Criminal Justice Testing and Evaluation Consortium
A Program of the National Institute of Justice

Vehicle Stoppage and Pursuit Management
for Law Enforcement Agencies

Enabling safer and faster resolutions through policy and technology

This brief provides an assessment of policies and approaches used by police agencies to manage vehicle pursuits.[1] The goal of this document is to inform the criminal justice community of the general policies that guide police pursuits and to provide illustrative examples of the current and future outlook on vehicle stoppage and tracking tools.[2]

Key Takeaways

- Although there have been limited changes in vehicle pursuit technology over the past 15 years, advancements in remote deployment systems, vehicle telematics, and telecommunication technologies have enabled incremental value-added innovation in existing tools.
- Agencies can leverage multiple approaches (including tools and techniques) that help immobilize or track a fleeing vehicle during a pursuit.
- Tools that intend to stop a vehicle using force come with bigger safety risks to the officer, fleeing occupants, and bystanders than tools that use tracking technologies.
- No vehicle stoppage approach guarantees an efficient, safe resolution to a pursuit, and agencies should consider the implications of implementing these tools.
- As manufacturers integrate more technology into vehicles, disabling or tracking solutions may enable safer, faster resolutions to vehicle apprehension.

Vehicle pursuits, though usually short in duration, can result in significant injury, property damage, and even death. From 1996 to 2015, police pursuits resulted in more than 6,000 fatal crashes in the United States, leading to 7,000 deaths, an average of 355 per year (or about one per day). Of these pursuit-related fatalities, 65% involved the driver or occupants of the fleeing vehicle. However, vehicle pursuits not only jeopardize the safety of the occupants of the fleeing vehicle, but also police officers and bystanders. Of the 6,000 fatal crashes associated with vehicle pursuits, approximately 30% of fatalities were bystanders and 1% were police officers.[3] As shown in **Figure 1**, improving outcomes of vehicle pursuits is a shared goal across the criminal justice community, touching both technology and policy.

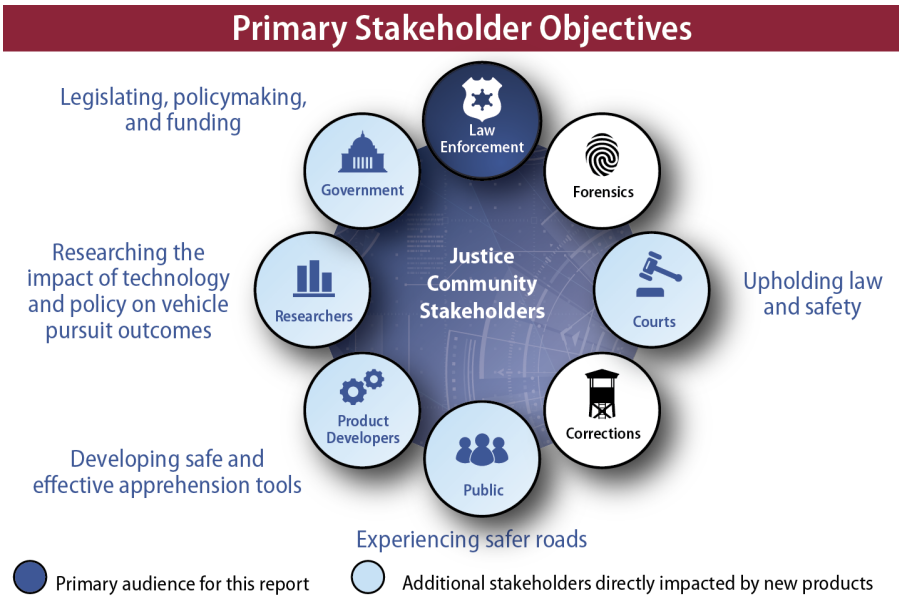

Figure 1: Members of the criminal justice community can improve vehicle pursuit outcomes by using clear policies and promoting the adoption of tools.

1. In this brief, CJTEC defines vehicle pursuit management approaches as either tools or techniques employed to stop or track a fleeing vehicle. Some tools covered in the report are commonly referred to as "devices" (e.g., tire deflation devices).
2. Products referenced in this document are used for illustrative purposes and do not represent the National Institute of Justice's or Criminal Justice Testing and Evaluation Consortium's recommendation, endorsement, or validation of product claims.
3. Reaves, B. A. (2017 May). *Police vehicle pursuits, 2012-2013*. (NCJ 250545). Bureau of Justice Statistics, Office of Justice Programs, U.S. Department of Justice. Retrieved from https://bjs.ojp.gov/content/pub/pdf/pvp1213.pdf

Realities of Vehicle Pursuits

The decision to pursue a fleeing vehicle is based on whether the risk of the pursuit will further the goal of protecting the public. When an individual in a vehicle flees from a law enforcement officer, after a traffic stop by law enforcement or some other incident, officers may pursue them as part of their responsibility to control and deter crime. Engaging in a vehicle pursuit, however, may endanger the safety of suspects, the public, and law enforcement officers (as shown in **Figure 2**). Because engaging in high-speed chases can result in injuries, fatalities, and the destruction of property, law enforcement agencies have been compelled to implement policies and adopt tools to improve safety measures and reduce adverse outcomes.

Potential Outcomes of Vehicle Pursuits

Pursuits may lead to successful outcomes like ...	▪ Deterring the public from future vehicle pursuits ▪ Preventing the fleeing individual from injuring other motorists/pedestrians or inflicting property damage ▪ Causing the fleeing individual to slow down or stop in response to certain approaches (e.g., GPS tracking tools, mentioned below) ▪ Facilitating just outcomes in response to a crime
Pursuits may lead to adverse outcomes like ...	▪ Injury and death of law enforcement officers, motorists, and pedestrians. For example, the City of Portsmouth, Virginia is giving $11 million in settlements to Temika Pleas, who lost her husband and sustained debilitating brain injuries in a car crash that took place while police were chasing a car that ran a red light. ▪ Significant property damage to law enforcement vehicles and other vehicles/infrastructure. For example, the City of Jacksonville, Florida will pay $40 to $50,000 to a homeowner whose gate and brick posts were damaged at the end of a police pursuit where the sixth pursuit intervention technique (PIT) maneuver finally forced the car off the road and onto the homeowner's property. ▪ Litigation, settlements, and poor public perception of agency. For example, in 2021 the Chicago Police Department agreed to a $2 million settlement with the family of a 55-year-old woman who was struck and killed by a vehicle that was fleeing from law enforcement after a traffic stop. ▪ Lack of an arrest, because the fleeing individual may get away

Figure 2: Vehicle pursuits can help law enforcement uphold public safety and work toward just outcomes, but pursuit comes with uncertainty and risks.

"Law enforcement officers and agencies must determine whether the public is best protected by engaging in a pursuit or by taking some other form of action. Agencies must balance the risks, take all of the factors into consideration, and reach a decision that is best suited to their jurisdictions."[4]

—International Association of Chiefs of Police, Law Enforcement Policy Center

4. International Association of Chiefs of Police. (2019, December). *Vehicular pursuits*. Retrieved from https://www.theiacp.org/sites/default/files/2019-12/Vehicular%20Pursuits%20-%202019.pdf

Given changes in attitudes toward vehicle pursuits, as well as the inherent risks associated with pursuits, law enforcement agencies are adopting policies to create safer pursuit outcomes.

Policies regulating vehicle pursuits typically fall into one of four categories, as shown in **Figure 3**: prohibited, discouraged, restrictive, and discretionary.[5]

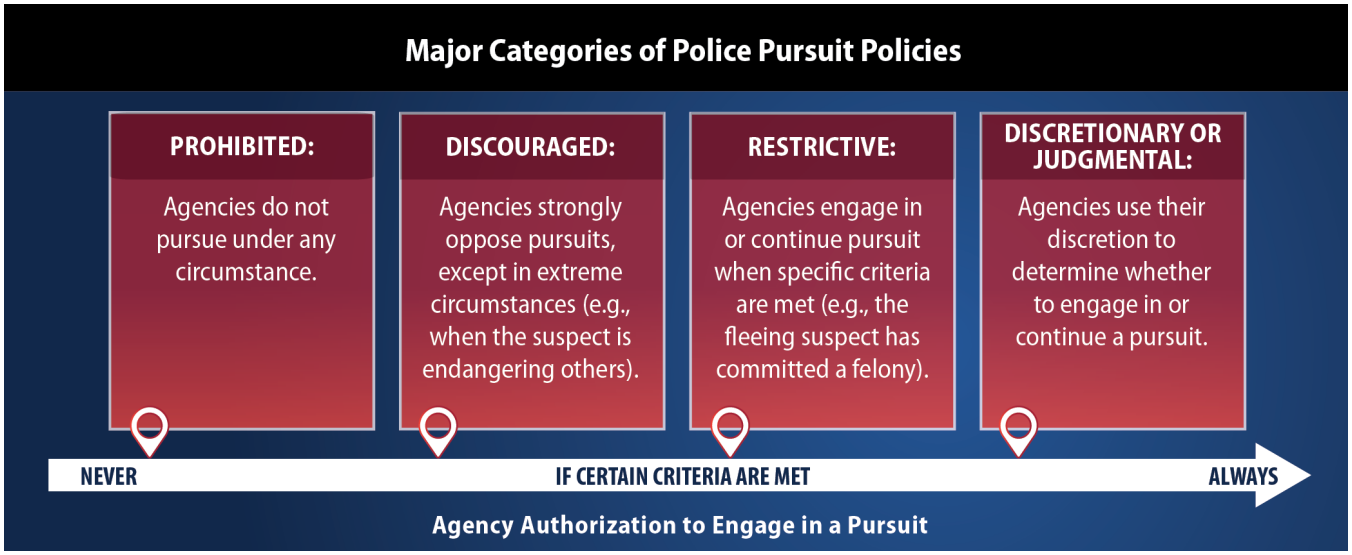

Figure 3: Police pursuit policies vary on the degree to which an officer has authorization to pursue.

Critics of discretionary policies argue that officers' propensities for pursuing vehicles may differ across agencies and by individual. Evidence suggests that discretionary policies lead to more frequent pursuits, which inherently carry safety risks. The 2017 Bureau of Justice Statistics report *Police Vehicle Pursuits, 2012-2013* indicated that agencies with a discretionary pursuit policy, on average, conducted 17 pursuits per 100 officers employed, while agencies with discouraged or restrictive policies engaged in 10 pursuits per 100 officers.[6] Specific criteria within discouraged and restrictive policies—such as whether the suspect is operating a stolen vehicle, has outstanding warrants, or is fleeing a minor offense—may differ widely across agencies. On the other hand, prohibited policies may be seen as impeding an officer's ability to enforce the law.

Studies suggest that more agencies are employing restrictive policies than discretionary policies: roughly 65% of agencies responding to the 2016 Law Enforcement Management and Administrative Statistics survey employed restrictive pursuit policies, and 25% employed discretionary policies. State and highway law enforcement agencies had the most frequent instances of discretionary policies (43%), almost twice as often as local, county, and regional police agencies (23%). Less than 10% of agencies employed discouraged or prohibited pursuit policies.[7]

Over the last 20 years, there has been a shift away from discretionary policies; the percentage of officers in agencies with discretionary policies dropped from 17% in 1997 to 11% in 2013.[6, 8] These changing policy trends are reflected in legislation and often covered by the media. For example, in April 2021, District of Columbia Council members introduced

5. Different entities use different words to describe and define police pursuit policies. For consistency, this document uses the policies as defined by the Bureau of Justice Statistics (2016) in the Law Enforcement Management and Administrative Statistics survey. Retrieved from https://bjs.ojp.gov/data-collection/law-enforcement-management-and-administrative-statistics-lemas
6. Reaves, B. A. (2017, May). *Police vehicle pursuits, 2012-2013*. (NCJ 250545). Bureau of Justice Statistics, Office of Justice Programs, U.S. Department of Justice. Retrieved from https://bjs.ojp.gov/content/pub/pdf/pvp1213.pdf
7. Bureau of Justice Statistics. (2016). *Special tabulation, 2016 Law Enforcement Management and Administrative Statistics (LEMAS)*. Retrieved from https://bjs.ojp.gov/data-collection/law-enforcement-management-and-administrative-statistics-lemas
8. For the purposes of this brief, the "permitted, restricted by criteria" policy is interpreted as the restrictive pursuit policy, and the "permitted, subject to supervisory approval/review" is interpreted as the discouraged policy.

IACP Policy Guide

The International Association of Chiefs of Police's Law Enforcement Policy Center has developed a vehicular pursuit policy guide.[11] The guide aims to provide agencies with information on balancing the risks, considering the factors that go into a decision to pursue, and reaching a decision that is best suited for their jurisdiction.

a bill that would prohibit District of Columbia officers from engaging in pursuits, unless the officer "reasonably believes that the fleeing suspect has committed or has attempted to commit a crime of violence and that the pursuit is necessary to prevent an imminent death or serious bodily injury and is not likely to put others in danger."[9] Some agencies are actively involved in reforming policies in response to community perception: in early 2021, the Hamilton County Association of Chiefs of Police sought community feedback via survey to create a uniform pursuit policy for the county's 44 law enforcement agencies.[10] Pursuit policies, while helping officers make informed decisions on whether to engage in a vehicle pursuit, only represent one step in enabling safer vehicle pursuit resolutions.

"Six years ago, we had a very liberal pursuit policy, but several reasons drove it to change to pursuing those with felonies only. Agencies need to consider, will being able to track a vehicle be enough, or do you need to apprehend the vehicle now?"

—Lt. Michael McCarthy, Michigan State Police Precision Driving Unit

Agencies must consider multiple factors when determining an appropriate pursuit policy.

Existing agency policies, agency resources, public perception, and geography of the jurisdiction can help inform a vehicle pursuit policy. These factors may vary considerably across different agencies. **Figure 4** offers examples of helpful questions to explore when considering a vehicle pursuit policy.

Factors That May Inform Vehicle Pursuit Policies

Existing Agency Policies	▪ Has your agency established a threshold on level of crime that necessitates a pursuit (e.g., felony versus a moving violation)? ▪ Has your agency identified specific behaviors or circumstances that warrant a pursuit (e.g., if the fleeing individual is endangering lives)? ▪ How has the agency clearly developed, communicated, and enforced existing policies?
Agency Resources	▪ Does your agency have training resources for operating emergency vehicles, making decisions, and safely de-escalating a vehicle pursuit? ▪ Does your agency vehicle fleet possess performance capabilities (e.g., speed and maneuverability) to safely and effectively pursue fleeing vehicles?
Public Perception	▪ How has the community responded to your current policies and procedures related to police pursuits? ▪ Will the community have a voice in establishing a pursuit policy?
Geography	▪ Does the geography of your jurisdiction facilitate or impede pursuits? ▪ Is the jurisdiction primarily located in an urban area, with more traffic and larger roads, or in a rural area, with few alternative routes to apprehend the suspect? ▪ Are these areas typically crowded or subject to regular severe weather?

Figure 4: Agencies may consider many factors to help inform a viable pursuit policy that weighs the opportunities and risks of a pursuit.

9. Council of the District of Columbia. (2021). B24-0213 - Law Enforcement Vehicular Pursuit Reform Act of 2021. Retrieved from https://lims.dccouncil.us/Legislation/B24-0213
10. McGee, Jatara (2021, Feb). Hamilton County police agencies seeking public input on high-speed pursuits. Retrieved from https://www.wlwt.com/article/hamilton-county-police-agencies-seeking-public-input-on-high-speed-pursuits/35424549#
11. International Association of Chiefs of Police. (2019). *Vehicular pursuits*. Retrieved from https://www.theiacp.org/sites/default/files/2019-12/Vehicular%20Pursuits%20-%202019.pdf

Technology-Based Solutions

Circumstances that lead to a vehicle pursuit are often uncertain, but high-risk situations are dangerous to officers, suspects, and bystanders. Technology can play a role in enabling safer, more efficient resolutions to pursuits under the right circumstances. When choosing the most appropriate tools, agency leadership must consider their policies, tolerance for potential risks, budget, and environmental circumstances. Some approaches may require close proximity between law enforcement and the fleeing vehicle, while some can be deployed at a distance. The technology-enabled approaches identified in **Figure 5** and **Figure 6** fall under one or both of the following categories:

- **Vehicle stoppage:** Law enforcement can use approaches that directly contact the fleeing vehicle with the intent of slowing and/or immobilizing the vehicle.
- **Vehicle tracking:** Rather than actively chasing a fleeing vehicle in close proximity, law enforcement can employ approaches to track a specific vehicle's location, with the intention of de-escalating the pursuit, tracking the vehicle, and apprehending the suspect in a more controlled and potentially safer way.

For both vehicle stoppage and tracking approaches, few novel products have entered the market over the last 15 years; however, advancements in remote deployment systems, vehicle telematics, and telecommunication technologies have enabled incremental value-added innovation in existing products. To improve implementation of vehicle stoppage and tracking approaches, agencies must invest the time to train officers to appropriately employ the devices; allocate resources to provide operational maintenance; and clearly establish, communicate, and enforce the policies and procedures for when and how these tools and techniques are used.

The following section provides an overview of approaches for vehicle stoppage and tracking. There is no one perfect solution for resolving a pursuit, and implementation of each approach yields both benefits and drawbacks.

Vehicle Stoppage Approaches

Deployment of vehicle stoppage tools and techniques, including tire deflation devices, tire entrapment devices, and the PIT maneuver, often requires close contact with the fleeing vehicle either by pursuing, physically engaging with, or getting ahead of the vehicle. Law enforcement officers employing these tools and techniques also have to consider bystanders, vehicles not involved with the pursuit, and infrastructure. Some tools can be deployed at a distance or controlled remotely, effectively alleviating the need for an officer or a police vehicle to be in the direct path of a fleeing vehicle.

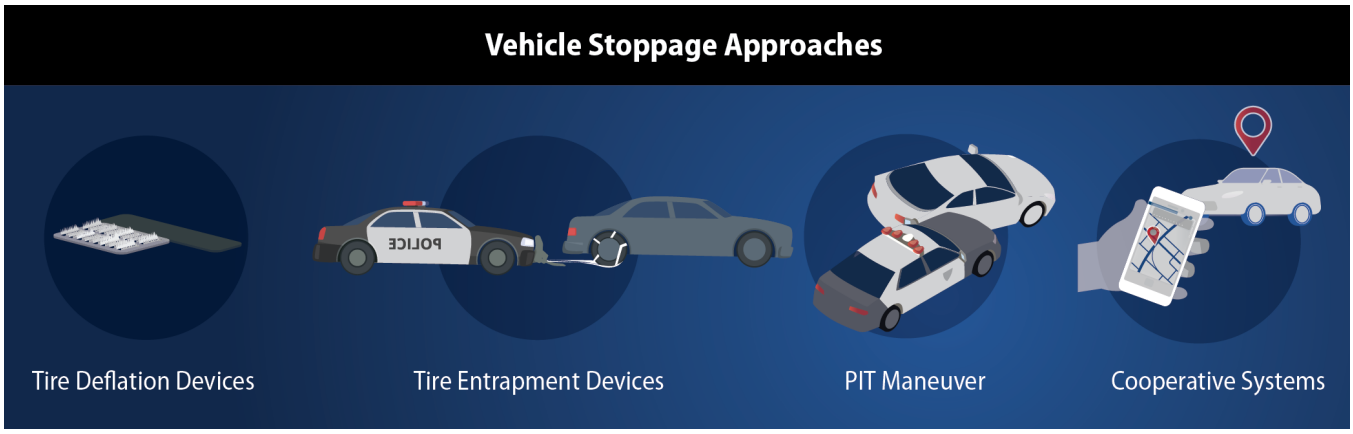

Figure 5: Agencies can leverage one or a combination of approaches to resolve a pursuit. Many of these approaches involve the use of commercially available devices meant to be deployed during an active pursuit.

Tire Deflation Devices

Tire deflation devices are the predominant pursuit management tools used by law enforcement agencies in the United States.[12] These devices puncture a fleeing vehicle's tires as they roll over the device. Although older models contained solid spikes, today's devices incorporate hollow quill spikes that allow for the penetration and regulated deflation of a fleeing vehicle's tire(s). This attribute mitigates against blowouts and helps flatten tires at a controlled rate, ultimately slowing the vehicle's speed and reducing the chance that the vehicle operator will lose control. For example, the Stop Stick device consists of hollow Teflon-coated quills encased in a three-sided plastic housing, which is deployed using a tethered nylon sleeve. An officer throws the tool from the side of the road and retrieves it with a pull cord after the fleeing vehicle passes. Although most tools, such as Stop Stick, Magnum Spike, and Spike Devil require officers to manually deploy the strips across a roadway and retract them, some products, such as NightHawk, Stinger Spike System, and DynaSpike, can be activated via remote control and deployed using compressed air, gas propellant, or electric motors, limiting the need for an officer to stand roadside. The NightHawk device, for example, combines MATADOR RoadSpikes with a gas-propellant deployment system, enabling officers to extend and retract the spike strip up to 24 feet in under 2 seconds using a remote control. Made from corrugated plastic, the RoadSpikes are reusable and reloadable into the NightHawk, leading to cost savings. One of the inherent risks of using a tire deflation device is that an officer needs to stand along the roadway during deployment. Because of this dangerous situation, remote-activated devices provide an advantage to manually deployed devices; however, the added capabilities make the unit more complex, increase the device's size and weight, and are more expensive.

The NightHawk device extends retractable spikes using a gas-propellant deployment system (photo provided by Matador Law Enforcement Technologies/PSEMC).

The MobileSpike device enables officers to stop pursuits from the safety of their vehicle with a push of a button (photo provided by MobileSpike).

One tire deflation device that is not deployed from the side of the road is the MobileSpike device, which employs an electrically extended spike bar that is mounted to the bumper of a police cruiser. This device allows the police officer to remain in their vehicle during deployment but requires the officer to chase and maintain a close distance to enable contact with the fleeing vehicle's tire(s), which may be challenging if the fleeing vehicle is elusive.

Advantages

- Tire deflation devices are the most used vehicle pursuit management tool because they are effective at slowing a vehicle, simplistic in function, and economical.
- Hollow quill spikes provide regulated tire deflation, reducing the chance of a tire blowout.
- Remote-deployed spike strips enable officers to extend these tools from a safe distance.
- Although spike strips irreparably damage tire(s), minimal damage is caused to the rest of the vehicle.

Disadvantages

- These devices can cause a vehicle to lose control at high speeds.
- Manually deployed spike strips require an officer to stand close to the roadside for both extension and retraction, which may present safety concerns.
- Vehicles with run-flat tires may take longer to deflate and prolong the pursuit.
- Remote-deployed tire deflation devices may require charging or replacing gas propellent for multiple deployments.
- Fleeing individuals may lose control of their vehicle when trying to steer around the devices.

Implementation Considerations

- Costs can range from a couple hundred dollars to several thousands of dollars per unit; remote deployment products are the most expensive.
- After deployment, spike strips require replacement quills/spikes.
- Different lengths of spike strips are available for most devices.
- Training on the proper use of tire deflation tools is necessary to promote responsible use.

12. Wood, R. (2009, November 16). *Police pursuits: Balancing the safety of citizens with the apprehension of criminals.* Criminal Justice Institute, School of Law Enforcement Supervision. Retrieved from https://www.cji.edu/wp-content/uploads/2019/04/policepursuits.pdf

Tire Entrapment Devices

The Grappler system is a bull bar device permanently positioned on the front bumper of a police vehicle (photo provided by Police Bumper).

Tire entrapment devices result in the forceful stoppage of a fleeing vehicle by deploying a strong netting material around the vehicle's wheels or axle. These devices have been demonstrated to effectively stop a vehicle while minimizing the fleeing vehicle's loss of control and distance traveled. The Grappler, an entrapment device mounted to the front bumper of a police car, uses a Y-shaped net that can be deployed to contact a fleeing vehicle's back tire. To be effective, the Grappler requires an officer to chase the fleeing vehicle and get close enough for the netting to contact the wheel, which can pose a challenge and safety risk in high-speed or evasive pursuits. Alternatively, some entrapment devices are deployed across a roadway and use high-strength netting combined with spikes or hollow quills to assist with ensnaring the wheels or axle. One of these devices, X-Net, can be manually rolled or pulled across the roadway to forcibly stop a vehicle weighing up to 10 tons. Manually deployed tire entrapment devices present similar challenges and safety concerns as hand-thrown spike strips, in that they require an officer to be positioned roadside and potentially at risk of being struck by oncoming traffic. While not used for law enforcement applications, the tire entrapment device ArrestNet was designed to be remotely activated from a distance of 100 feet. This device, developed for military applications, mitigates the hazard of manual deployment by using a gas propellent to deploy a barbed netting across a roadway and into the path of a fleeing vehicle. Although effective, the netting apparatus of any tire entrapment device can only be used once because it gets fouled within the vehicle's undercarriage and requires a replacement net for each deployment, which can be costly to law enforcement agencies.

Advantages

- Devices stop fleeing vehicles in a short distance while reducing the vehicle's loss of control.
- Devices can effectively stop large and heavy vehicles.
- Available products provide differing deployment methods, allowing agencies to determine the best option for their needs.
- While not currently used for law enforcement applications, remote-activated roadside entrapment could enable the officer to deploy the tool from a safe distance.

Disadvantages

- Entanglement nets cause major, possibly irreparable, damage to the fleeing vehicle.
- Bumper-mounted systems require the officer's vehicle to get close to the fleeing vehicle, presenting safety risks.
- Entrapment netting must be replaced after each use.
- Police cruisers that deploy these devices are difficult to move once they are entangled with the fleeing vehicle.

Implementation Considerations

- Tire entrapment devices cost several thousands of dollars.
- Roadside devices may provide the most value in limited applications, such as defending a protected or restricted area.
- Training on the proper use of tire entrapment tools is necessary to promote responsible use.
- Bumper-mounted systems may require multiple installations within the agency's vehicle fleet.

PIT Maneuver

The precision immobilization technique, or PIT maneuver, is a technique in which officers make contact with the rear quarter panel of a fleeing vehicle to attempt to cause a controlled spinout, making it easier to isolate or forcibly stop the vehicle. There is little available data on PIT maneuver policy trends across agencies, though agencies commonly recommend that the maneuver be performed at slower speeds (35 to 45 mph) unless authorized for use of deadly force. Data on injuries and deaths associated with the PIT maneuver are incomplete, but this technique has been the subject of controversy; the *Washington Post* reported that since 2016 at least 30 individuals have been inadvertently killed and hundreds more injured (including police officers and bystanders) in crashes directly related to using the PIT maneuver.[13] Recent litigation from a case involving a PIT maneuver, which flipped a pregnant woman's car, compelled the Arkansas State Police (ASP) to alter their PIT maneuver policy. The ASP elected to switch their PIT policy from a subjective to an objective standard required to justify executing the maneuver.[14]

Advantages

- The PIT maneuver can be safe if performed by a trained officer and attempted at slow speeds in areas with minimal traffic, infrastructure, and bystanders.[15]

Disadvantages

- The PIT maneuver can be dangerous at high speeds, causing the fleeing vehicle to lose control and potentially resulting in death, injury, or property damage.
- Training officers on the technique is challenging because of the expense of vehicle repairs.

Implementation Considerations

- Vehicle electronic stability control and collision avoidance systems may affect the performance of the technique, resulting in unpredictable results; this requires changes to the PIT training curriculum.[16, 17]

Cooperative Systems

Cooperative systems are manufacturer-developed or aftermarket services, purchased by the vehicle owner, that can remotely shut off the ignition or slow down the vehicle, communicate with the driver, and track the vehicle via GPS, among other features. Advances in vehicle telematics systems, which enable communication between vehicles and wireless networks, have driven the development of cooperative systems. Law enforcement officers can work with cooperative system providers to execute vehicle slowdown, stoppage, and tracking functions. LoJack and Teletrac are some of the most commonly used cooperative systems, though they provide limited functionality as primarily GPS-enabled trackers; General Motors' OnStar service has a Stolen Vehicle Slowdown function, where the system can slow the moving vehicle, and Remote Ignition Block to prevent an individual from restarting a vehicle. While cooperative systems are considered stoppage technologies for the purposes of the report, they are also capable of tracking the vehicle (the topic of the next section of this report). Enabled by smartphone and telematics technology, cooperative systems allow vehicle owners, in conjunction with law enforcement, to also track their vehicle via their smartphone and possibly lead officers to the fleeing vehicle.

Advantages

- Cooperative systems may have hybrid stoppage and tracking abilities.
- Law enforcement can stop or track a vehicle remotely.

Disadvantages

- Products are only available in a limited number of vehicles, though newer vehicles are pre-equipped with apps that enable tracking. As of 2021, GM offers OnStar to >16 million customers in the United States and Canada, representing a small percentage of cars on the road.[18]
- Law enforcement must take additional steps to get in contact with the cooperative system provider and/or vehicle owner, if applicable, to slow or track the vehicle. It may be challenging to get in contact with these companies in a time-sensitive event.

Implementation Considerations

- Vehicle owners pay for these subscription-based plans, which require GPS satellite and cellular signals to track the vehicle.

13. Raviv, S., & Sullivan, J. (2020, August 24). Deadly force behind the wheel. *The Washington Post*. Retrieved from https://www.washingtonpost.com/graphics/2020/investigations/pit-maneuver-police-deaths/
14. Schmidt, H. (2021, November 19). *Lawsuit over PIT maneuver used on pregnant woman leads to ASP policy changes*. 5 News. Retrieved from https://www.5newsonline.com/article/news/state/lawsuit-over-pit-maneuver-used-on-pregnant-woman-leads-to-asp-policy-changes-arkansas-state-police/527-8d302832-3aee-476b-83a4-d1b67fe73e2b
15. Schultz, D. P., Hudak, E., & Alpert, G. P. (2009). Emergency driving and pursuits: The officer's perspective. *FBI Law Enforcement Bulletin, 78*(4).
16. Burleson. T., Covelli, E., Westerberg, S., & Brady, M. (2015). *Effects of electronic stability control on the pursuit intervention technique.* Portland, OR: Portland Police Bureau. Retrieved from https://www.iadlest.org/Portals/0/PIT_ResearchBrief_FINAL_09212015.pdf
17. Tortorell, P., & Giovengo, R. D. (2017). *Electronic stability control and the precision immobilization technique.* (FLETC-ARB-01-2017). U.S. Department of Homeland Security, Federal Law Enforcement Training Center. Retrieved from https://www.fletc.gov/sites/default/files/ARB%20Newsletter-2017-1%20PrintVersion10-030317%20%28002%29.pdf
18. General Motors and AT&T set automotive connectivity benchmark with 5G. (2021, August 19). Retrieved from https://media.gm.com/media/us/en/gm/news.detail.html/content/Pages/news/us/en/2021/aug/0819-att.html

Vehicle Tracking Approaches

Vehicle tracking approaches, shown in **Figure 6**, may be used with approaches that stop vehicles. Some tools require close proximity of law enforcement to the fleeing vehicle, while others enable remote law enforcement intervention. Some approaches rely on surveillance technologies, like cameras and sensors, to direct officers to the general location and direction in which the fleeing vehicle is traveling. Tracking can prevent a police pursuit from escalating into a high-speed chase that may endanger the lives of officers, suspects, and bystanders.

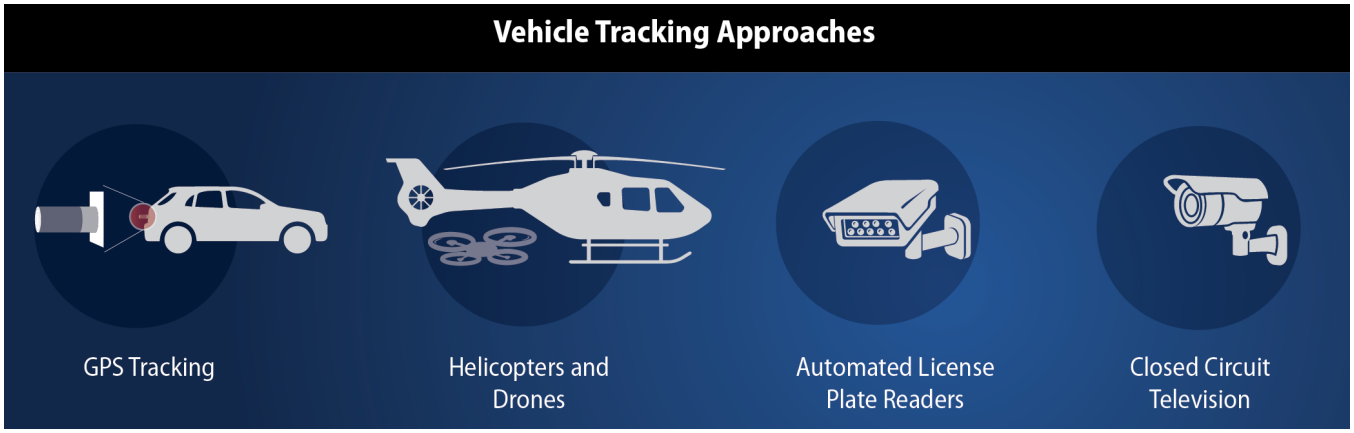

Figure 6: Agencies can leverage alternative approaches to pursuing a fleeing vehicle; these tools can be used with traditional pursuit methods or in place of them if the agency has strict no-pursuit policies.

GPS Tracking

GPS tracking provides an alternative to the traditional police chase by enabling law enforcement to affix a GPS dart to a fleeing vehicle and continuously track the vehicle with the intention of apprehending the vehicle in a controlled and safe environment. This method is considered "less lethal" because it does not require direct engagement with the fleeing vehicle or a change in the vehicle's kinetics in any way. Unlike cooperative systems, which are purchased as a subscription service by vehicle owners, GPS tracking devices are purchased and deployed by law enforcement to de-escalate a pursuit. StarChase is the sole provider of a remotely deployable GPS tagging system for pursuit management. This system uses a suite of tools, including adhesive GPS tags, vehicle-mounted launchers, handheld launchers, and a mapping platform application for real-time visibility and location monitoring via computer and/or mobile device. Its flagship product, "Shadow," is a vehicle-mounted launcher that uses pneumatic propulsion to launch 54-mm GPS tags that nonpermanently adhere to a suspect's vehicle. Another product, "Guardian," is a handheld, one-shot launcher, using identical mechanisms to Shadow. Both products allow law enforcement to retreat from potential direct confrontation in a high-risk, high-speed pursuit, while continuing to track a suspect, as well as arranging additional resources to promote de-escalation and safe apprehension in a controlled environment. Currently, StarChase is employed by police departments in 28 states.[19]

The Guardian, a handheld GPS launcher, is one of two GPS tracking devices offered by StarChase and is employed to follow a suspect's vehicle to a controlled environment for de-escalated apprehension (photo provided by StarChase).

19. Prather, S. Twin cities suburban police battling car thieves with new GPS technology (2022, March 9). *StarTribune*. Retrieved from https://www.startribune.com/suburban-minnesota-police-battling-car-thieves-with-new-gps-technology/600154295/; Also, in discussions with CJTEC staff, the company claims to have "hundreds of agencies using our technology throughout 30 different states (at every level – local, county, state, and federal)."

Advantages

- StarChase demonstrated an 80% arrest rate of tagged vehicles, equivalent to conventional methods while mitigating the high risk of vehicle chases.[20]
- Studies have indicated that fleeing suspects tagged with a GPS tracking dart may slow down rapidly, reducing the risk of a crash or adverse incident.[20]

Disadvantages

- Winter conditions may affect GPS tag adherence to a fleeing vehicle.[21]
- The system requires the officer to get within 20-25 feet of the fleeing vehicle, which may present challenges for accurate and successful adhesion of the GPS tag.

Implementation Considerations

- Cost varies on what suite of tools is adopted; however, the vehicle-mounted launcher can cost thousands per unit.
- Rigorous training is necessary to develop successful deployment protocols under various environments and use case scenarios.

Helicopters

Helicopters can be used to strategically track the location and direction of a fleeing vehicle to support officers in ground pursuit or to continue tracking if the ground pursuit is called off. These aircrafts can move in any direction or remain stationary and can report on traffic or environmental conditions.

Advantages

- Helicopter operators can track a fleeing suspect, even when they are fleeing on foot.
- Officers can use infrared cameras or other visualization to track a suspect.

Disadvantages

- Helicopters are difficult to deploy in a timely manner, especially when pursuits are often short (most are less than 5 minutes in length).[22]
- Deployment is highly dependent on weather conditions.

Implementation Considerations

- The costs to deploy helicopters are significant (beyond procurement, training, and maintenance costs).
- Agencies without direct access to helicopters may be able to seek assistance from partner agencies, though this may add to response time.
- Helicopters may be less effective in environments like urban settings and densely wooded areas.

Automated License Plate Readers

Automated license plate readers (ALPRs) are high-tech cameras, typically mounted on a police cruiser or affixed to permanent (e.g., bridge or light pole) or movable structures (construction barrels). ALPRs scan license plates of vehicles that pass by, recording the plate number, date, location, and sometimes a photo of the vehicle. ALPRs can help establish the whereabouts of a stolen vehicle, missing person, and potentially a suspect.

Advantages

- ALPRs are often already implemented in law enforcement operations for applications like locating stolen cars.
- ALPRs can help provide a general location for the fleeing vehicle and can help officers better strategize on locating the suspect (e.g., focusing officer manpower in one area vs. scattering them).

Disadvantages

- ALPRs only provide value if officers or the technology can read the license plate before the vehicle flees.
- ALPRs only provide a "snapshot" view of where the vehicle may be traveling and cannot track it in real time.
- ALPR data can only be valuable to police pursuits if it is delivered to law enforcement in real time.

Implementation Considerations

- Agencies must have policies and technology in place to receive ALPR data in real time.

20. Fischbach, T. A., Hadsdy, K., & McCall, A. (2015, September). *Pursuit management: Fleeing vehicle tagging and tracking technology*. Retrieved from https://www.ojp.gov/pdffiles1/nij/grants/249156.pdf
21. Praised Milwaukee Police StarChase pursuit program shelved. (2019, July 31). WTMJ-TV Milwaukee. Retrieved from https://www.tmj4.com/news/i-team/praised-milwaukee-police-starchase-pursuit-program-shelved
22. Report to the Legislature, Senate Bill 719: Police Pursuits. (2020, September). California Highway Patrol. https://www.chp.ca.gov/Documents/Police_Pursuits_SB_719_2020.pdf

Closed Circuit Television

Closed circuit television (CCTV) leverages strategically placed video cameras that transmit a signal to a set of monitors often for surveillance and security purposes. CCTV can be used to document evidence and help determine where a vehicle may be traveling.

Advantages

- Video footage may provide the direction of a vehicle being pursued.
- Officers can use CCTV footage to monitor the behavior of fleeing vehicles, detect incidents, and coordinate police responses.
- CCTV footage may provide legal evidence.

Disadvantages

- CCTV only provides a "snapshot" view of where the vehicle may be traveling.
- CCTV data can only be valuable to police pursuits if it is delivered to law enforcement in real time.

Implementation Considerations

- Agencies should have agreements in place to access near real-time CCTV footage when needed.

When choosing the right products to implement, agencies should consider the range of deployment methods for vehicle stoppage and tracking technologies.

Despite sweeping changes to vehicle technologies over the last 15 years, vehicle pursuit management approaches have largely remained static. However, there has been incremental innovation related to how these tools are deployed for a fleeing vehicle. Figure 7 shows the range of deployment methods for vehicle stoppage and tracking approaches, which may help agencies resolve pursuits in a safer way. Fifteen years ago, most vehicle pursuit management tools were "manually deployed," where the officer had to be in physically close contact with the fleeing vehicle and/or vehicular traffic to deploy tools like tire deflation devices; this could leave the officer vulnerable if the fleeing driver lost control of their vehicle. Cruiser-affixed products provide an added level of safety in case the pursuit ends in a crash but may require the officer to pursue the fleeing vehicle closely. These products cannot be easily shared by multiple officers in one department. Some devices can be set up and deployed entirely remotely, like tire deflation devices inflated by a gas propellant, from a safe distance away in a police cruiser. Many vehicle tracking tools are capable of remote surveillance, whether the approach is capable of actively trailing a fleeing vehicle or by alerting law enforcement when a suspect has been "recognized" by ALPRs or CCTV. As products move from "manually deployed" to "remotely deployed," they tend to increase in cost but also provide an added layer of safety.

Deployment Methods for Vehicle Stoppage and Tracking Approaches

Approach	Manual Deployment	Direct Contact With Cruiser	Affixed to a Cruiser	Remote Deployment	Remote Surveillance
Tire Deflation Devices	✓	✓	✓[23]	✓	
Tire Entrapment Devices	✓	✓	✓[23]	✓[24]	
PIT Maneuver	✓	✓			
Cooperative Systems				✓	✓
GPS Tracking			✓	✓[25]	✓
Helicopters					✓
ALPRs					✓
CCTV					✓

Figure 7: Vehicle stoppage and tracking approaches offer various deployment methods.

23. MobileSpike, a tire deflation device, and the Grappler, a tire entrapment device, have the potential to be affixed to a cruiser.
24. Current remotely deployed tire entrapment devices are available for limited law enforcement applications, though devices have been developed for military applications.
25. For example, StarChase can be deployed remotely from a handheld launcher.

Future of Police Pursuits

Several emerging technologies have the potential to help law enforcement agencies manage vehicle pursuits, including unmanned aerial systems (UASs), autonomous vehicles, and augmented reality (AR)/virtual reality (VR).

- **UAS**, often referred to as drones, are beginning to be used by law enforcement to augment response.[26] Chula Vista Police Department, for example, created a drone program in 2017 to support tactical operations (which may include vehicle pursuits).[27] These drones are equipped with high-definition cameras and devices to communicate with individuals in the field. Drones can be leveraged to provide helpful insights about a scene before law enforcement arrives or to help track fleeing vehicles or crimes in progress. However, like helicopters, these systems require significant technical expertise, Federal Aviation Administration (FAA) authorization, and clear agency policies and procedures to operate. FAA laws currently limit deployment of UASs at night, as well as in inclement weather conditions (e.g., precipitation, wind, fog).
- As the transportation ecosystem continues to adopt **autonomous, or "self-driving," vehicle technology**, the instances of police pursuits may likely decrease or be eliminated over time. Although society is far from widespread market integration of "highly autonomous" vehicles (HAVs), these vehicles may be designed to make way for law enforcement and emergency vehicles, whether through signals from connected vehicles or infrastructure communication or prompted by the sirens and lights of the vehicles. HAVs will likely be deployed as fleet-managed systems, given practical implications to managing cost, safety, and maintenance. As such, HAVs will be tracked closely through GPS, internal and external cameras, and other measures; they will be designed to stay in designated speed limits and obey traffic laws. It is unclear whether a user may have the ability to override these autonomous controls. These features will limit the value of these vehicles as getaway cars.
- **AR and VR** are emerging "immersive" technologies that can simulate a police pursuit and help train officers on effective pursuit management approaches. AR- or VR-enabled training gives officers the opportunity to learn and practice pursuit techniques in a simulator, which helps officers make informed decisions during a real-life pursuit. Agency vehicles may also be subject to less wear and tear if agencies switch to simulator-based training. Apex Officer's VR Driving System allows users to practice responding to high-speed pursuits, including the use of the PIT maneuver.[28] In the future, product developers offering AR and VR simulation could widen their offerings of police pursuit management techniques (i.e., GPS tracking, tire entrapment devices) to allow officers to gain experience with a suite of management options.

26. Zercoe, C. (2018). *5 applications for UAS in law enforcement*. Police1. Retrieved from https://www.police1.com/2018-guide-drones/articles/5-applications-for-uas-in-law-enforcement-IYC8xQMGVFsDb0J4/
27. Chula Vista Police. (2021). *UAS drone program*. Retrieved from https://www.chulavistaca.gov/departments/police-department/programs/uas-drone-program
28. Oliver, A. (2021). Police driving simulator. *Apex Officer*. Retrieved from https://www.apexofficer.com/resources/police-driving-simulator

Four points that law enforcement leadership should consider related to vehicle pursuits

1. Agencies are moving toward more restrictive vehicle pursuit policies, but few have prohibited pursuits altogether. In 2016, most agencies—65%—had restricted pursuit policies or policies where specific criteria (such as a suspect with a felony record) should be met before engaging in a pursuit. But 25% of agencies had discretionary policies that left pursuit decisions up to the officer's discretion. Few agencies have pursuit policies that either discourage pursuits, except in "extreme" circumstances outlined by the agency (8%), or entirely prohibit pursuits in any circumstance (2%).[29]
2. Pursuit management tools and techniques use two general approaches: vehicle stoppage and tracking. Vehicle stoppage or immobilization technologies often require close proximity of officers with a fleeing suspect's vehicle. Remote activation of devices or deployment from the front bumper of a patrol car can be leveraged for either stoppage or tracking purposes. Enabling distance between the fleeing vehicle and the officer when deploying tire deflation devices, tire entrapment systems, and GPS tracking systems helps protect law enforcement from injury.
3. In general, vehicle pursuit management approaches have remained static over the past 20 years, albeit with some incremental innovation in deployment systems and other safety measures. Tire deflation devices (spiked strips to puncture tires) remain one of the most common pursuit tools. GPS tracking (tracking darts affixed to fleeing vehicles) is being piloted or used by multiple agencies. Tire entrapment devices (nets that entangle a vehicle's tire and axle) and cooperative systems (devices that track or slow a vehicle remotely) are evolving and currently only provide value in limited applications. Helicopter tracking and surveillance systems (ALPRs and CCTV) can be used to track the location of a fleeing suspect, even if a ground pursuit has been called off.
4. Implementation of pursuit approaches—including no pursuit—may involve risks for officers, bystanders, and suspects. To help mitigate the associated risks, agencies should ensure proper training and maintenance of any devices and establish and communicate clear policies for their use.

29. Bureau of Justice Statistics. (2016). *Special tabulation, 2016 Law Enforcement Management and Administrative Statistics (LEMAS)*. Retrieved from https://bjs.ojp.gov/data-collection/law-enforcement-management-and-administrative-statistics-lemas

Published: **May 2022**

More Information

Steven Schuetz
Senior Science Advisor/Physical Scientist
National Institute of Justice
U.S. Department of Justice
Steven.Schuetz@usdoj.gov
Tel +1-202-514-7663

Jeri D. Ropero-Miller, PhD, F-ABFT
Project Director, CJTEC
RTI International
jerimiller@rti.org
Tel +1-919-485-5685

Suggested Citation

Shute, R., Parsons, M. N., Miller, L., Camello, M., Mecray, M., & Planty, M. (2022). *Vehicle stoppage and pursuit management for law enforcement agencies.* National Institute of Justice, Office of Justice Programs, U.S. Department of Justice. https://cjtec.org/

CJTEC would like to thank Lt. Michael McCarthy, Michigan State Police Precision Driving Unit, and Geoffrey Alpert, Professor, Criminology and Criminal Justice, University of South Carolina, for their expertise and insights in developing this document.

This publication was made possible by Award Number 2018-75-CX-K003, awarded by the National Institute of Justice, Office of Justice Programs, U.S. Department of Justice. The opinions, findings, and conclusions or recommendations expressed in this publication are those of the author(s) and do not necessarily reflect those of the Department of Justice.

https://cjtec.org/