a matter of if we are targeted, but when we will be targeted. The cybersecurity team must be prepared but also responsive when an incident occurs. The cybersecurity team is in charge of these operational activities that can included, and depending on the incident, subjects such as detection, impact analysis, containment, eradication, recovery and root cause analysis. All stakeholders will be involved when needed.

DATA RECORDING

In order to drive autonomously, vehicles must collect and process a vast amount of data before making the right decision at the right time.

Our AUTONOM vehicles are making this decision by collecting the raw data coming from several sensors, embedded equipment as well as the software.

At NAVYA, we developed our own black box architecture to store useful data such as:

- Obstacles detection raw data
- Position measured by fusion of several raw data streams from GNSS, Lidars and IMU
- Commands like powertrain, braking, steering, emergency braking, lighting, door position among others
- Status such as speed, mode, lights, door positions or engine temperature
- An "emergency stop" activation or failure of sensors, or other events
- Camera streams

The data, status and events are stored locally in the vehicle and sent to our supervision center via NAVYALEAD. The supervision team can then determine a first level of comprehension. If advance analysis is needed, the supervision team contacts the customer to retrieve a part of the full black box content. This data can be used to precisely determine what happened during a certain timeslot using our own forensic tools. The collected data is also used to improve our algorithms and to provide better products in terms of performance, quality and safety.

NAVYA is truly committed to data privacy for our customers, as well as our employees. We have built our approach based on best practices provided by the French Commission named CNIL (Commission Nationale de l'Informatique et des Libertés) to protect personal data, support innovation, preserve individual liberties; and on the European General Data Protection Regulation.
For instance, camera streams are stored locally, and securely, for a limited period, before being deleted automatically. If the supervision center wants to display the video stream, they can do it through NAVYALEAD without storing it, or by physically retrieving logs from the vehicle and then analyzing them using our forensic tools.

CONSUMER EDUCATION AND TRAINING

NAVYA is aware of the educational need to understand and accept autonomous vehicles. NAVYA is committed to various training to help and support its customer in this new era of transportation.

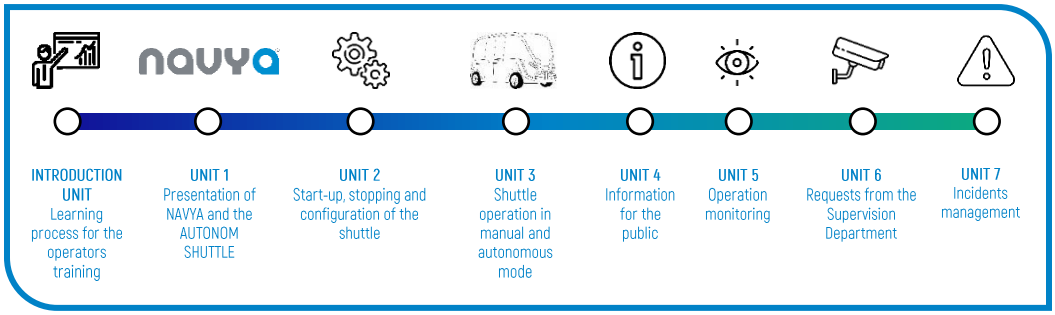
This training sessions have been a strong pillar for NAVYA since the creation of the company. We continuously improve and develop accurate and exhaustive panels of training. To fulfill these training needs, NAVYA has created a dedicated training center, in order to deliver and certify our training programs.

The safety operator training helps people who want to understand and operate our AUTONOM solutions safely. The safety operator trainer training is for those who want to gain experience and be involved deeply in our vehicle's operation. Those training programs are designed, thought, and actualized by our dedicated training team who has developed rich and clever content to learn and integrate knowledge in the most efficient way possible.

Fallback Minimum Risk Condition and safety operational measures, specified during our system safety program, are also an important part of the training to make sure that a safety operator can identify unwanted behavior or any latent failure.

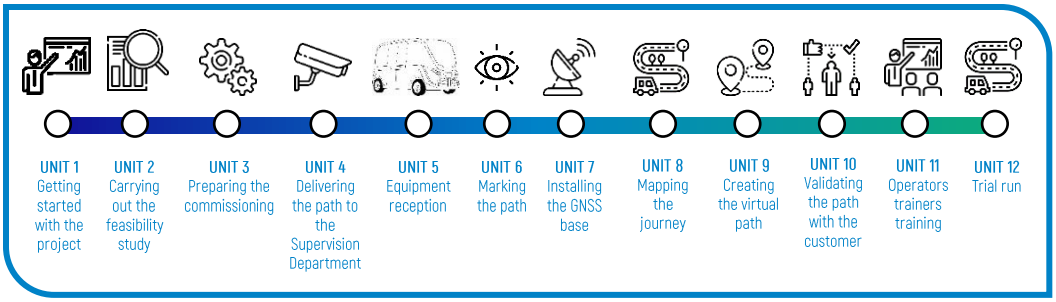
NAVYA provides a commissioning training to customers willing to deploy vehicles safely themselves.

Safety operator training



The safety operator training program is built in eight (8) units that embraces needed skills to operate the autonomous vehicle in the optimal conditions. This includes the general information about the vehicle and information to the public or incidents management. A bus driver license is a pre-requisite for the safety operator as well as for the safety operator trainer training.

Commissioning training



The commissioning training aims to provide the technical and safety knowledge to the trainees in order to set up properly a vehicle or a fleet of vehicles according to the Object and Event Detection Response in the Operational Domain Design.
The commissioning training program is built in 12 units. Each module includes theoretical and practical exercises which cover all knowledge and expertise needed, such as mapping, creating a virtual path or conducting a trial run.
All trainees receive training manuals and other essential documentation such as operational safety and owner manuals.
Trainees must be certified by their trainer and must demonstrate they are able to pass all units successfully before they can start working.

Maintenance training

NAVYA is also providing maintenance training. This training gives the opportunity to the customer to operate basics maintenance intervention. The purpose of this training is to teach low-maintenance operations.
The maintenance training program takes place in our facilities. Each module includes theoretical and practical exercises which covers all knowledge and expertise needed such as manual driving, safety and all specific sensors replacement operations.
Trainees will get specific tool kits, training manuals, a full Operating Procedures Standard manual for all the mechanical operations to perform, and all necessary software.
Once validation is completed, the trainees will be certified to safely work on NAVYA's vehicles.

FEDERAL, STATE AND LOCAL LAWS

NAVYA is a French company founded in 2014 and thus, all our vehicles have been primarily designed to comply with European regulations.

Directive 2007/46/EC from the European Parliament and from the Council of the September 5th, 2017 established a framework for the regulation of motor vehicles and their trailers, and all systems, components and separate technical units intended for such vehicles.

As a first step, the classification of our vehicles was made in order to identify applicable regulations for each specific category. In Europe, the classifications for vehicle category are defined in part A of the annex II of the UNECE directive 2007/46/EC. In addition to the classification, the assessment of driver-based requirements has been the challenge. The strategy is to provide the same level of safety as a conventional car, based on the considered requirements.

The AUTONOM shuttle, radiation emission setup

The AUTONOM shuttle, radiation immunity

Equivalent to the FMVSS, European regulations focus on nominal performances to guarantee the safety of the driver, the passenger and any other road user such as:

- ElectroMagnetic Compatibility (EMC)
- Noise level
- Rear underrun protective device
- Audible warning devices
- Steering system
- Vehicle braking
- Automatic Emergency Braking (AEB)
- Strength of seat and their anchorage
- Lighting installation
- Speedometer
- Towing device
- Safety glazing
- Maximum speed limitation
- Assembly of tires
- Electrical safety

At NAVYA, we are aware that some functionalities are new for the automotive market and certain regulations aren't yet available. However, NAVYA has decided to move forward by implanting a tailored mitigation, based on its own risk analysis.

Assessment by independent certified agency

For all applicable European regulations, NAVYA has conducted tests to assess the compliance with independent certified agencies and laboratories. Independence and Certification is the key to impartiality and proficiency of the conducted tests. These regulatory agencies include Astra in Switzerland, TÜV in Germany and Austria, IDIADA in Spain, UTAC in France, RDW in Netherlands and STA in Sweden. The reports and technical documentations are available to any country or safety agency if applying for public road operation approval.

NAVYA and FVMSS

In order to address the FMVSS, NAVYA needed to identify what standards are applicable, as it is in Europe, and classify properly our autonomous vehicle. According to the U.S. Code 30102 as a motor vehicle means "a vehicle driven or drawn by mechanical power and manufactured primarily for use on public streets, roads, and highways, but does not included a vehicle operated only on a rail line".

Then, a motor vehicle classification is defined in 49CFR571.
For our AUTONOM shuttle, the vehicle can be associated under the bus classification. The bus is classified as 'a motor vehicle with a motive power, except a trailer, designed for carrying more than ten (10) persons'.
For our AUTONOM cab, it can be assimilated to "a passenger car as this vehicle falls into the category of a motor vehicle with a motive power, except a low-speed vehicle, multipurpose passenger vehicle, motorcycle, or trailer, designed for carrying ten (10) persons or less".

As the vehicle may be used on public roads and may be classified as a motor vehicle, it will fall under NHTSA jurisdiction.

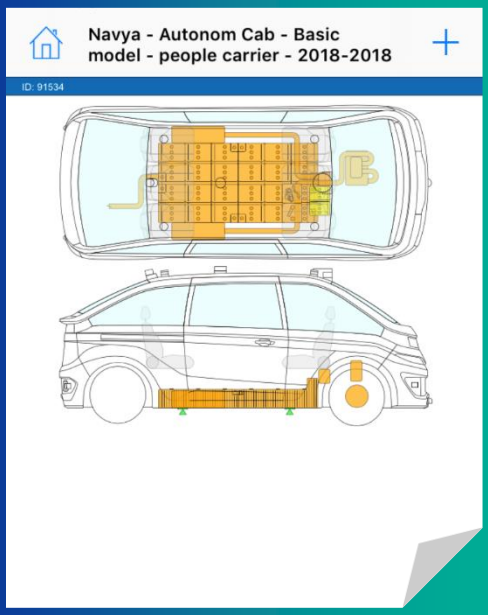
Finally, a self-assessment was made to identify the gap between European 2007/46/EC and US FMVSS. When needed, a mitigation has been implemented to address the gap in order to provide the same level of safety as required by the FMVSS.

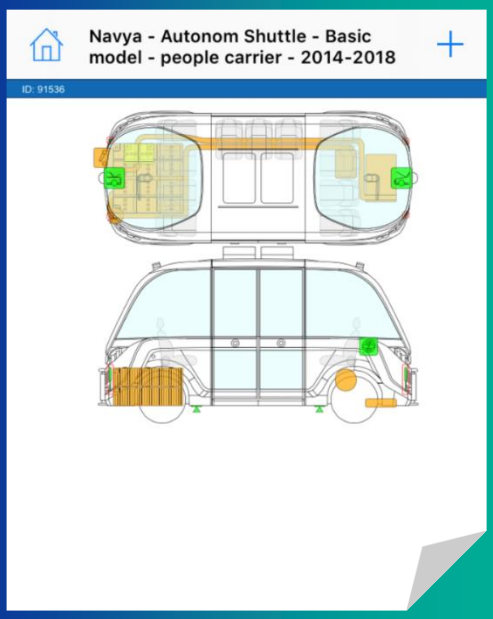
Today, all our deployments take in consideration European Union and US requirements for all new projects.

Road Traffic Laws

During the commissioning of a vehicle on a predefined path, we ensure compliance, not only to our ODD, but also the road traffic safety as presented in the OEDR (yields, stops, traffic lights, speed limits).
Our commissioning team will determine the optimum behavior of the vehicle to meet those road rules and achieve the highest traffic safety.

The on-board safety operators, trained by NAVYA's team, will play a central role by paying attention at all times and ensuring the vehicle is not violating road rules.



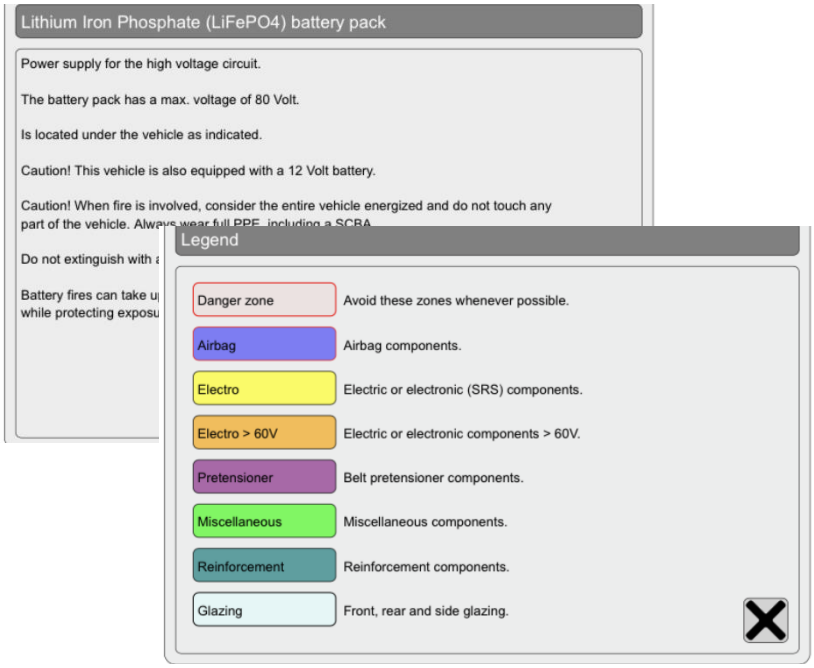


Information for first and second responder

The core mission of all automated vehicles is to avoid being involved in any kind of incident. Potential incidents must be considered when automated vehicles and regular cars share the same environment.

NAVYA has made information available for first and second responder, such as emergency rescue guides, in order to provide essential information for the responders.
To be easily understandable worldwide, the use of harmonized ISO17840 standards have been made.

If an emergency intervention happens, time is critical. Therefore, the access to the information, such as battery technology or type of glazing, is essential. For that reason, NAVYA has made all the required information available digitally for first and second responders via the platform I-Car Rescue Solution (iCRS) from MODITECH. All information is shared to local authorities before the start of any operation.



Acronyms

AEB	Automatic Emergency Braking
AV	Automated Vehicle
ASIL	Automotive Safety Integrity Level
DDT	Dynamic Driving Task
E/E system	Electrical and Electronic System
EMC	ElectroMagnetic Compatibility
FMEA	Failure Mode and Effects Analysis
FMVSS	Federal Motor Vehicle Safety Standard
FTA	Fault Tree Analysis
FuSa	Functional Safety
GNSS	Global Navigation Satellite System
HARA	Hazard Analysis and Risk Assessment
ICRS	I-Car Rescue Solution
NHTSA	National Highway Traffic Safety Administration
NTRIP	Networked Transport of RTCM via Internet Protocol
ODD	Operational Design Domain
OEDR	Object and Event Detection and Response
RTCM	Radio Technical Commission for Maritime Services
RTK	Real Time Kinematics
SOTIF	Safety Of The Intended Function
UNECE	United Nations Economic Commission for Europe
V2X	Vehicle to Everything

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