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Cellepathy Inc.
Docket comments to
NHTSA-2013-0137
Draft Visual-Manual NHTSA Driver Distraction Guidelines
for Portable and Aftermarket Devices (the "Guidelines")

Background on Cellepathy

Cellepathy was founded in 2010 to develop a technological solution to the "Passenger Problem", and, in so doing, pave the way for a practical, enforceable solution to mobile device-based distracted driving.[1] Our central contribution is the Passenger Verification Task™ ("PVT"), which NHTSA describes on page 49 of the Guidelines.[2] PVTs are a critical piece of technology that make it possible for distracted driving enforcement software to allow ***passengers*** to dismiss Driver Mode without creating a loophole that can be misused by ***drivers***.

Cellepathy's singular focus on distracted driving prevention technology has led to approximately 50 filed and pending patent applications—perhaps the largest portfolio in the world on the subject. The company is primarily made up of inventors, software developers, algorithmic engineers, and experts in various fields of technology including driver psychology, human-machine interfaces, and more.

We have been involved in government and industry efforts to address the epidemic of distracted driving since our first meeting with Secretary Ray LaHood in 2012. During 2013-2014 we participated in the Consumer Technology Association (CTA) working group on Reducing Visual-Manual Driver Distraction. Also in 2014, NHTSA invited us to participate as an expert panelist in its first (and to date, only) public meeting on the subject of Driver Distraction Guidelines for Portable and Aftermarket Devices.[3] That meeting, almost three years ago, ultimately culminated in the publication of the draft Guidelines.

We warmly welcome this document, and note with particular optimism NHTSA's declared intention to begin testing consumer products for compliance with them. Although the right of the US Department of Transportation to regulate mobile devices for safety purposes has been challenged by others in the

[1] A technology columnist for the New York Times coined the term "Passenger Problem" in 2010 when referring to the need of any distracted driving management system to treat drivers and passengers differently. Without a solution to the Passenger Problem, distracted driving systems must treat all users the same—which either means unfairly restricting passengers, or allowing drivers to claim to be passengers and endanger themselves and others.

[2] The PVT is a brief action that can be easily performed by a passenger, but which, by construction, cannot be performed by the driver of a moving vehicle. Cellepathy has invented several different types of PVT; two of them are shown in this video https://youtu.be/NndeKlyDPko. Just as there are many ways to prove to a smartphone that you are an authorized user and not a thief (i.e. typing a secret PIN, swiping a unique pattern, or presenting a thumbprint), there are many ways to prove that you are a passenger and not a driver.

[3] This excerpt shows Cellepathy's presentation to the Advanced Technology Expert Panel at the Phase 2 public kickoff meeting on March 12, 2014 https://youtu.be/sqlSMYOOT04.

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industry, Cellepathy supports the DOT's position. Smartphones are now a platform for sophisticated turn-by-turn navigation, voice assistance, and other applications—they have become the most ubiquitous of all driving aids. It is therefore entirely appropriate for them to fall under the jurisdiction of the DOT. Further Government action on distracted driving at the federal level is sorely needed, and these "voluntary guidelines" are an important step in that direction.[4]

Some type of regulatory or legislative action is required because the mobile ecosystem will not take action on its own. Distracted driving safety technology is not something that will help sell more phones and therefore the profit motive will not drive development of such technology. (Everyone wants the ***other*** driver to use safety interventions, but few will use it for themselves.)

The traditional three-pronged approach to modifying driver behavior (legislation, education, enforcement), which was so effective at increasing seatbelt use and reducing drunk-driving is a poor match for the challenge of distracted driving. If you start a drive in a responsible state of mind and apply your seatbelt, the seatbelt does not repeatedly test your willpower by unbuckling itself numerous times throughout a trip. However, a mobile device is designed to constantly reach out for your attention with new beeps, lights, and notifications. When you crash or are pulled over, if you were driving under the influence you can't just stop being drunk or high, but if you were using your phone a moment before you can immediately switch it off and deny having done anything wrong. There are significant obstacles to accessing phone or text records after a crash, and even once acquired by the police, cellular records don't show email activity or other types of messaging (Facebook, Snapchat, WhatsApp). Reviewing those other forms of communication requires either access to the servers of those companies or a detailed review of the device in question. Finally, many forms of media consumption (e.g. reading, playing games, watching videos) leave little or no record and are therefore nearly impossible to prove under even the best of circumstances—today.[5] For all of these reasons, the difficulty of enforcing distracted driving by traditional means significantly undercuts the deterrent effect of the law and erodes the effectiveness of public education efforts.

Therefore, integrating government-mandated safety technology that can actively prevent dangerous driver behavior without restricting passengers is crucial for the safety of road users everywhere. Once such technology exists at a sufficient level of maturity, Cellepathy hopes that governments around the world will begin to regulate or legislate its widespread deployment. Our hope is that NHTSA's

[4] The Federal Communications Commission already regulates mobile devices for safety (limiting the strength of the wireless signal radiation they may emit) but not from the perspective of driver distraction.

[5] There exists a mobile forensics device, commonly referred to as a "Textalyzer", which police officers could physically connect to a driver's smartphone in the field in order to extract a log of recent mobile device use—in much the same way that a Breathalyzer is administered. A bill known as Evan's Law, which would permit the use of such technology in New York State, is pending. Cellepathy is not sufficiently familiar with the capabilities of this device to know whether browsing the internet, playing games, or watching videos would show up in the Texalyzer's logs (cellular phone calls and SMS texts certainly would) but nevertheless we support the use of any method that can effectively deter any type of dangerous driver behavior.

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Guidelines will provide a framework that will encourage the development, and eventual adoption, of such technology in the U.S. and worldwide.

Cellepathy's Comments to the Guidelines

This document represents Cellepathy's formal public comment to the Guidelines. At a high level, we have three main suggestions:

1. Driver Mode should support programmatic activation and configuration by 3rd party software;

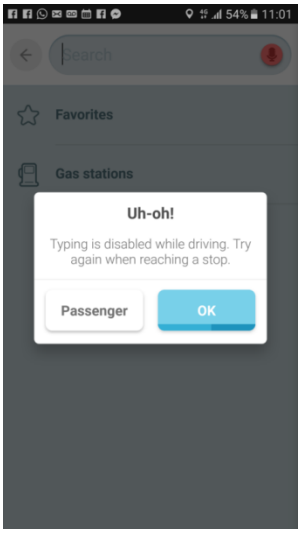
2. The Guidelines' definition of the "authentication task" should be amended to include non-skill based, non-time-based tasks; and

3. Active Passenger Differentiation should be included as an appropriate "Near-Term Option" for activating Driver Mode when nomadic devices are not paired to a vehicle, with Figure 1 (Flow Diagram) amended accordingly.

Cellepathy offers a detailed discussion of these suggestions in the following sections.

In addition, we feel that the Guidelines should acknowledge the efforts being made by certain actors in the mobile ecosystem to encourage the responsible use (or avoidance) of their products by drivers. Over the past few years, developers across a range of industries—among them navigation, gaming, and social media—have added various warning screens and pop-up messages reminding drivers not to engage in certain activities on their devices. For example, the navigation app Waze, the augmented reality game Pokémon Go, and the visual media sharing app Snapchat have all introduced an "I'm a Passenger" button or other warning screen.

WAZE (navigation)



Pokémon (game)

Snapchat (social)

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Such a button appears whenever a GPS signal indicates that the user is travelling at driving speeds, and forces the user to dismiss a warning screen before they can type, take a selfie, or otherwise interact with the software. While this approach is not an effective ***enforcement*** solution, it does serve as a safety reminder which raises the user's awareness of distracted driving risk at a critical moment, and offers a symbolic deterrent that may shorten the duration of the unsafe behavior even if it does not prevent it. This approach is preferable to ignoring the issue completely and therefore, in our opinion, it is worthy of recognition and encouragement by NHTSA.

There is one more point to address before we proceed to the substance of this document. NHTSA asks (in page 12 of the Guidelines), whether combining Phase 1 and Phase 2 into a single document would be preferable to keeping them separate. In Cellepathy's opinion, it is easier to reference and search a single document.

1. Activation of Driver Mode

NHTSA's recommendation that makers of the mobile operating systems ("OS") and device manufacturers build Driver Mode into their products is the most important element of the Guidelines—and indeed, of the DOT's Blueprint for Ending Distracted Driving. Because the vast majority of drivers use unpaired devices, establishing a Driver Mode that activates automatically when a device is being used by a driver is the most effective way to reduce the frequency of avoidable crashes. It is also the most effective way to incentivize drivers to pair their devices with in-vehicle infotainment systems. Drivers are hungry for connectivity, and when their mobile devices are selectively restricted for safety, they will be far more likely to purchase and use the connectivity interfaces built-in to the automobile.

The OS and device manufacturers (together, the "Makers") are uniquely qualified to build Driver Mode. Unfortunately, to date, this task has been left to third-party developers of distracted driving prevention systems like Cellepathy – who are far less well equipped to so.[6] Building the OS-level features that Driver Mode requires, without access to the lower-level OS functionalities that only Makers have, is an incredibly complex task. It is also a tremendous duplication of effort and waste of scarce resources which has resulted in many distracted driving innovators abandoning their efforts, or going bankrupt over the years.

Once the Makers have built Driver Mode into their products, the entire ecosystem will benefit and the field can be thrown open to innovation. Companies like Cellepathy will be able to focus their efforts on improving other required technologies. These include sensor algorithms to autonomously detect trip starts and trip ends ("Trip Detection"), algorithms to determine whether a trip is on a two-wheeled vehicle, a four-wheeled vehicle, a bus, or a train ("Vehicle Type Inference"), techniques that allow

6 Dozens of first-generation distraction prevention solutions have been introduced to the market over the years by other third-party software developers. Most of them have since disappeared.

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passengers to ***prove*** that they're not driving ("Active Passenger Differentiation") and methods of ***automatically*** differentiating drivers from passengers ("Passive Driver Detection").

However, there is a grave danger. As currently written, the Guidelines call for only three methods of applying NHTSA's safety principles:

i. Voluntarily, by the user, when pair their device to an in-vehicle system (via a cable, smart-dock, or wireless sync—whether manual or automatic);

ii. Voluntarily, by the user, when they press a button or provide some other input (the same way Airplane Mode is applied—or not applied—by users today); and

iii. Non-voluntarily, by the device itself, when some future form of driver detection becomes available.

Cellepathy strongly urges NHTSA to add an additional method to this list. Specifically, the Guidelines should explicitly recommend that Driver Mode be designed in such a way that third-party software can programmatically activate it and fully configure it. This is an absolute requirement for continued innovation in the distracted driving safety space. If the Makers (Apple, Google, and others) build a Driver Mode that can ***only*** be activated by pairing the phone to a vehicle or pressing a button, Cellepathy and technology providers like us will be excluded from the playing field.

This would be disastrous for the future of distracted driving prevention technology. The autonomous "driver detection" tech that NHTSA calls for in the Guidelines can only emerge in an open environment that is conducive to innovation. Small companies, like Cellepathy, are the ones investing time, money and creativity into solving the Passenger Problem, improving Trip Detection, and developing Vehicle Type Identification. The largest companies in the mobile ecosystem are not properly incentivized to invest serious resources into developing those capabilities to the degree of accuracy and reliability required by a distracted driving prevention system. If the Makers develop Driver Mode in a way that limits the ability of Cellepathy and other tech innovators to work with it, innovation will stagnate and NHTSA's Preferred Option of the future will never appear.

2. Definition of the Authentication Task

On Page 49 of the Guidelines, NHTSA specifically addresses Cellepathy's concept of the PVT, which we introduced to the world at the Phase 2 Public Kickoff Meeting in Washington, D.C. almost three years ago. The Guidelines refer to this technology as an "authentication task". It can also be described as ***Active*** Passenger Differentiation (as distinct from automatic, or ***Passive*** Driver Detection).

Our comment to this section is quite straightforward; not all Passenger Verification Tasks are skill-based or attention-based; some PVTs are location-based. For example, using the camera to prove that you are located somewhere in the vehicle other than behind the steering wheel is not ***challenging*** for a passenger (it's actually incredibly easy) and it is not ***challenging*** for a driver either (if properly

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designed, it's impossible). In addition, there are some PVTs that are impossible for drivers even given infinite time. For this reason we suggest the following improvements to the relevant paragraph in the Guidelines for accuracy and readability (deletions are shown in red strikethrough and additions are shown in blue bold):

> "Finally, a device-only solution uses an ~~authentication task~~ **active** approach where a device automatically goes into a limited use state (e.g., Driver Mode) at a speed threshold, and a quick, ~~but challenging~~ **authentication** task is required to re-enable full functionality on the device. These authentication tasks are designed to be quick and easy for non-drivers, but nearly impossible to complete successfully ~~within the short time limit~~ for drivers."

3. Adding a "Near Term Option" to NHTSA's call for a "Preferred Option"

Page 11 of the Guidelines describes NHTSA's Preferred Option for how Driver Mode should function on an unpaired mobile device while it is in a moving vehicle. This is the scenario that describes most situations prevailing on the road today (and in the foreseeable future). The majority of mobile devices in America are purchased, used, and eventually replaced without **ever** having been paired to a vehicle's infotainment system. These devices accompany their owners throughout the course of everyday life (stored in a pocket or purse, held in the hand, resting on a desk, etc.) and only occasionally travel inside of a moving vehicle. Of the time they *do* spend in a moving vehicle, their owner or user is only the driver for a fraction of that total time—the rest of the time their owner/user is a passenger. For this reason, the Guideline's treatment of unpaired devices—the Preferred Option—is the potentially the most significant piece of the entire document.

Unfortunately, from a technological perspective the Preferred Option is the most complex. It is not feasible today nor will it be in the near future because it requires Passive Driver Detection technology (e.g. the ability to automatically, passively, detect "that it is being used by a driver who is driving"). In other words, it requires a smartphone to autonomously make this determination—*without the need for any action or cooperation on the part of the user*. The ability to do this using only the sensors on the mobile device—in real time—is the "Holy Grail" of distracted driving technology. However it is also notoriously difficult to make such a determination with the LOW LATENCY and HIGH ACCURACY required of a mandated distraction prevention solution. This is a technological area in which Cellepathy has a significant IP portfolio and significant R&D experience with a team of professors, PhDs and algorithmic engineers. It is our expert opinion that such technology is still a very long way off. We are not aware of any companies that even claim to come close to solving it.[7] The Preferred Option may be available someday, but not someday soon.

For this reason, we urge NHTSA to call for an intermediate option, which is much more feasible technologically and can be achieved within the next year or two given the appropriate tailwind. Such a "Near Term Option" would fall on the timeline between what the Guidelines refer to as the "2nd Option" (currently available) and the Preferred Option (very far off). When combined with a Driver Mode provided by the Makers, the Near Term Option would result in a significant reduction of deaths and injuries from crashes related to mobile distraction.

[7] Several companies are developing techniques (driver-signature methods, GPS-based methods, device-usage-based methods) to solve the Passenger Problem in the Usage-Based-Insurance ("UBI") space. However, UBI tracks activity in the background and does not change the behavior of the device. It therefore has much lower standards of accuracy and latency than Distracted Driving protection, which must engage in real-time and can almost never be wrong.

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Whereas the Preferred Option requires Passive Driver Detection, a type of technology which may never achieve sufficient reliability, the Near Term Option leverages two types of technology that already exist and are rapidly improving. These are (1) Vehicle Type Inference, (2) and Active Passenger Differentiation. (Both the Preferred Option and the Near Term Option rely on autonomous Trip Detection technology—which already exists today at a high level of maturity—to know when a device is in a moving vehicle.[8])

Vehicle Type Inference (the ability to know what *kind* of vehicle the device is in—bus, train, car, truck, etc.) is an area of technology which is being actively developed by a number of different companies, particularly those aiming to serve the Usage-Based-Insurance industry. In addition to the efforts of a number of massive multinational companies, many millions of venture capital dollars have been invested into startups working on this problem over the past several years and solutions are already emerging.

Active Passenger Differentiation, as mentioned earlier, is already available in the market, with new techniques under development and coming soon. Cellepathy's current PVT takes a passenger approximately 7 seconds to prove that they are not driving. Our camera-based techniques promise to bring this time down to just 1-2 seconds. Furthermore, Apple invented and disclosed camera-based concepts in a patent they were granted in 2014, and there may be other types of active techniques that we are not aware of or have not been invented yet.[9] NHTSA's encouragement of this approach will further drive the refinement of existing Active Passenger Differentiation techniques, not to mention the invention of new ones.

To show how the Near Term Option would fit into NHTSA's current vision, on the next page we have reproduced Figure 1 from page 56 of the Guidelines document.

[8] Cellepathy's movement detection algorithms, for example, require less than 5% of a typical smartphone battery per day, on average, to autonomously detect the start of a trip within 30-60 seconds (and the end of the trip within 60-90 seconds) with an accuracy rate greater than 99.99%.

[9] Apple's patent 8,706,143 discloses a passenger authentication task: "For example, the holder of the device can be required to pan the camera around the vehicle (e.g., 360 degrees), so that the camera can take either a series of pictures or a video. The picture/video data can be digitally analyzed by scenery analysis programming in handheld computing device to determine if the holder of the device is deemed to be in safe operating area". This technique is a bit cumbersome when compared to Cellepathy's more passenger-friendly PVTs, but it was quite innovative when originally filed in 2008.

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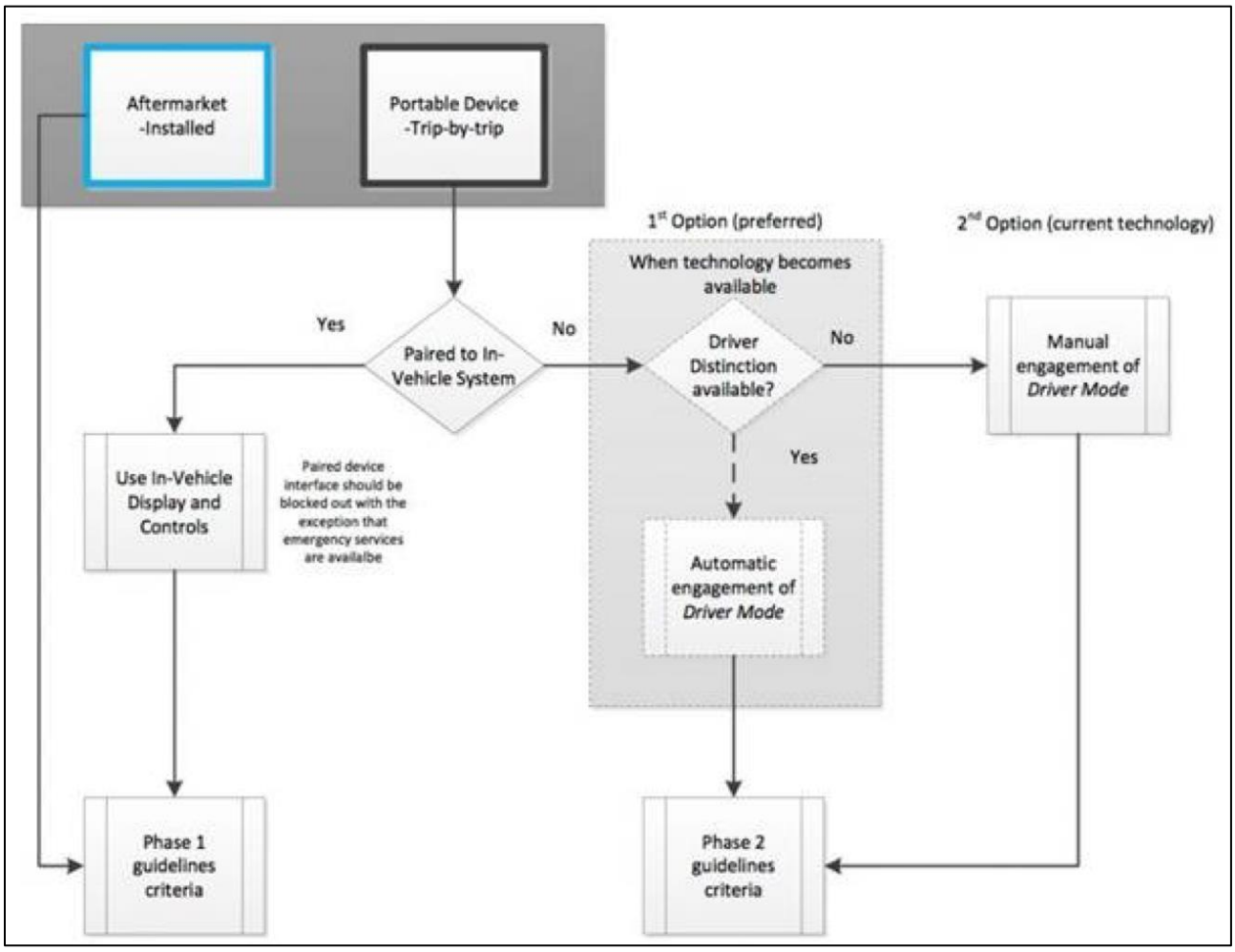

Illustration 1: Reproduction of Figure 1 from page 56 of the Guidelines.

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As noted earlier, the most important pieces of the preceding flow diagram are those that refer to the three possible scenarios of an **unpaired** device: (1) not in a vehicle, (2) in a vehicle while its user is a passenger, and (3) in a vehicle while its user is a driver. In the following illustration we simplify the flow diagram by removing the references to infotainment systems and paired devices, making it easier to focus on the unpaired sections.

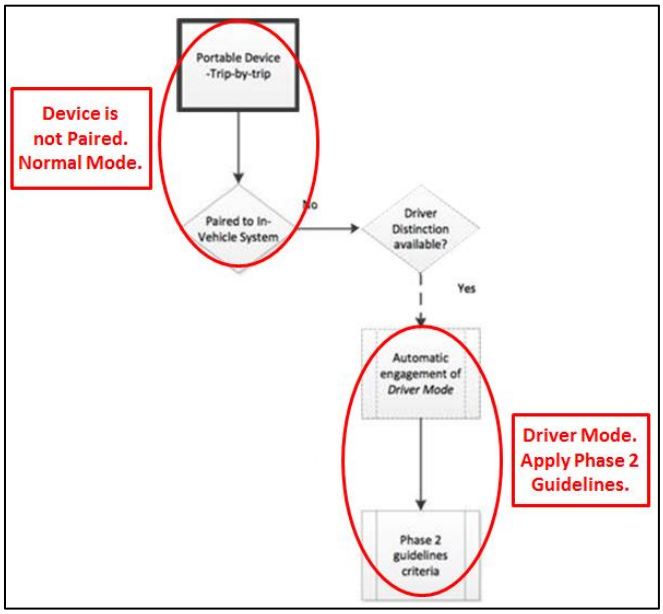

Illustration 2: Portions of the original Figure 1 with sections related to aftermarket systems and paired devices removed.

We can further simplify Illustration 2 by consolidating the shapes circled in red, since (1) the default state of every portable device is unpaired—not in Driver Mode, and (2) we can assume that any Driver Mode built in compliance with the Guidelines should meet the Phase 2 safety criteria. Illustration 3 is the resulting simplified diagram of the Preferred Option, which shows how an unpaired portable device should behave once, and if, Passive Driver Detection technology is productized.

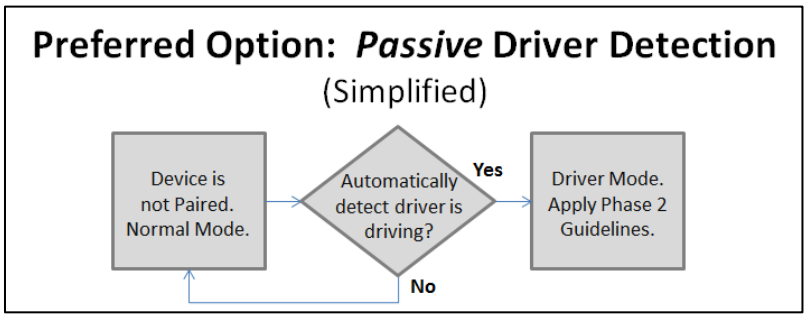

Illustration 3: Simplified diagram of the Preferred Option.

Illustration 4 is a slightly more precise expression of the Preferred Option. From a technological architecture perspective, the question "Is this mobile device being used by a driver?" is really two separate questions asked in serial. The first question "Is this mobile device in a moving vehicle?" proceeds the second one "Given that the portable device is in a moving vehicle, is its user a driver?" If the answer to *either* of those questions is NO, then the unpaired device is left in Normal Mode. Only if the answer to *both* of those questions is YES will Driver

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Mode be applied. This is not a modification of NHTSA's Preferred Option, it is just a more technical explanation of how a solution based on Passive Driver Detection would be engineered.

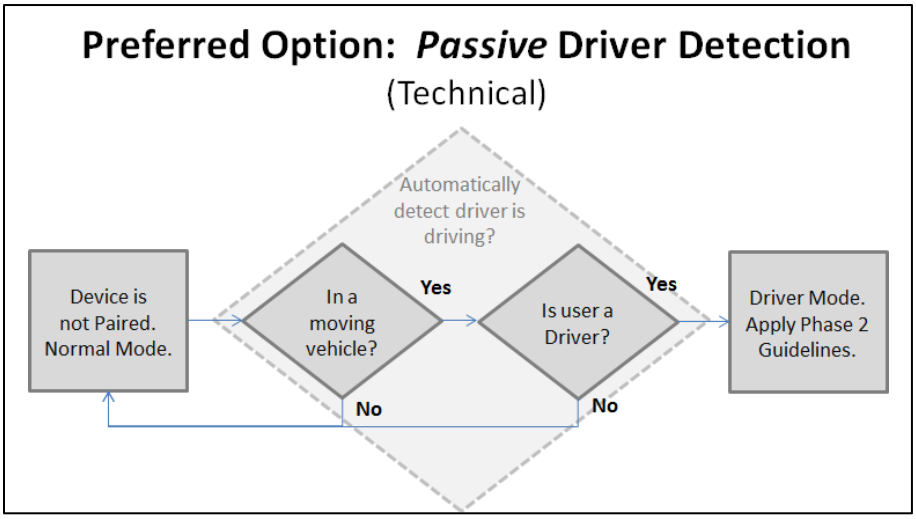

Illustration 4: Technical architecture of the Preferred Option.

Illustration 5 shows the Near-Term Option. It could realistically be implemented in the near future—years, perhaps even a decade or more—before the Preferred Option will become technologically feasible. The Near-Term Option differs from the Preferred Option in that it does not require Passive Driver Detection and instead leverages two types of technology which already exist today and are undergoing refinement by numerous companies. These are (1) Active Passenger Differentiation, and (2) Vehicle Type Inference.

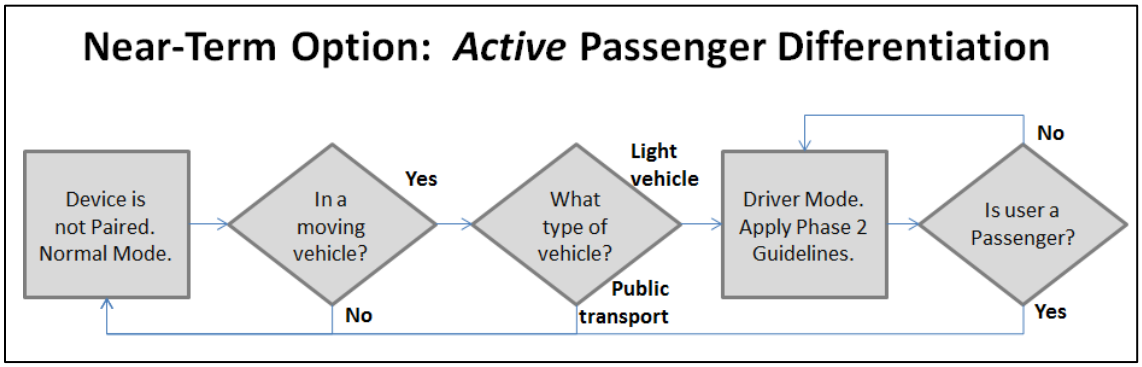

Illustration 5: Technical architecture of the proposed Near-Term Option.

The Near-Term Option begins just like the Preferred Option with the question: "Is this mobile device in a moving vehicle?" If the answer is YES, the next question is "Given that the portable device is in a moving vehicle, is it public transport (e.g. bus, train) or a light passenger vehicle?" Only if the answer is LIGHT PASSENGER VEHICLE is Driver Mode applied.[10] Once in Driver Mode, if the user is in fact a passenger they can easily prove this via

[10] While the Near-Term Option as it is proposed here does not address bus drivers and train conductors, there are far fewer of them than there are drivers of light cars and trucks. Furthermore, while technologies exist to prevent distracted driving in mass transportation vehicles, that subject is beyond the scope of both the Guidelines and this document.

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Active Passenger Differentiation (i.e. by performing a PVT or other). Since a driver cannot do this successfully, the device will remain in Driver Mode until it autonomously detects that it is no longer in a moving vehicle.

Illustration 6 describes the state of the three main technological components required by the Near-Term Option. The technology to ask and answer the "Moving Vehicle?" question, passively, and persistently on a mobile device without excessively draining the battery (e.g., through GPS use) already exists at a high level of refinement. Several companies supply this technology to the market today and it could be easily built in to every smartphone tomorrow.

The technology to passively ask and answer the "Vehicle Type?" question (bus or train vs. light car, truck, or motorcycle) already exists, but has not yet achieved sufficient accuracy and latency to enable a distracted driving solution like the Near-Term Option. However, as mentioned above, several companies are actively developing this technology and in all likelihood it will be sufficiently reliable soon.

The technology that enables a passenger to easily and reliably prove that they're not driving (e.g. to answer the "Passenger?" question) has already been invented, developed, and commercialized. Cellepathy's current PVT takes approximately 7 seconds to complete successfully, and we are working on additional methods that leverage the device's camera to shorten that time to only 1-2 seconds. We hope to make these available soon.

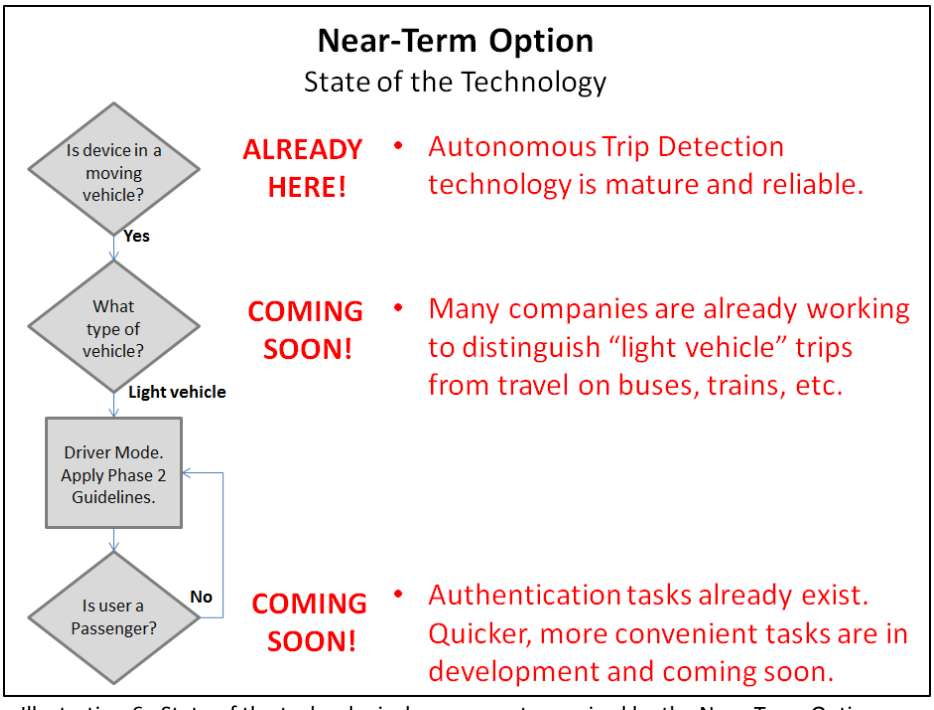

Illustration 6: State of the technological components required by the Near-Term Option.

Illustration 7 on the following page shows how the Near-Term Option might be integrated into the original Figure 1. The Preferred Option is very challenging technologically and far off in the future, the Near-Term Option is technologically achievable within the next year or two, and Current Technology can be easily implemented today (what the draft Guidelines referred to as the "2nd Option").

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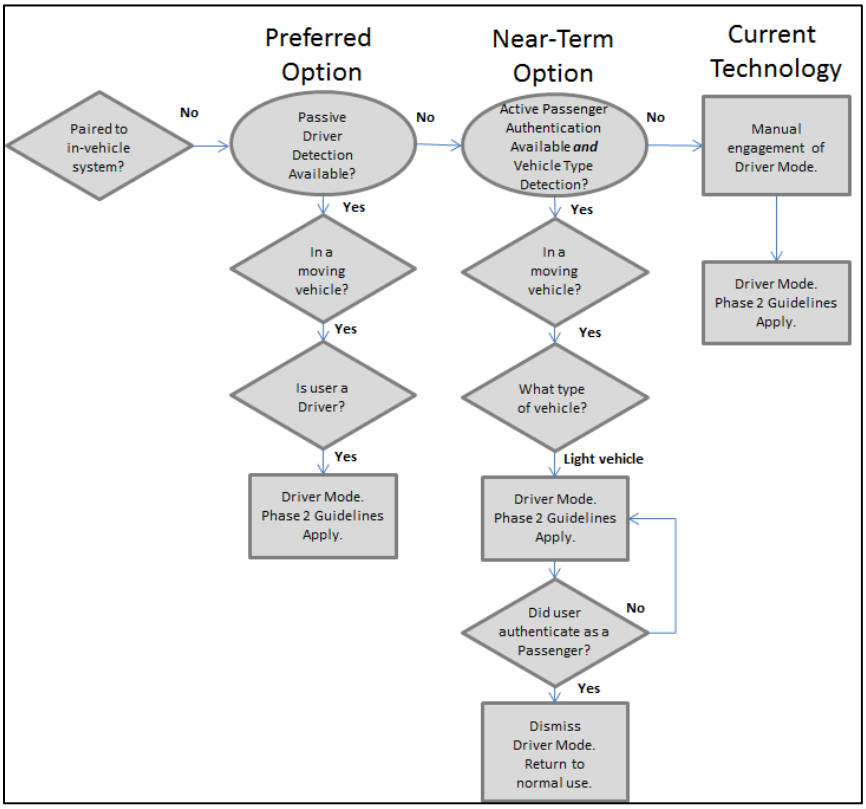

Illustration 7: Figure 1, modified to include the Near-Term Option.

Illustration 8 is just a compressed version of Illustration 7, which we submit for inclusion in the final Guidelines.

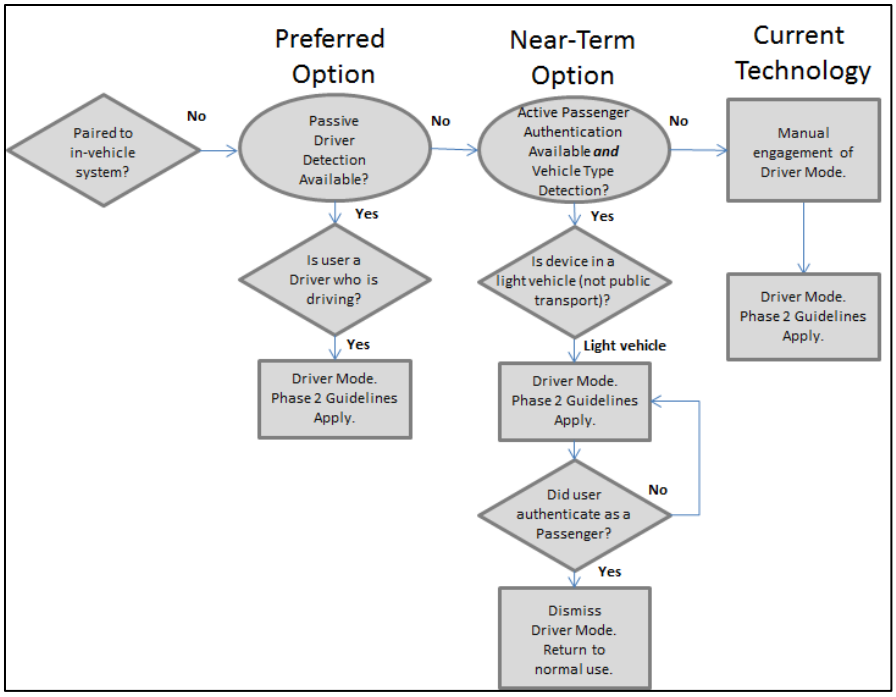

Illustration 8: Logically identical to Illustration 7, but slightly compressed for simplicity.

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Conclusion

The first technological solutions to distracted driving were proposed before Cellepathy was founded, before the first National Distracted Driving Summit in 2009, and even well before the launch of the first iPhone in 2007. As scores of tech review articles and many comments to the docket for these Guidelines have pointed out, the Passenger Problem has always been the critically limiting factor. However, the lack of an easily-configurable, programmatically-activated Driver Mode (or a Maker-supported means to build one) is an artificial barrier to the implementation of distracted driving technology which has severely deterred innovation in this area for over a decade. These Guidelines, and the improvements that we have suggested to them, promise to finally change that. Once implemented, they will free up tech innovators like Cellepathy and others to focus on the ***real*** technological challenges, developing the solutions needed to prevent hundreds of thousands of avoidable crashes, injuries and deaths in the U.S. and around the world each year.