Proposal for

Nevada: USDOT AV Proving Grounds Designation

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1. Introduction

The State of Nevada stands at the precipice of a major transformation. For the past six years, Nevada has established the foundation for Autonomous Vehicles (AVs), creating policies, and focusing economic development towards the advancement of AVs. These efforts have helped transform Nevada into a national leader of AV programs. From becoming the first state to license AVs, to establishing a statewide collaboration focused on AV initiatives, to educating legislators and officials on the impacts AVs will have on commuters and the social benefits AVs can bring, Nevada has taken critical steps in becoming the nationwide leader in testing vehicles that drive themselves. Nevada has proactively addressed the policies, made infrastructure investments, and supported economic collaboration with major AV companies, to propel the state into a major player in AV progression.

Having the distinction of a Designated AV Proving Ground will further support Nevada's plans in being a leader in AV program advancement. Through this designation, Nevada intends to expand their collaboration with federal agencies to provide a stage for methodically and safely testing AVs, sharing lessons learned with other states, and establishing the foundation for a nationwide network of AV test facilities. Through these efforts, coupled with Nevada's in-place policies and progressive and collaborative policymakers, Nevada can help accelerate the promotion of AVs and other innovative transportation programs across the country.

The State of Nevada is submitting this proposal to the USDOT to become a Designated AV Proving Ground. The partners for this application include:

- **Nevada Department of Motor Vehicles (DMV)** – DMV serves as the regulatory agency responsible for licensing AV drivers and vehicles for testing and consumer deployment throughout the state. Since 2011 , DMV has been at the forefront of establishing policies and coordinating with state and federal legislators to develop and deploy AV test and licensing policies. DMV has also established certification requirements to deploy autonomous vehicles and technologies through a licensed automotive dealer or after-market company in Nevada.
- **Nevada Department of Transportation (NDOT)** –NDOT is a key player in AV initiatives as any AV project impacts their transportation system. For the past few years, NDOT has been a major player in the national conversation and about the states' roles in AV Policy and implementation. NDOT staff has lead, hosted, and participated in numerous conferences and workshops as well as taken on roles in national committees and task forces to further the conversation in various aspects of the will continue to share best practices and lessons learned across multiple agencies and organization.

- **Nevada Governor's Office of Economic Development (GOED)** – GOED promotes a robust, diversified and prosperous economy in Nevada, through attracting new business and facilitating community development. GOED is also closely coordinating with the Nevada Institute of Autonomous Systems (NIAS) and the Nevada Center for Advanced Mobility (NCAM), both key players in the promotion of AV initiatives. GOED has worked diligently to bring AV companies into Nevada through innovative test programs, including Google, Audi, Daimler/Freightliner, Local Motors, Tesla, and Faraday Future
- **Nevada Department of Business and Industry (B&I)** –B&I collaborates with AV companies and, once contracted, ensure that fair business practices are being exercised and that the interests of AV users and project owners are being protected.
- **Nevada Department of Public Safety (DPS)** – DPS includes several divisions, two of which have an important role in the development and deployment of AVs. The Nevada Highway Patrol (NHP) mission is to promote safety on Nevada Highways by providing law enforcement traffic services to the motoring public. The Office of Traffic Safety (OTS) prepares and administers an annual comprehensive Highway Safety Plan aimed at reducing the number and severity of traffic crashes on Nevada public roadways. The plan supports innovative traffic safety projects at the state and local level, focusing on reducing the contributing factors associated with traffic crashes through enforcement, engineering, and educational programs.
- **Metropolitan Planning Organizations (MPOs)** – MPOs play a pivotal role in the long-term viability of AV programs. The MPOs are tasked with ensuring the longevity of Nevada's transportation infrastructure for the major cities in Nevada and have considered AV.
  - The **Regional Transportation Commission of Southern Nevada (RTCSNV)** is the MPO for southern Nevada including the Las Vegas metropolitan area. They have formed a partnership with NDOT to maintain southern Nevada transportation operations and manage the Intelligent Transportation Systems (ITS) network and also serve as the regional transit agency.
  - The **Regional Transportation Commission of Washoe County (RTC Washoe)** is the MPO for the Reno/Sparks metropolitan area. RTC Washoe not only serves as the planning organization, but also as the transit agency and project delivery agency. RTC Washoe is exploring autonomous and connected technologies to enhance safety, particularly on their transit system.
  - The **Tahoe Regional Planning Agency (TRPA)**, which contains the Tahoe MPO serves as the regional planning agency and the MPO for the Lake Tahoe Basin through a bi-state compact and Congressional designation. The TRPA has a strong interest in safety and reducing vehicle miles travelled (VMT) in the basin. This agency partners closely with the Tahoe Transportation District, the project delivery and transit agency for the region.
  - The **Carson Area MPO (CAMPO)** is the MPO for the Carson City metropolitan area. CAMPO is housed within Carson City Public Works, which also includes a Regional Transportation Commission which delivers the capital program, and the transit operations for the City

All MPOs are currently updating their **Regional Transportation Plan (RTP)**, with the exception of CAMPO who adopted theirs earlier this year. All reference new transportation technologies, including AVs.

- **Nevada Automotive Test Center (NATC)** –NATC is a private-sector partner with the State of Nevada to further the research and testing of automotive systems with heavy emphasis on AV initiatives. NATC is proposing use of their facility in Silver Springs, NV to expand their footprint for a functional AV controlled test facility.
- **Academia** – There are several academic institutions across Nevada who contain departments specializing in transportation innovation and research. These institutions, namely: University of Nevada-Las Vegas (UNLV), Brookings Mountain West, University of Nevada-Reno (UNR), and Desert Research Institute (DRI) all have programs that support development and testing of AV programs.
- **City and county agencies** – There are several key city and county agency partners who are directly involved in AV testing. Each of these agencies will lead the coordination and implementation of AV test programs that reside within their jurisdictional boundaries. The City of Las Vegas is specifically referenced in this application. Other cities and counties actively perusing AV advancement include City of Henderson, Clark County, and City of Reno. As AV/CV projects are pursued, other city and county agencies, and even some quasi-governmental agencies, such as Clark County Aviation-McCarran Airport, may also become involved and participate in AV/CV initiatives.

This application provides the details on why designating the State of Nevada as an AV Proving Ground helps launch the USDOT's vision for furthering AV testing and deployment. This application will clearly demonstrate Why Nevada makes the perfect candidate, What Nevada has done to further AV Testing, Key Objectives for Furthering AV Testing, and How Nevada has invested in AV Programs.

2. Why Nevada?

Nevada is an epicenter for innovation: there is no bigger stage for rolling out and promoting new ideas capitalizing on the testing and introduction of innovation. Nevada possesses some unique characteristics that make it an ideal candidate for becoming a designated AV proving ground, some of which are further described below.

2.1 Experience in Statewide Testing and AV Programs

Nevada is one of the few states that has practical experience in working with federal agencies to establish a statewide testing initiative. Through the Nevada Institute of Automated Systems (NIAS), a non-profit corporation, supported by GOED, has worked with both the FAA and NASA to designate the entire state for Unmanned Aircraft Systems (UAS) testing. NIAS works directly with the FAA to establish the clearances necessary to test UAS test vehicles statewide. NIAS is also working directly with NASA to spearhead the UAS Traffic Management program, which works to resolve traffic congestion as UAS programs become mainstream. Nevada will follow this model to prepare the necessary policies and programs needed to deploy statewide AV testing for the designated program initiative.

NIAS also supports the growth of the Nevada Autonomous Vehicle Industry through business teaming relationships, collaboration with primary research institutions, and helping enhance the UAS and AV industry knowledge base in order to attract new and permanent business within the State of Nevada.

The State of Nevada is partnered with the Nevada Automotive Test Center (NATC), an independent engineering, test and evaluation proving ground, in order to further the research and testing of automotive systems with heavy emphasis on AV initiatives. NATC has compiled an extensive database of worldwide operational and infrastructure conditions allowing accurate definition of user duty cycles and creation of test programs across a wide range of vehicle types representative of service environments encountered around the world. NATC is a leading innovator in translating real world conditions and user requirements into safe, repeatable test scenarios throughout the lifecyle of the vehicle from prototype development to production and post-production. NATC also has experience developing systems and subsystems to support autonomous and semi-autonomous vehicle operation over the past 20 years. Complete vehicle systems have included: four class 8 trucks which accumulated 800,000 miles of autonomous operation; fully autonomous hybrid electric vehicle development; semi-autonomous HMMWV; and design, engineering and test support for original equipment manufacturers.

NATC provides the necessary engineering, instrumentation and data acquisition/database management support to enable structured and safe real world evaluation of autonomous, semi-autonomous and sensor subsystems in a mixed fleet environment.

Nevada's plan is to leverage the capabilities and resources of the NATC to test AVs in a controlled, "test track", environment prior to testing across key corridors. NATC is also submitting an application and will provide an excellent partner and enhancement to the statewide efforts. More information can be found at www.natc-ht.com

Nevada agencies are in full collaboration for AV initiatives, lessening the amount of required bureaucracy needed to get initiatives accomplished. Many Nevada states agencies (including GOED, NDOT, DMV, B&I, DPS), Cities and Counties (Las Vegas, Reno, Henderson, Carson City, Clark County, Washoe County), MPOs (RTC-Southern Nevada and RTC-Washoe), and Universities (UNLV, UNR, and DRI) are already in full collaboration for AV initiatives, through the AV Task Force, created in January 2016. Since its inception, this task force has worked on developing joint policies and initiatives aimed at furthering AV programs (to include testing) across the State. Nevada's collaborative nature, coupled with the full support of the Governor's office, make it an ideal candidate for bringing initiatives to reality, such as quickly becoming a designated AV proving ground.

2.2 Nevada...A State of AV "Firsts"

Most recently, Nevada DMV and DPS have been focusing on truck platooning testing. They worked directly with the private sector to define test criteria and regulatory needs for truck platooning testing. Daimler Trucking, with the full support of Nevada, successfully conducted a series of truck platooning tests on Nevada highways October 31st through November 12th.

"I believe we now stand at the threshold of a new Nevada – a Nevada prepared to take its place among the most innovative, visionary, and well-prepared states in the union."

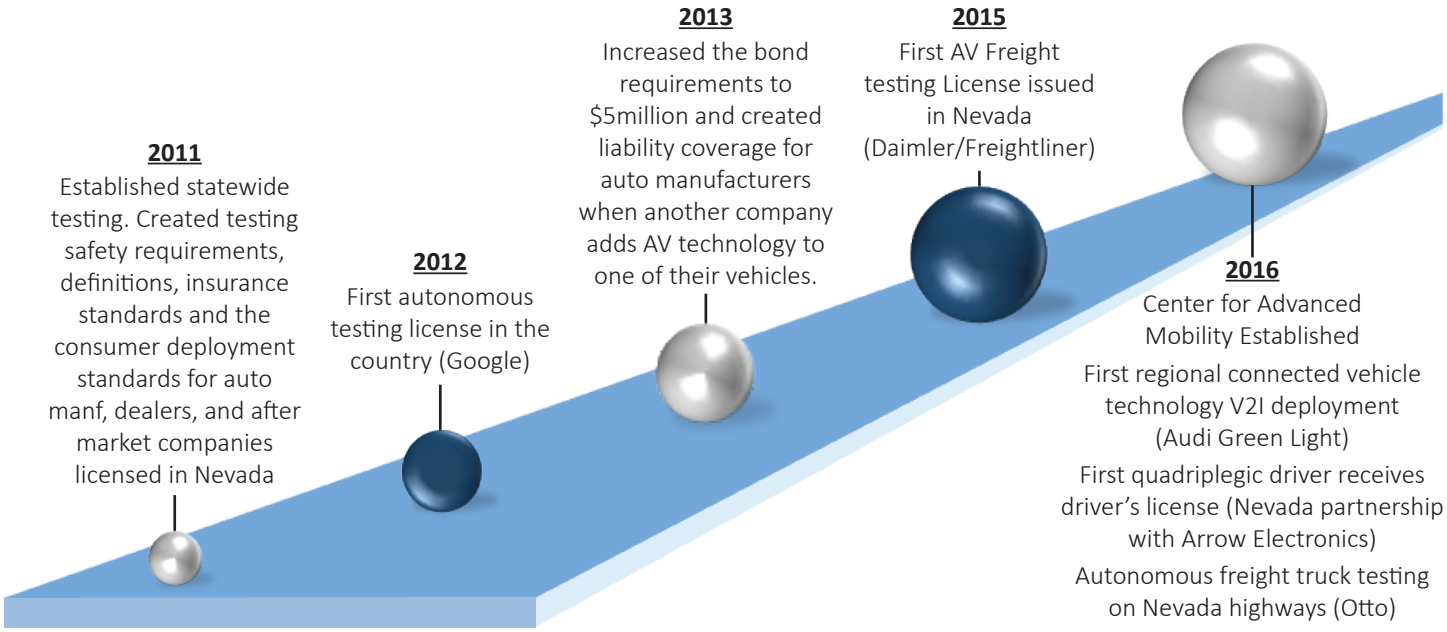
– Governor Brian Sandoval, State of the State Address, January 15, 2015

Nevada has been focused on AV programs for the last several years and has become the nation's frontrunner in developing and deploying policies to support AV testing and consumer deployment. Since 2011, Nevada has been exploring AV testing and the impacts AVs will have on enhancing multimodal transportation.

Some of Nevada's first include:

- **First** to create AV regulations for testing and consumer deployment
- **First** to create an AV testing program
- **First** to create an AV consumer deployment program
- **First** to license a company for AV testing (Google)
- **First** to license a commercial vehicle for testing
- **First** to license a company who created an vehicle for a quadriplegic test driver
- **First** to issue a restricted handicapped autonomous driver's license for testing
- **First** to issue to an Autonomous Technology Certification Facility (ATCF) consumer deployment license to an after-marker AV company
- **One of** 6 test sites for UAS. The only site to encompass an entire state.
- **First** regional deployment of connected vehicle technology through the Audi Green Light Program

Nevada's commitment to AV testing has surged over the past two years. In January 2016, Governor Brian Sandoval announced at the annual Consumer Electronics Show, the launch of the Nevada Center of Advanced Mobility (NCAM). This entity, housed within the Governor's Office of Economic Development (GOED) focuses on establishing Nevada as the nationwide leader in the testing and development of cars that drive themselves by serving as a single point of contact for this technology wishing to operate in the state. Since its inception, NCAM has focused on its mission by establishing policies, collaborating with private partners such as: Tesla, Faraday-Future, Toyota, Audi, Google, BMW, and Daimler, and coordinating with other state agencies such as NDOT, DMV, DPS, and B&I; as well as with major MPOs including the Regional Transportation Commission of Southern NV (RTC SNV), and Regional Transportation Commission of



Commercial and Passenger Vehicle Company Testing Licensing

- A Surety Bond cash deposit, insurance, or proof of self-insurance in the amount of $5,000,000;
- Proof that one or more of the applicant's AV's have been driven for a combined minimum of at least 10,000 miles in Autonomous mode, under varying types of roads, weather conditions and times of day and night;
- Safety plan for testing on public roadways;
- Plan for hiring and training the test vehicle operators.

Washoe County (RTC WA); to make Governor Sandoval's vision a reality and begin deploying programs that further the advancement of AVs while improving Nevada's overall economic health, motorist safety, and incubate innovation through expanded partnerships with private companies and universities.

2.3 An Optimal Statewide Environment for Testing

Nevada is an optimal environment for statewide testing. The state provides a wide array of population centers, varying environmental characteristics, an expansive freeway network comprising both freeway corridors and rural roads, where controlled and open road testing can be conducted safely.

Nevada contains four major population centers that provide a wide range of population, environmental, and traffic characteristics that can each be tested to evaluate how AVs operate in multiple settings. For AVs to be truly tested, they will need to be vetted in multiple demographic and population scenarios. Nevada's urban centers (Las Vegas, Reno/Sparks, Carson City, and Lake Tahoe) each provide varying urban and rural settings and varying terrain and weather which can each pose a unique set of challenges in testing AVs. Connecting each of these urban areas are hundreds of miles of rural highways, which provide safe and optimal test corridors for more controlled testing prior to launch in a more congested urban area. Through Nevada's statewide initiatives, city managers and transportation leaders for each of these urban areas are in full support of AV initiatives and are excited to continue testing AV programs throughout each of their areas.

Nevada also offers a wide range of environmental characteristics that can each be used to evaluate AVs in a myriad of environmental and terrain environments within hours of each other, instead of months like other states. Southern Nevada presents the dry terrain and climatic characteristics of a desert environment. Northern Nevada presents mountainous terrain with snow conditions that present a unique set of challenges for AV testing and integration.

Nevada's progressive political will, economic advantages for innovation companies, and vastly differing demographic areas, create the perfect environment to create a proving ground for AV programs.

2.4 Nevada Investments to Support AV Testing

In addition to establishing policies and tax incentives for AV companies, Nevada has already made considerable investments in the state to support future transportation needs. Some of these investments, which will be further leveraged to conduct AV testing, include:

- US-95 Electric Highway: In 2015, Nevada launched an initiative to deploy a series of Electric Vehicle (EV) charging stations and their associated infrastructure along US-95 from Las Vegas to Reno. Nevada intends to leverage this infrastructure and technology enhancements along this key corridor to support the testing of AVs from Las Vegas to Reno. This corridor is also designated as a future interstate (I-11) and was submitted as a possible test corridor for hyperloop.
- US-93 Infrastructure improvements: Nevada is also making initial investments in the technology and infrastructure on US-93 that connects southern Nevada to I-80 in Northern Nevada. This corridor provides freight mobility access and may also be used to test AV freight vehicles connecting southern and northern Nevada, and ultimately connect into I-80 for advanced freight mobility programs. US-93 presents a unique test corridor as it leads to the new Faraday Future Autonomous Electric Vehicle manufacturing facility; and is a location for the Hyperloop One "DevLoop" Test Facility.
- City of Las Vegas Innovation District: Nevada's statewide successes in launching advanced technologies and innovation has also been embraced by cities. In April 2016, city resolution R-3-2016 was passed that identifies the downtown Las Vegas urban area as an Innovation District. This Innovation District will provide increased visibility to technologies and complement mobility initiatives already underway in the state and the region. The Innovation District will house many AV-centric initiatives, the first of which is the deployment of an autonomous people mover along the downtown transit circulator. The City of Las Vegas, one of Nevada's key partners, is leading this initiative and is also submitting a proposal to become a designated AV proving ground. The coordination between the City, MPO, and State is a national example of multiple levels of government working together to accelerate technology.

3. Objectives, Plans, and Performance Metrics

In preparation of launching AV programs throughout the state, Nevada has developed several measureable goals, objectives, and long-term plans which will be used to not only monitor existing performance, but also set the stage for advancing AV programs across the country.

The objectives and plans already established for Nevada's AV initiatives closely align with the USDOT's vision and considerations. These objectives and plans, as well as some initial performance indicators are provided in the following subsections.

Nevada's primary goal is to review, research, determine and address the challenges of implementing AVs. This includes evaluating and addressing the following:

- AV testing and licensing requirements
- Consumer registration and titling requirements
- Insurance challenges
- Law enforcement challenges
- Legal challenges
- Security/Data Challenges
- Highway Infrastructure challenges
- Consumer Education

As these challenges are addressed, Nevada intends to expand AV testing to full multimodal capabilities and integrate AVs with other multimodal transportation options. Additionally, Nevada will continue to promote AV ubiquity through public and legislative outreach and education, collaborate with city, university, organizational, and private partners to foster the best in innovation, and work directly with organizations (i.e. AASHTO) to address the benefits and impacts AVs will have to operations.

3.1 Overarching Objectives

Nevada as already established some short-term objectives for deploying AV programs. In early April 2016, representatives from NDOT, GOED, and DMV convened for a chartering meeting to define the overarching charter for the Nevada AV Task Force, and identify some short term plans for fully developing the necessary organizational structure, policies, and plans necessary for furthering AV programs. Some of the plans included establishing a fully staffed and functioning organization focused on furthering AV policies and programs; conduct an infrastructure gap analysis along key corridors that could support AV testing; complete a Strengths, Weaknesses, Opportunities, and Threats (SWOT) analysis that identifies potential organizational and functional gaps, and defines ways Nevada's strengths can be utilized to mitigate gaps; and identify and evaluate alternative procurement strategies that protect the interests of Nevada but also incubate innovation and encourage private sector participation.

3.2 Safety

Safety considerations are at the forefront of Nevada's vision. The increased demand on infrastructure, coupled with expected population growth, has made ensuring the safety of Nevada's motorists, pedestrians, and bicyclists a challenge. In 2015, Nevada had 41,252 total crashes, which resulted in 325 fatalities. There were also 1,335 pedestrian and bicycle accidents that resulted in 83 fatalities. Given the anticipated growth, additional prevention means are necessary. The ability to AV programs will allow Nevada to not only focus on safety considerations relative to AVs and their operators, but also focus on ways AVs can help reduce crashes and fatalities both between vehicles and between vehicles and pedestrians and bicyclists.

Regarding AV safety considerations, Nevada, through NDOT, DMV, and DPS , will continue collaborating both with NHTSA and with other states to identify and address safety concerns relative to AVs. This will include evaluating the need for and identifying onboard redundant systems, maintaining and ensuring accurate sensor data, maximizing systems security to prevent unauthorized intrusion, and conducting full-scale human factors engineering to ensure information is readily and frequently conveyed to the AV operator while minimizing distractions and allowing for immediate and safe operator intervention. As a designated AV Proving Ground, Nevada will evaluate both federal and state safety considerations, identify use cases that fully test AVs against these safety considerations, and openly and collaboratively provide safety test data and results to NHTSA and other stakeholders for continued analysis. Based on the outcome of these tests, Nevada will also provide a series of safety recommendations and reports to USDOT and NHTSA that identify test results and new considerations relative to AV safety that can be included in future AV publications, guidelines, and ultimately, policies.

While AVs have their own unique set of safety challenges, a larger concern is how AVs will safely integrate with other non-autonomous vehicles. As part of becoming a designated AV Proving Ground, Nevada, will continue close

collaboration with NHTSA, to explore ways that AVs and their associated technologies can better protect Nevada motorists, pedestrians, and bicyclists. As part of this commitment, Nevada proposes that AV programs could decrease the number of crashes and associated fatalities by 15% over the next five years. Our designated Safety Officer, Ken Mammen, NDOT Chief Traffic Safety Engineer, will use this performance metric as the fundamental objective in evaluating AV programs.

Ken Mammen is NDOT's Chief Traffic Safety Engineer. He has over 25 years of experience with traffic safety, including extensive experience with safety data. His division is responsible for the State Strategic Highway Safety Plan including organization and staffing of the Nevada Executive Committee on Traffic Safety (NECTS) and the Highway Safety Improvement Program. He also has experience exchanging information and best practices nationally. Ken is an active member of several American Association of State Highway & Transportation Officials (AASHTO) committees, including the Committee on Highway Traffic Safety (SCHOTS) and the Subcommittee on Safety Management, where he is currently serving as Chair of the Towards Zero Deaths (TZD) Task Force. This task force primary function is to build upon the Toward Zero Deaths initiate and coordinate with States Zero Fatalities initiatives and the "Vision Zero" network, all in support of the parent AASHTO TZD Committee. He has represented NDOT on over 10 FHWA sponsored peer exchanges with many other states to share knowledge on various traffic safety topics.

Ken also has vast experience working with crash data. He has been instrumental over the past 5-10 years working with law enforcement across the state to develop a consistent crash and citation system. This new system, which should be fully implemented next year has data base capabilities which greatly enhance the crash reporting methods which will provide much more reliable and consistent data across jurisdictions.

The Officers have a map of their beat sector, it has auto population of approved street names, GPS location capabilities which will be utilized soon, auto population of ID information from bar scan technology, and other improvements that make data capture more efficient.

Ken has been working closely with the Department of Public Safety, including Nevada Highway Patrol and the Office of Traffic Safety for decades and has built an excellent working relationship with law enforcement and safety professionals throughout the state (and the country)

3.3 Regulations

As a result of Assembly Bill 511, the DMV was required to create regulatory requirements for testing standards, definitions, insurance standards, and standards for deploying technology to the public. The DMV identified numerous stakeholders (NHTSA, Auto Industry, Law enf., Insurance Companies, Nevada Automotive Test Center, and the Attorney General's Office) to help identify the issues and build a solution that will be accepted by all. The DMV was successful and by March of 2012, the regulations were adopted into law and have been the standard by which the DMV has operated. By May 2012, the DMV built their internal testing program and issued the first test license to Google. In 2015, the DMV partnered with Daimler Trucking to successfully issue the first autonomous commercial test vehicle. The DMV worked with NDOT, DPS, and GOED staff to coordinate, to date, the biggest media campaign around this milestone event and due to this multi-agency involvement, it was a great success.

In 2015, the DMV reached out to a company called Arrow Electronics to discuss their cutting edge technology that expanded the autonomous/automated definitions of today. Arrow Electronics technology was designed and created around a quadriplegic driver. The driver hired by Arrow was ex-professional racecar driver Sam Schmidt. The technology allows Mr. Schmidt to electronically control the vehicles brake and accelerator through a sip-and-puff method. The steering is controlled by sensors installed on his sun glasses that allows him to direct the vehicle. The DMV worked with Arrow to create additional safety testing requirements to ensure that our citizens and Arrow staff are safe during their testing. In addition, the DMV introduced the first quadriplegic autonomous restricted driver's license for Mr. Schmidt. The regulations dealt with the additional safety measures involved in this new technology and the liability issues under for a restricted driver's license for a handicapped test driver. During the regulatory process, the DMV worked with NDOT, DPS, GOED and the Governor's Office to create a media event for this next milestone in our autonomous program and to introduce Arrow's technology that one day could change the lives of millions of handicapped individuals. In 2016, the DMV continued to work with GOED, NDOT, DPS, and all other Nevada stakeholders to work with various ride sharing and after-market companies for test license opportunities and programs in Las Vegas.

In 2016, the DMV also worked with an after-market company called Otto to become the first business to successfully be licensed as an Autonomous Technology Certification Facility (ATCF). This allows Otto to attach and sell their autonomous technology for commercial trucks. As well, Otto was purchased by Uber and together they

will eventually begin to attach this technology to passenger vehicles. The DMV's consumer deployment regulations are based on a "self-certification" process along with minimal safety requirements the auto manufacturer/dealer and after-market company must comply with.

DMV is currently working with NAVYA and Varden Labs to issue a test license to each company. NAVYA is a fully autonomous ride share service and Varden Labs is another automated company who wants to test their technology on commercial trucks (after-market). NAVYA will be licensed on or before the end of December, 2016, and Varden labs by the end of January, 2017. The DMV is working with other companies who are interested in establishing their test license in Nevada. The DMV continues to partner with all stakeholders in a common sense approach to build safe testing and consumer deployment standards.

3.4 Data Research and Analytics

The influx of technology into transportation has led to an exponential increase in the amount of data that can be collected and analyzed. Nevada sees data as one of the foundational components to create a launching point for innovation, transforming Nevada into the state of the future.

One key element of the Nevada AV Proving Ground is the data collection and analytics engine, or Mobility Management Hub. This platform, developed and maintained by our university and commercial data partners, will collect sensor from AV probe test vehicles, transform that data into standard interoperable protocols, and integrate the collected data with other disparate data sources (state and municipal ITS networks including the USDOT award winning RTC-FAST system, Nevada's Road Weather Information System (RWIS), geospatial data (both commercial and provided by Nevada UAV test vehicles), and commercial data sets). This integrated data will then be analyzed by our university partners to both monitor AV test performance, and set the stage for enhanced statewide planning and robust information dissemination to our motorists through mobile apps, websites, and AV heads up displays. Nevada has already established an integrated a state-wide Highway Safety Information System to enhance decision making and save lives and prevent injuries on Nevada roadways. Law enforcement and other agencies collaborate by contributing state-wide traffic data to the Nevada Citation and Accident Tracking System (NCATS). NCATS is hosted by the Nevada Department of Public Safety. NCATS supplies traffic crash data to government and non-governmental agencies and the public through Nevada Department of Transportation Traffic Safety Engineering. NCATS data is used in many ways, from planning or mitigating roadway construction and improvement projects to safety program data for better, safer roadways and vehicles. NCATS data is also used to improve outcomes in emergency and trauma medical care. The Traffic Records Coordinating Committee (TRCC) and NCATS are funded through grants from the National Highway Traffic Safety Administration and NDOT's Federal HSIP allocation. Some of the foundational components of NCATS can be leveraged to support the Mobility Management Hub.

Initially, this data will be housed with our university partners. As test programs evolve, and the amount of data increases, Nevada could employ the resources of switch, one of the largest and most powerful data centers in the western US to house and maintain the Data Accelerator. Switch is also developing a highly robust superloop which will provide fiber connectivity between Los Angeles, San Francisco, Reno, and Las Vegas. This network will further support connectivity of AV test data between Nevada and California test sites.

Additionally, Nevada is committed to advancing open data, by making data accessible, discoverable, and useable by the public to fuel entrepreneurship and innovation. Nevada has data sharing agreements in place with private companies (Google Waze, Traffic.com) and the general public through GISMO (Geographic Information System Management Office)—cooperation through interoffice agreements—that already support the open, fully interoperable sharing of data. These partnerships will be expanded to include automotive and infrastructure technology data providers to allow increased integration of data and support data interoperability and testing of AVs.

To support these commitments, Nevada will launch a series of milestones that culminate in the development and deployment of a fully interoperable data collection and analytics platform. Within three months, Nevada will establish Memorandums of Understanding (MOUs) with automotive partners who have an interest in testing in Nevada. As part of developing these MOUs, using NCATS and our university partner models as examples, Nevada will establish a mutually agreeable Interface Control Document (ICD) which will fully define the data points and data formats which will be needed for the tests. The ICD will be vetted with each of our partners and used as a performance standard for any automotive or technology provider who wishes to conduct testing in Nevada.

At the same time, our university partners will begin designing and procuring the Data Accelerator. Initially, Nevada intends to use the RTC-FAST data center until the

Data Accelerator can be launched. Our end goal is to have the Data Accelerator fully designed, procured, installed, tested, and ready to accept data within six months.

3.5 Regional Collaboration

Nevada also sees the importance of collaboration with neighboring states. This collaboration can be used to share lessons learned, develop regional AV policies, and ultimately establish regional testing and performance criteria for AVs that may travel between Nevada and other states in the West. The regional plans and policies developed through joint collaboration between Nevada and other states (e.g. Arizona, Utah, California, etc.) can then be used to further regional programs, interconnect test facilities, and be used to establish a nationwide model for deploying AVs across neighboring, collaborative states.

Nevada is well equipped to tackle the task of regional collaboration. As a leader in establishing policies and plans for testing AVs, Nevada has also led large-scale regional collaboration initiatives such as the I-15 Alliance, a joint collaboration between Nevada, California, Arizona, and Utah, geared at improving safety, furthering freight movement, enhancing key infrastructure, and establishing regional administrative policies and funding models for one of the most critical corridors in the U.S (i15alliance.org). Relative to AVs, Nevada intends to establish policies and plans for launching AV testing along I-15 and will leverage the in-place collaboration with the I-15 Alliance to successfully deploy AVs across a major regional thoroughfare.

4. Approach for Becoming an AV Proving Ground

Nevada is primed to become an AV Proving Ground. Its innovation, collaboration with industry-leading technology companies, supportive and proactive legislators, and established policies for the testing and licensing of AVs make Nevada the optimal setting to become an AV Proving Ground. There are several key initiatives that Nevada will undertake to continue this momentum and further the state as the leader in AV testing and licensing.

4.1 Key AV Test Projects and Plans

To further support Nevada's designation as an AV Proving Ground, there are several key planned projects that will establish the foundation of AV testing including the establishment of dedicated test lanes along key corridors: US-95 for AV Passenger Vehicle Testing, US-93 and I-80 for Freight Mobility Testing, and US-50 for AV Passenger and Maintenance Vehicle Testing. Additionally, Nevada proposes leveraging the Nevada Automotive Test Center (NATC) as a controlled test track, where automobile manufacturers and technology providers can deploy their AV-related capabilities in controlled settings prior to launching on test corridors and multimodal environments. These projects are currently in planning and stages; however, could be expedited should additional grant monies or private sector investments could be made available.

4.1.1 AV Test Corridors

These projects would create dedicated lanes on key Nevada corridors for use in AV and Freight Mobility Testing. The candidate corridors identified for initial deployment are expected to encompass portions of interstate, state highway, and city roads including US-95 from the Las Vegas Innovation District to I-80 near Reno, and US-93 from the Las Vegas Innovation District to I-80 in Wells. As these projects mature, and regional collaboration with neighboring states can be further established, these corridors could also be expanded to stretch US-95 to Southern California and US-93 to Arizona; to allow for regional testing in a multi-state environment.

The plans for each of these corridors is to establish dedicated lanes for AV and Freight Mobility testing. As needed, Nevada will conduct the requisite studies, appropriate virtual and physical safety measures, and coordinate with city, county, and state agencies to safely test AVs. These tests would initially be in rural, less populated areas, but would eventually expand to more congested areas and eventually be tested along these corridors fully integrated with other multimodal transportation alternatives.

Additionally, each of these corridors would be outfitted with Information and Communications Technology (ICT) infrastructure including sensors, Dedicated Short Range Communication (DSRC) and 4G/5G cellular radios, Closed Circuit Television (CCTV) cameras, Dynamic Message Signs (DMS), Radar/Lidar, and fiber optic communications infrastructure. This ICT would collect and disseminate information from each of the test vehicles (AV and freight vehicles) for analysis and integration with other transportation data sources. Nevada has already installed robust fiber optic communications backhaul along these corridors so the integration of ICT and connectivity to test operations centers,

research laboratories, and traffic management centers, can be easily accommodated with very little infrastructure improvements needed.

Nevada is also launching programs to test autonomous and connected maintenance vehicles. This includes autonomous snowplows in the snow areas of Nevada, namely along US-50 and I-80; and connected roadside maintenance vehicles that can integrate with AVs to display locations and provide alternate routing and automatic lane shifting in road maintenance areas.

4.1.2 Transform the Nevada Automotive Test Center into an AV Controlled Test Facility

The Nevada Automotive Test Center, headquartered in Silver Springs, NV, is an independent test, evaluation, design and engineering facility offering development and compliance testing for passenger, commercial, and military vehicles. NATC provides dynamic test environments that can conduct full turnkey component and operational testing for a variety of systems. The test time spent at this facility could be used to meet the 10,000 autonomous miles requirement for licensing AVs.

NATC currently has a variety of test tracks that represent performance over urban environments, suburban environments, and rural areas. These test tracks can be used to evaluate the performance of an AV in a controlled environment. Additionally, NATC provides expertise in white box to provide cyber security evaluations on the vehicles intelligent systems to identify potential threats during evaluations. Other operational scenarios including Vehicle to Pedestrian, Vehicle to Bicycle, and Vehicle to Freight would also be tested in a controlled environment prior to launch along the test corridors. Passenger car to class 8 truck interaction including potential loss of control events (steer, tire blowout, obstacle avoidance, split coefficient lane to shoulder deviation, etc.).

Given the investment, NATC could be outfitted with additional infrastructure to provide testing in additional urban, suburban and rural settings and multiple weather scenarios (heavy rain, snow, fog, etc.). The facility would be constructed in a flexible manner where operational settings could be easily changed based on the types of testing to be conducted. Data collected from AV test vehicles at NATC will be integrated into the State of Nevada's planned data management system.

4.1.3 Other AV-related Projects

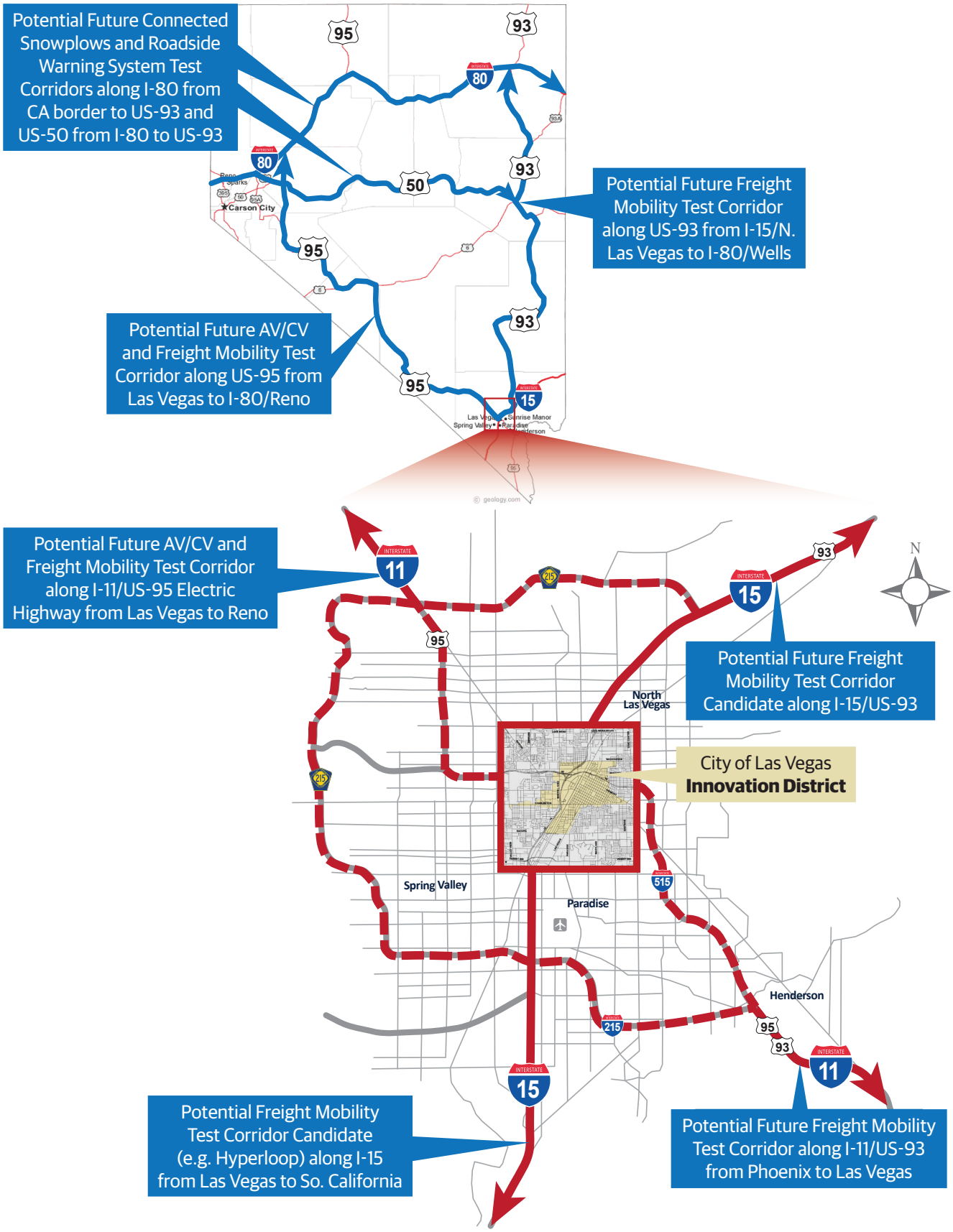
In addition to providing test facilities and corridors, Nevada is also deploying a series of other AV-related projects that can be integrated with the AV Programs, and enhance the overall AV initiatives.

4.1.3.1 Autonomous Snowplows

The Autonomous Snowplow project involves an automated snow removal fleet of trucks incorporating Nevada's existing RWIS (Road Weather Information System) in northern Nevada in connecting the trucks together to provide information on road and weather conditions and locations to feed back to the public. The project would build off of the existing advances in snow removal fleet technology in operation by NDOT, and will greatly improve motorist and plow operator safety and reduce incidents from adverse weather conditions.

Under this project, existing NDOT snowplows would be outfitted with AV ICT (sensors, Radar/Lidar/FLIR, GPS, DSRC/5G cellular) and robotics capabilities. Additionally, key corridors in northern Nevada (initially I-80 and ultimately expanded to include US-395, I-580 and US-50 and other highways) would also be outfitted with similar ICT to support data collection and information transfer between plows and motorists. Lane beacons will also be installed along these corridors to keep plows aligned during heavy snow conditions.

During heavy snow conditions, these plows would be deployed to conduct normal snow removal operations. During these operations, the plows would collect and analyze data from Nevada's RWIS and other data sources to both maintain plow safety, and provide information to motorists (through DMS, traffic apps, and vehicle heads-up displays) to show plow locations, current weather conditions, and identify potential route alternatives to promote motorist safety.


Potential Future Connected Snowplows and Roadside Warning System Test Corridors along I-80 from CA border to US-93 and US-50 from I-80 to US-93
Potential Future Freight Mobility Test Corridor along US-93 from I-15/N. Las Vegas to I-80/Wells
Potential Future AV/CV and Freight Mobility Test Corridor along US-95 from Las Vegas to I-80/Reno
Carson City
Potential Future AV/CV and Freight Mobility Test Corridor along I-11/US-95 Electric Highway from Las Vegas to Reno
Potential Future Freight Mobility Test Corridor Candidate along I-15/US-93
North Las Vegas
City of Las Vegas
Innovation District
Spring Valley
Paradise
Henderson
Potential Freight Mobility Test Corridor Candidate (e.g. Hyperloop) along I-15 from Las Vegas to So. California
Potential Future Freight Mobility Test Corridor along I-11/US-93 from Phoenix to Las Vegas
N

4.1.3.2 Connected Roadside Warning System

The Connected Roadside Warning System includes outfiting road maintenance vehicles (such as crash attenuators, message sign trucks, and service vehicles) with ICT to notify motorists of exact maintenance crew locations, and greatly improve motorist and road worker safety. Additionally, road worker safety gear (vests, hardhats, etc.) could be outfitted with small GPS transmitters and Bluetooth radios that would transmit worker location and further prevent injuries resulting from crashes. The information collected from the maintenance vehicles and workers would be collected by a crash attenuator and then transmitted via cellular communications to NDOT's TMC to show the exact location of maintenance activities. This information would be disseminated to motorists through heads-up displays, mobile apps, and AV crash avoidance systems. This technology could be integrated with other AV/CV corridor test scenarios to further enhance the multimodal test experience.

4.2 Expand AV Task Force Organization

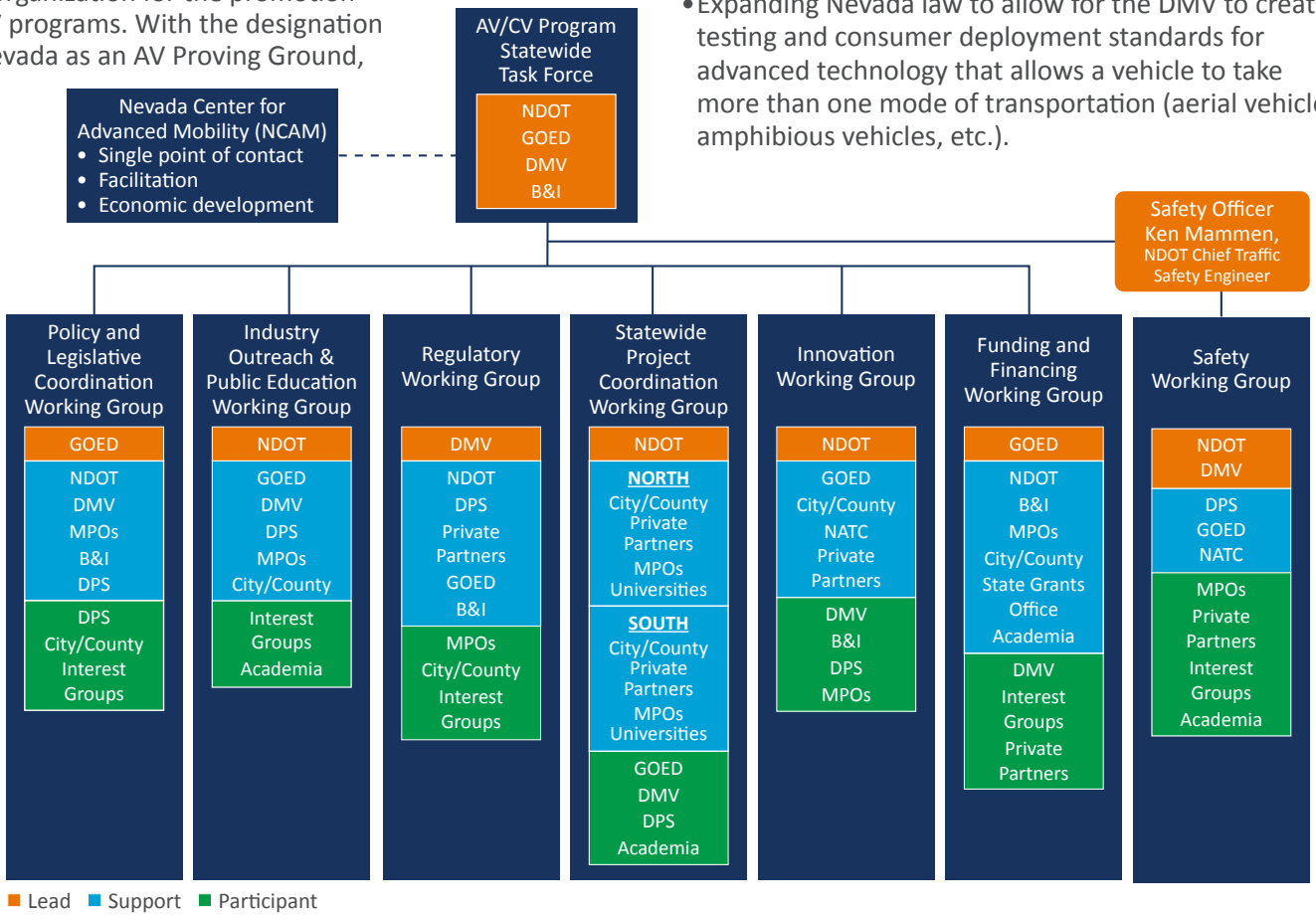
As previously mentioned, Nevada has developed an AV Task Force focused on establishing statewide collaboration and organization for the promotion of AV programs. With the designation of Nevada as an AV Proving Ground, Nevada will expand this existing organizational framework to include federal agencies (NHTSA, FHWA), private sector partners (automobile manufacturers and technology providers), and other states. The framework Nevada has developed can also be used as a model for other states that are not as mature in the organizational development. Eventually, Nevada intends to establish a Southwest AV Center of Excellence where Nevada, and their partners in neighboring states can collaborate on regional policies, requirements, operational scenarios, and test criteria. Additionally, Nevada wishes to interconnect their test facilities and corridors into other state corridors to create a regional network of test facilities.

4.3 Policy and Regulatory Plans

To further advance AV testing and consumer deployment in Nevada, additional and updated policies are intended. Some of these include a second set of regulatory revisions to address the following topics:

Additional Statutory Requirements or Advancements:

- Expanding Nevada law to have the authority to create platooning testing and deployment standards with industry partnership
- Expanding Nevada law to allow for the DMV to create testing and consumer deployment standards for advanced technology that allows a vehicle to take more than one mode of transportation (aerial vehicles, amphibious vehicles, etc.).



Additional Regulatory Requirements:

- AV testing penalties for companies who do comply with Nevada requirements.
- Research technology advancements in autonomous vehicles that are controlled by an operator or person that is outside of the vehicle during testing.
- Review current testing requirements to determine what is relevant with the knowledge we have today.
- Incorporating additional commercial truck testing rules to ensure testing remains safe.
- Review current consumer deployment requirements to determine if additional "self-certification" rules are needed.
- Create additional regulatory requirements that address autonomous vehicles being transferred to Nevada and registered.
- Work with Nevada law enforcement, attorney general's office, and auto industry stakeholders to identify and create the best practice for retrieving crash data that does not violate a person's rights, acceptable for industry, and the most efficient for law enforcement.

Policy Programs:

- Enhancing DMV's current electronic interface with law enforcement to ensure they can retrieve test license and consumer deployed information for autonomous vehicles.
- Enhancing our testing program to create a web-based system for companies to apply and submit required documents.
- Continue to work with Nevada Center for Advanced Mobility to build State programs for autonomous projects (AV ride sharing, AV limo's, AV deliver services, AV bus shuttles, etc), connected vehicle, vehicle to infrastructure connectivity, intelligent traffic control systems, etc.

4.4 Economic Development Plans

As part of becoming a designated AV Proving Ground, Nevada plans to leverage AV initiatives to further bolster its economy. The core initiative is the creation of the Nevada Center For Advanced Mobility (CAM). Nevada CAM creates advanced mobility opportunities for visitors, residents and industry. For the millions of visitors every year mobility plays a major role and Nevada CAM aim to make the experience memorable by showcasing the most advanced technology solutions. Opportunities for residents involve providing a range of mobility options for the residents of Nevada while addressing the challenges of safety, congestion and capacity. In industry Nevada is well known for its welcoming business environment but for advanced mobility we go the extra mile. Automotive manufacturing through to big data are supported by empowering legislation through to world's largest data center ecosystem.

4.5 Nevada Plans to Augment Social Initiatives with AV

In addition to using AV programs to improve motorist safety, enhance mobility, and bolster the economy, Nevada plans to use AV programs to support several social initiatives, geared at improving mobility for economically underserved populations and disabled residents, enhancing mobility in rural populations, and using AV programs and their associated technologies to improve overall Nevada air and water quality.

One of Nevada's plans for AV programs is to provide improved mobility to underserved populations. One example of this is the City of Las Vegas' plan to deploy an autonomous circulator around the innovation district, an area which was hard hit with Nevada's economic downturn. The circulator will initially provide autonomous pick up and drop off service at key points throughout downtown Las Vegas and is expected to be expanded to key economically underserved residential areas.

This program will also be expanded to provide autonomous mobility for physically disabled residents to travel from their residences to key locations, such as medical campuses, social service centers, and key shopping districts. As previously mentioned, Nevada recently provided a driver's license to the country's first quadriplegic driver, Sam Schmidt, who can drive on Nevada roads in a semi-autonomous vehicle. Nevada plans to further this initiative through increased AV testing and licensing, and ultimately support mobility for disabled residents using AV or semi-autonomous programs.

Nevada intends to continue being a leader in AV programs and having the designation as an AV proving ground will only further support that intent. Regardless of the outcome, Nevada will continue to creating policies, partnerships, and initiatives that can further the advancement of AVs and ultimately lead to their ubiquity in a safe environment for all motorists while enhancing mobility and supporting many social initiatives that can immediately benefit from AV programs.

5. Conclusion

Automotive technology is rapidly changing. The operational considerations and impacts that AVs will have on transportation is still largely unknown. As this technology and its associated operational considerations evolve, new stakeholders will need to be brought into the discussions to ensure enhancements, considerations, and policies occur in lock-step versus creating conflicting paths and ideas. One of the biggest strengths, Nevada can offer as a designated AV Proving Ground is its' strength in collaboration, built on a strong foundation of policy and planning. Every level in the state are "all in" from the Governor to state agencies, from MPO's to individual cities across the broad state. This collaboration is unique and has helped Nevada move the needle on AV initiatives across the country. Nevada is a state that is nimble to react and flexible to accommodate unknowns. For the past six years, they have quietly built a base to identify issues and challenges and address such and to grow and implement the new and exciting technology.

For AV programs to be successful, a full collaboration between policymakers, public officials, universities, and private-sector innovators must occur. Nevada has already established this foundation and continues to be the model for other states to view when exploring how to effectively collaborate in this exciting and ever changing AV environment. By becoming a designated AV Proving Ground, Nevada will expand this collaborative effort and work towards interconnecting its corridors and facilities with other states to create a nationwide network that can help propel US AV initiatives across the world.

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RTC SNV – Tina Quigley, General Manager

GOED – Steve Hill, Director

RTC Washoe – Lee Gibson, Executive Director

NCAM – Robert Clark, Director

City of Las Vegas – Mayor Carolyn Goodman

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