Point to Point Cameras – A beneficial safety measure in reducing speed-related collisions

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Caitlin Sowers
14 Riva Ridge Road
Douglas, New Brunswick
Canada
E3G 7X5

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Caitlin Sowers, B.Sc.Civil Engineering
University of New Brunswick

Abstract

Point-to-point speed cameras measure the average speed of vehicles over long distances. Point-to-point (P2P) speed cameras have been implemented in a number of countries as a means to decrease speed related collisions. Their implementation has shown reductions in fatal and serious-injury speed-related crashes, where there were previously historically high crash rates. P2P systems have been shown to reduce average/mean vehicle speeds, 85th percentile speeds, the proportion of speeding vehicles, and speed variability. P2P implementation has resulted in a 65%, 55%, 37% and 19% collision reduction in England, Australia, Scotland, and Italy respectively [5, 7, 8,]. The homogenised traffic flow provided by P2P speed cameras has resulted in reduced collisions, fuel consumption and traffic emissions. Operational recommendations including site location requirements, system requirements, legal requirements, and maintenance are discussed. Speed-enforcement technologies are often met with an adverse public reaction as speeding enforcement is perceived as a revenue tool, instead of a safety measure. Public education and transparency within P2P implementation is a crucial aspect of its success. An overview of the benefits of P2P systems and successful implementation is discussed.

Introduction

Travelling speed is a major risk factor for the safety of road users; therefore, successful speed-reduction enforcement methods allow for an increased level of safety on roadways. Though still in their infancy, P2P systems have provided promising results in terms of speed reduction, and thus speed-related collisions. The results of P2P cameras in Australia, Europe, and the UK will be discussed, as well as operational recommendations. An emphasis on public perception of the P2P system is also necessary as it is a publically funded system, which success depends on the majority of drivers viewing it as a useful safety measure.

Background

The P2P camera system or “section control”, features two or more rear-facing or forward-facing cameras in sequence on a section of roadway that has a history of speed-related collisions. A photo of each vehicle entering the section of roadway is taken at the entrance and exit with a time stamp, and is saved to a local server. A photograph of the driver may also be accompanied for driver liability. Vehicle registration data is also collected and automatic number plate recognition (ANPR) is used to identify the vehicle, which is also saved to a local server. This

information is then sent to a central processing computer where the average speed of the vehicle is calculated by dividing the corridor length by the travel time of the vehicle. If the average speed plus a possible enforcement tolerance is greater than the posted speed, an infringement file is created containing the necessary information for the purpose of lawful enforcement [1]. Human assessment is most often needed to confirm the validity of the infringement, in which case confirmation results in an infringement notice [2]. A simple diagram of a P2P speed enforcement system is shown in Figure 1.

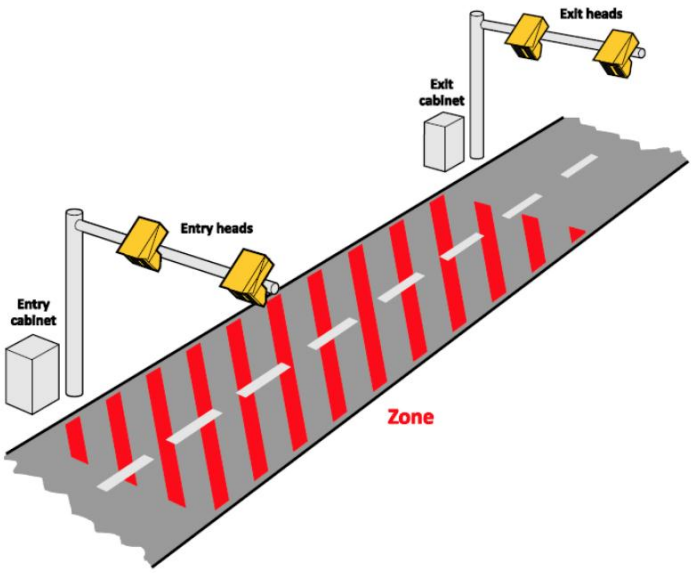

Figure 1 – Basic P2P Illustration [4]

Benefits

The most effective and affordable way to reduce fatalities and serious-injuries is to reduce travelling speeds [3]. Speed cameras as a whole are successful in creating safer roads as they increase the driver's perceived threat of being caught speeding. Drivers are motivated by punishment avoidance, which is more effective in discouraging speeding than punishment itself [4]. A decrease in driver's speeds decreases not only the likelihood of a collision, but the severity of the collision if it is to occur.

Instantaneous speed cameras often achieve a localized benefit, characterized by drivers' lack of continued adherence to the speed limit. Drivers will slow down while within immediate vicinity of a speed camera, however in as little as 200m will likely return to their original speed [2]. This speed discontinuity hinders traffic flow and limits vehicle capacity, while adding to harmful gas emissions and noise pollution [2]. However, the P2P operates in an entirely different manner, where speeding in any location between the entrance and exit to the specified corridor can result in an infringement. Heterogeneity between vehicle speeds has been cited as increasing the likelihood of a collision [4]. As P2P systems promote a homogenized flow by reducing speed [5], vehicle capacity and safety is increased, while harmful gas emissions and noise pollution are decreased.

As P2P speed cameras are a relatively new technology, much of their implementation lacks a formal evaluation. However, there have been promising results of P2P systems that have been operating at a minimum of 3 years in terms of speed reduction. Similar speed reduction has also been found in many European P2P systems, as well as the UK. Austroads has reported reduction of average/mean speeds, 85th percentile speeds, the proportion of speeding vehicles, and speed variability. Average speeds have been reduced to or below the posted speed limit [2].

P2P systems can also be used for additional purposes such as identifying stolen vehicles. All P2P systems are equipped with ANPR; therefore, this data can be compared to that of a stolen vehicle's identification. Furthermore, a P2P system on the Tower Bridge in London has been used to identify both average vehicle speed, as well as vehicle weight. Recording the vehicle weight is meant to guard against unnecessary stress on the bridge, which is an important landmark [5].

Successful Implementation

The point-to-point system is a relatively new technology that has not yet allowed for many comprehensive studies to be completed. However, there are promising statistics available within Australia, the UK, and Europe, of reduction in vehicle speeds and collisions. The variety of enforcement practices within each country shows the variability in the way in which P2P systems can be integrated within current speed enforcement practices.

1. Australia

Heavy vehicles, defined by a gross mass of more than 4.5 tonnes [6], are the P2P target within Australia, as the nature of their travel is a long route, which is most suitable for the P2P system. Although heavy vehicles in Australia only represent 3% of vehicle registrations, they account for 20% of road fatalities [6]. New South Wales implemented P2P systems in 21 locations by the end of 2013; Two in 2010, 13 in 2011, five in 2012, and one in 2013. Only one of the 21 locations has been in service for a three year period (2011-2013), which has provided promising reductions in speed. Before installation at this section, there were 11 heavy vehicle crashes including one fatality and eight injuries. After the installation there have been five heavy vehicle crashes including one fatality and two injuries. Additionally, at this location post installation infringements have decreased since 2012 and remain low, indicating a greater driver adherence to posted speeds [7].

There were 25 enforcement lengths across NSW as of 2014, shown in Figure 2 on the following page.

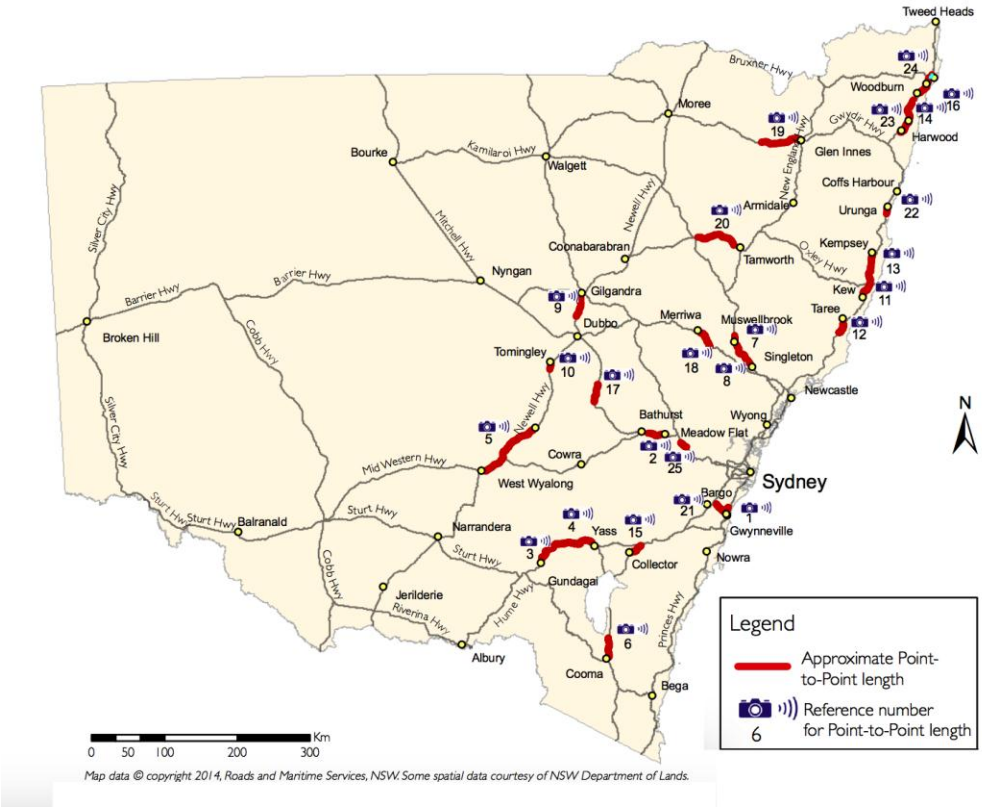

Figure 2 - NSW P2P Enforcement Corridors 2014 [7]

As the coast of Australia is more densely populated than inland, it is clear the implementation is being done where high traffic volumes are present.

2. Austria

P2P systems are especially useful in areas where policing is difficult, or dangerous to do. A study was performed on a point-to-point system in Vienna, Austria, where a section of road through a tunnel had a posted speed of 80 km/hr. An average speed reduction of more than 10 km/h was found in its first year of operation. The study estimated that within two years of operation the system would reduce injury related crashes by 33% and fatal and serious injuries by 49% [8].

3. Italy

Italy began implementing P2P systems in 2006. In its first year of service, Autostrade per L'Italia (ASPI), the network operator, reported a reduction of 51% of causalities from speed-related collision, as well as a 19% reduction in the overall number of collisions. Due to the success of implementation, as of 2009, 2,220 km of roadway operated by ASPI include P2P system, approximately 33% of the total network which ASPI operates [5].

4. England and Scotland

Nottinghamshire and Northamptonshire, both countries in the East Midlands of England, reported an average reduction of 65% and 60%, respectively, of fatal and serious-injuries

resulting from speed-related collisions. The average was taken over 11 roads equipped with a P2P system in Nottinghamshire, whereas Northamptonshire's reduction was found on the A43 Lumber tubs way [5].

Strathclyde, a region in Scotland, has reported a reduction of 37% of fatal and serious-injuries resulting from speed-related collisions. The reduction of 37% was found on the A77, which is equipped with a 32 mile controlled zone [5].

Operational Recommendations

1. Overview

Although the infancy of the P2P system lends to a still evolving best practice, to date there are recommendations in place for maximized benefit when implementing a P2P system. However, these recommendations are likely to evolve as more comprehensive studies are done on the P2P system.

2. Site Location

In order for a P2P system to be implemented within a location, there should be high traffic volumes with a history of speed-related crashes and casualty incidents. These accidents should have taken place over a section of the road, and not in a specific location; in that case a separate road safety measure targeting a specific location would likely be a better solution. The likelihood of delayed travel times for vehicles along a section of road, such as stopping at a gas station, are not best suited for a P2P system. The likelihood of vehicles taking alternative routes while within the P2P corridor to avoid the P2P system is also not an ideal operation for the system. Therefore a feasible section of road would be one without exits or roadside businesses. Furthermore, a site should be chosen with no foreseeable changes to the infrastructure that would affect the shortest practicable distance for vehicles to travel.

Although gas emissions and traffic congestion are often reduced by the P2P system, they should not be used as the main criteria for site selection. Instead, a history of speed-related crashes on a section of road will indicate a need, with gas emission and traffic congestion reduction being ancillary benefits of the P2P system [4].

3. System Requirements

Various P2P suppliers can provide hardware components, processing software, and back-office support depending on the country of which the P2P system is being implemented [1].

Higher capture rates allow for the P2P system to operate at a higher level of accuracy. The highest capture rates are observed when cameras are located above traffic lanes, with both rear-facing and forward-facing cameras, if this is economically feasible for the country in which they are being implementing. Vehicle detector loops should be used to trigger the camera when vehicles are within the corridor [1,4].

Cameras should be mounted at a sufficient height to allow for the height of both passenger and heavy vehicles. Additionally, cameras should be cantilevered outside of the clear zone, or cantilevered behind guiderail if this is not feasible. Monochrome digital cameras with infrared

flash are suggested as they are the most efficient and cost-effective. One camera per travel lane is recommended to eliminate vehicles intentionally crossing-over lanes to go undetected by the system [1,4]. A divided corridor is ideal, however if this is not economically feasible, then one camera per travel lane is an alternative solution. If possible, the ANPR should be done on site with the local processor, with only the infringement data being transferred back to the office [1,4].

4. Legal Requirements

The P2P system will need to operate at a level which can stand defense at an infringement trial. Therefore the P2P system itself should be lawfully approved for the purpose of speed patrol. The premise under which the P2P system operates and using average speed to identify speeding should be approved as a lawful means of measuring speed violation. Additionally, the shortest practicable distance should be surveyed and approved by an independent surveyor using national standards. If infrastructure or the purpose of the road is to be altered, the corridor should be re-surveyed and the shortest practicable distance should be updated. The photograph time stamps should operate with time clocks that are synchronized to a common time source, with a secondary reference system. Synchronization between time clocks should be performed regularly [4].

As law from country to country will vary, various laws will affect which aspects of the P2P system need greater considering. Many European countries have driver liability laws, which would require a P2P system to have driver recognition if the P2P system is aiming to legally enforce speed limits [5]. This is a feature available to P2P systems, however the cost of implementation will be higher if additional cameras are needed for driver recognition.

Finally, it is important to note that the P2P system should not be used as a solution to significant flaws in a road design. They should instead be used as a complimentary speed enforcement method to those currently in use. Therefore the P2P system corridor should still be under continued patrol for other offences such as drinking and driving, and seat-belt use [4].

5. Maintenance

Manual maintenance, as well as calibration and testing should be done annually at a minimum, however more frequent maintenance is recommended to improve the accuracy and efficiency of the system. Rigorous testing should be done on the ANPR to ensure accuracy in legal proceedings. Each system should be independently operated and maintained by the respective jurisdiction [4].

Speed Enforcement and Public Perception

The P2P system is still in its infancy; therefore, it is important for the system to be operated overtly. Giving notice to drivers, through signage inside of the corridor, is best practice to allow for greater public understanding. In South Australia, most speed cameras began as concealed in a vehicle parked on the side of the road, however it became common practice to notify drivers of the P2P system by road-side signage [3]. Although it is recommended to notify the driver of the P2P system for greater effectiveness, intentionally not signing the end of the P2P system corridor may permit for an extended perceived threat of infringement, resulting in a continued reduction of speed.

Public education should explain the system, with focus on its reliability and integrity. Generally, P2P cameras are perceived as more fair to drivers than other speed camera, as an average speed method is perceived to be a more accurate representative of the driver's speed throughout their route, than an instantaneous speed method. However, the term "fair" should be avoided in public education, as it may relay a contradictive message in terms of other safety measures [4].

The P2P system should be targeting high-level speeding offences. The system should not be used to target low-level speeding offences [4]. A majority (58%) of drivers agrees that exceeding the speed limit up to three km/h is acceptable; however, the 58% agreement reduces to only 12% when asked if exceeding the limit by more than five km/h is acceptable [9]. It is very likely the majority of the public will agree that high-level speeding offences are worthy of infringement, whereas targeting drivers low-level speeding (5km/h), will likely create animosity from the public, and an unnecessary disagreement of the P2P system.

Credibility issues arise when speed cameras are viewed as a revenue-raising tool instead of a safety measure. In Australia alone, the installation of 21 P2P systems over the span of 3 years resulted in 1,267 speeding infringements, and fines totalling $501, 776, for heavy vehicles alone [10]. This revenue should transparently be returned to the respective jurisdictions to allow for more road safety improvements to be made, which would prevent a misconception from the public that the P2P system is being used as a revenue tool instead of a safety measure. Although P2P systems are designed with the means to provide speed-enforcement, a warning letter period may be allotted to allow for the public to recognize and identify the P2P system corridors before an infringement is issued.

P2P cameras are a publically funded system; therefore, it is important that the majority of the public accept the system. If the public rejects the system, such as Ontario rejected the regular speed camera system, then it becomes a negative cost of a wasted system with an additional cost of removal, which serves no benefit to the safety of roads. Contrarily, if the public views the P2P system as a transparent safety measure, not used as a revenue tool, it will likely be accepted. Because of this, public education is a crucial aspect of the success of a P2P system. P2P systems should only be implemented in areas of historically high speed-related collisions. This is information that should be transparently communicated with the public, to ensure understanding of selection is safety based, not revenue based.

Conclusion

P2P systems have been implemented in Australia and Europe on sections of road with high traffic volumes, and a historically high speed-related collision rate. These systems have been shown to reduce average/mean vehicle speeds, 85^{th} percentile speeds, the proportion of speeding vehicles, and speed variability [2]. Additional benefits have been shown as well including a reduction in gas emissions and an increases level of homogeneity amongst vehicle speeds [4].

Operation recommendations to date have been outlined for the P2P system, including site location, system requirements, legal requirements, and maintenance. These recommendations are likely to evolve and improve as P2P systems are accepted outside of Europe and Australia.

As the P2P system is publically funded, acceptance by the public is crucial for its success. Public education and transparency in their implementation has been outlined as very important

to the success of P2P systems. P2P systems should not be viewed as a revenue tool, but instead as a safety measure, with revenue generated being transparently returned to road safety improvement funds.

In conclusion, the P2P speed enforcement systems have provided promising results in speed reduction, while still in its early stages of gaining prominence amongst road safety measures. The future implementation of P2P systems will allow for more comprehensive studies to be completed, bettering the recommendations for best practice and the results of the P2P system.

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