# The Future of Road Signage

**John Tiffin**
**Emeritus Professor of Communications**
**Victoria University, Wellington, and**
**Contract Lecturer, Division of Environment, Society and Design**
**Lincoln University, Canterbury**
**New Zealand**

**Christopher Kissling**
**Foundation Professor of Transport Studies**
**Environmental Management Group**
**Division of Environment, Society and Design**
**Lincoln University, Canterbury**
**New Zealand**

# The Future of Road Signage

**Prof. Emeritus John Tiffin and Prof. Christopher Kissling**


**Abstract**

*The paper is derived from the MS of a book on Transport Communications and Globalisation by Professor Emeritus John Tiffin and Professor of Transport Chris Kissling. The book is the outcome of five years of collaborative research into the future of transport as it is impacted by information technology. This paper focuses on the system of communication that enables road traffic to use road infrastructures. For as long as there have been roads this has been based on people reading roadside signage. The system is inefficient and fraught with problems. At some point in the future it is likely to be replaced by a more efficient and safer communication system based on computers and radio. The paper examines some of the ways this could happen.*

## Introduction

You fly from Sydney to Auckland. There may be a howling gale below in the Tasman, but your biggest problem is the queue for the toilets. Contrast this to the nightmare you could face getting from Auckland airport into, or worse, through the city if it is rush hour - and in Auckland rush hours last all day. You were far safer in the sky than you will be on the ground and if you look at the time you spent getting to your plane in Sydney and from the airport to your destination in Auckland it probably equals the time you spent flying. Why is road transport so awful? Why does air traffic flow smoothly and relatively safely while road traffic is full of stops and starts and puts your life at risk?

This is to see a complex problem simplistically and subjectively. We recognise that any study of today's road traffic problems leaves us looking at problems linked to problems in a Gordian knot of problems. Is there no way to cut through it?

One possibility is to do what long distance aviation has done: update the communication system used by road traffic so that it is dependent on information technology instead of humans. Planes used to be dangerous when they were driven in the way people still drive cars, by sitting at the controls and working out what direction to take, how fast to go and what to avoid by looking through the windows. Of course, sometimes pilots still do that and that is when aviation gets dangerous again.

## Road Signage

The communication system between the road infrastructure and the traffic that uses it depends upon humans interacting with other traffic and with roadside signage. There may be some acoustic signals as at a railway crossing or some haptic communication from judder bars, but essentially road signage consists of dumb visual signs that communicate continuously one way to the people who use roads. They communicate directions, distances, locations, services, guidance, advice and warnings and they direct people what to do at a particular point on a road in accordance with the Highway Code.[1]

It is a system of communication at least as old as roads. The Romans marked their roads regularly to show distances and directions to towns. The pack horse roads of Europe used stone cairns as guides.[2] We may have improved signage over time, but the principles remain the same. It works, mostly, but by comparison with the way planes communicate with other planes and ground control, roadside signage is inefficient and dangerous. There is not the same continuous monitoring of compliance as occurs with air traffic control.

**The Problem**

Roadside signage uses reflected light to transmit its messages, yet for half the time there is no daylight and visibility can also be affected by sundazzle, rain or fog. Vehicles of course have headlights, but pedestrians do not. Urban areas have streetlights, but they are one of the reasons we use so much energy.

Signs are only visible in line of sight and send the same message to all traffic. There is no handshake that links the sign to the vehicle and ensures communication takes place, nor any way to stop signs sending their messages once they have been received. Nor is there any way to change the messages they send unless they are variable signs as found on some motorways. Day and night, year after year, whether there is anyone to see them or not, road signs are out there endlessly transmitting the same messages. They clutter the environment and consume precious maintenance funds.

Why do we need so many road signs? We have long gone past the basics of using signs to direct people to places and informing them of what is where. They have become the primary way of implementing the Highway Code. Any new traffic law or ruling means new signs. We now have thousands of different signs. Do we seriously expect people to remember them all?

Why do we need road signs at all? Because, of course, drivers are people and looking is their main way of getting information. They look through their car window at the road ahead and the signs upon it and then they take action according to what they see, or think they see, as the windscreen wiper tries to keep pace with the rain or the lorry on their inside lane drives into their line of vision or the setting sun dazzles, or the cataract they have waited six months to have fixed haloes the lights of oncoming vehicles. Motor transport kills far more people than terrorists and the problem is primarily with the people who drive. Despite the care with which signs are designed and developed and placed, people do not perceive them clearly or interpret them as they should.[3] Even when they do read signs correctly, people still do strange things because they get impatient, frustrated, drowsy and depressed and sometimes they drink too much. What is more, despite all the warnings, road safety campaigns and police traps, they will continue to behave like this because they are humans and that is their nature.

This takes us to a facet of human nature that is seldom considered in signage research even though it would seem to make people particularly unsuited to driving automobiles or for that matter planes or ships. It is the way we understand signs at two levels.

The first level of meaning is the denotative meaning we give to signs. It is when a sign means what it is supposed to mean. Every transport infrastructure has a code of conduct for the traffic that uses it. This is implemented through signage that should be understood clearly in the same way by every road user at this first order of meaning. The trouble is that people also, whether they want to or not, attribute a second level of meaning to signs. These are the connotations a sign carries. Second level meaning refers to the strange idiosyncratic meanings that people give to signs. Meanings that come out of the complexities of their lives and cultures and so vary from person to person. It is the kind of meaning motor car adverts seek to elicit in us when they suggest that 'if we buy this little beauty we can go like the clappers'.

We consider that technology is neutral. Yet when the traffic lights go against us, some people will feel there is no justice in the world and are tempted to shoot the red. Second order meaning in transport communications is concerned with the background thinking that people do as they make decisions and interact with transport systems. It is about the way we personalise transport communications and it is dangerous.

**Information Technology Solutions**

Computers do not think at the second level of meaning. They only process information at the first level of meaning. If a computer could see a sign that signified stop it would stop and it would always stop in the same way at the same place which would be the way all other computers programmed in the same way would stop. The computer would not have a set of qualifying thoughts along the lines of 'There is no one about to see me and I am in a hurry and coming to a complete halt is a bit childish, so….'

Why not have computer-driven cars where we tell the computer where we want to go to and let it work out the best route and drive us there in a correct and proper manner while we get on with other things? The technology for computers to control cars exists. The trouble is that road signage is designed for people not computers. Signage transmits by light and sound in channels intended for human eyes and ears. Computers can remember better than people, can respond to communications more consistently than humans and they do not have feelings, but as yet, computers cannot see or hear like people. Sensors in automobiles can detect if there is anything behind a reversing car, or if the braking lights on a vehicle ahead go on, but as yet computers cannot read road signs and street names and work out what to do and where to go. The complexities of down town traffic environments are far beyond any existing computer-based systems of driving.

What computers can do, however, is respond to radio signals and these are not limited by line of vision or affected by whether it is day or night, or foggy or rainy. If we are to think of computer-driven cars then we need to think of a new kind of signage system that computers can read. Imagine that at every intersection, at every place on a road where we now have signs, there was a radio transceiver linked to a computer control function. It would pick up from approaching vehicles signals that identified the vehicle and where it was going. It would tell the vehicle what to do so that it slotted harmoniously into the overall flow of traffic. This device would be linked to other devices and to a master control for the whole road system. Such a system could modify the overall dynamics of traffic, rerouting and warning of problems, accidents and delays. It could at the micro level pass on individual messages to the vehicle's occupants. It could also calculate exactly how much road vehicles used and charge them accordingly. We already have a model for such a system in mobile phones. It might even be possible to integrate the two.

Do we say that from such and such a day people are not allowed to drive any more and take down all the road signs, or do we create a dual system, like that in aviation, where people can drive if they want to or leave the vehicle on automatic? Such a dual system could have the computer equivalent to a back seat driver watching over the human driver and a warning signal that lets computer-driven automobiles know that aberrant behaviour can be expected from the car in front. An example of how a dual system might develop can be seen with regard to road speed limits.

The current system is to display legal speed limits as static signs alongside roads. As many motorists find to their regret, they can easily be missed, leading to apprehension and fines imposed by enforcement authorities using speed radar to clock those exceeding the posted limits. Variable message signs (VMS), often erected along major motorways, also indicate speed limits currently being applied as well as road conditions ahead. The driver still looks through the car window to read these signs. They are not linked into displays on the dashboard within the vehicle. They can be obscured by other vehicles, or shrouded in fog. It would make sense to be able to transmit speed limits to vehicles by radio signals and advise then when they were travelling too fast or slow for traffic conditions.

**Intelligent Speed Signs**

Drivers of motor vehicles have a factory-provided visual indicator of the speed at which they are travelling, usually by way of a needle pointing to the speed or a digital read-out located in the dashboard speedometer instrument. Some vehicles have audible signals when a factory-set speed is exceeded. That device can only be de-activated by removing it. Cruise control is yet another option that allows a driver to select a speed that the vehicle will travel at unless overridden by the driver when traffic and/or road conditions make travel at a constant speed impossible. It is left to the driver to respond to the speed limit information provided by external signage displayed intermittently along the roads and streets being travelled with all the inherent problems we have alluded to above.

It is possible to provide continuous in-vehicle information of what the legal speed limits are for any stretch of road anywhere in the country even when those sign-posted speeds change frequently as they do for highway construction and maintenance or to reflect changing environmental conditions. This indication is by way of a second needle in the speedometer that automatically changes with every variation in speed limit encountered.

This can be achieved in two ways: One is by use of Global Positioning System (GPS) technology coupled to a Geographical Information System (GIS) database that holds the speed limit data. The vehicle knows where it is at all times. The on-board computer can compare location of the vehicle with mapped speed limit data and provide that information to the driver [4].

Our colleagues at RMIT in Australia have found that this approach to updating the speed information is problematic, especially if the changes to the GIS database are frequent, as is often the case with variable speed signs [5]. GPS can be useful in providing independent corroboration of actual vehicle speed compared with the vehicle's factory-fitted speedometer.

A second approach to the provision of speed restriction information promises to overcome the need to update a GIS database frequently. Traffic signs can be made to emit a short-range directional radio signal that can be picked up by vehicles as they pass in either direction. Variable speed signs could be programmed to change radio signals whenever necessary, as in the case of school zones that require slower speeds during peak pedestrian times. This allows speed changes to reflect current environmental conditions including accidents ahead or slippery surfaces on major highways. They cannot then be overlooked inadvertently.

With such a system, drivers are provided with two visual speed reference needles on a display inside their vehicle – one tracking the actual speed and the other the legal speed limit. Driver response should seek to bring those two needles together to ensure that violation of the speed limit is avoided. The same system can be used to encourage slow drivers to travel with the flow of traffic at whatever the posted speed might be. That speed could be conditioned by area traffic control systems, such as SATS in Sydney, to platoon vehicles to move in a green wave through traffic lights minimising stop – go situations.

Cruise control in vehicles could also be linked in dynamic fashion to the speed indicated by the speed limit needle. More sophisticated speedometer displays could colour the wedge between the speed limit needle and the actual speed needle, say green for travelling slower or red for travelling faster than the set speed limit. Prolonged excessive speeding would lead to flashing colours and/or an audible signal. Excessive speeds lasting more than a short period – say 15 seconds to allow for overtaking could cause the engine to lose power or activate a speed violation flasher light. This display could alert enforcement agencies to take corrective action and could be used to stop drag racing.

**Research Proposal**

Would a dual needle speedometer encourage greater compliance with speed limits? Would we ever need to take the more draconian step of completely replacing people as drivers with computers? Research might provide some answers.

Various types of vehicle might be fitted temporarily with the display unit that processes radio speed limit signals within a specially prepared test area. When the vehicles are travelling inside the test area the second speed display would become active. It would not be necessary to tamper with the existing factory-installed speedometer instrumentation. A completely separate dashboard mounted display box incorporating a data logger could be constructed to show actual vehicle speed calculated by differential GPS, and legal speed limit as transmitted by the radio signals.

By comparing the recorded information of vehicle speed against legal speed, differentiated by whether the second needle was or was not active, over a period of time, speed behaviour comparisons can be made and the value of having dual needle speedometers could be evaluated. It would be possible to monitor speed compliance by vehicle types, and driver responses by gender and age.

Conceivably, the incorporation of such a system as standard in any vehicle with continuous loop recording such as used in aircraft "black boxes" would provide information needed for the investigation of serious vehicle crashes. Further, the analysis of speed data might reveal stretches of road where drivers habitually speed without causing any crashes, suggesting that the designated speed restriction is inappropriate unless there are other pertinent factors that need to be taken into account. Research of this nature could help address transport safety policy issues for government and road controlling authorities.

Such an in-vehicle speed display system lends itself to phased implementation – first in areas containing traffic black spots. It would not initially replace conventional reading of posted speed signs, but be reinforcement to them. Through time, if such units were seen to induce more responsible driving behaviour, they might become mandatory in designated areas similar to Singapore's area licensing system requiring all vehicles to carry an on-board cash-card device when passing through the electronic portals of the inner city restricted area.

**Conclusion**

Intelligent speed signs are hardly likely to replace the signage we already have in the immediate future. It takes time to put new infrastructures in place and for the incorporation of new systems in vehicles. A small country like New Zealand is hardly likely to attempt such innovation unless it can demonstrate an effective low-cost system based upon existing leadership in vehicle radio communications. Research projects such as the one outlined are needed to provide a periscope for policy making and a test bed for proving concepts that could lead to lucrative export markets for special vehicle instrumentation such as the taxi radio job dispatch systems that were pioneered here. We also need to begin a discourse that will anticipate the broader changes that will come to our roads as transport communications evolve.

The introduction of radio and computer based road signage will not only duplicate the purposes of traditional signage, but will introduce new forms of communication between road infrastructures and traffic. Smart automobiles will be able to recognise their fuel and service requirements and check themselves in to service stations on a Just-in-Time basis. Vehicle owners, both commercial and private, might find themselves paying for every bit of road they use whether their vehicle is mobile or parked, differentiated by time of day and level of traffic congestion. This form of road user charging could be much fairer than the blunt instrument of fuel tax that knows not where, how and when a vehicle is being used. Governments need not lose revenues as vehicle fuel systems change. Vehicles activated by computers using the same software and signage system could be packed closer together because they would know exactly what the other vehicles are doing and be able to plot routes that avoid traffic incidents that slow or block their passage.

## References


[1] Lay, M. G. (2004) 'Design of Traffic Signs' in Castro, C. and Horberry, T. (Eds.) (2004*) The Human Factors of Transport Signs,* Boca Raton, Florida, London, CRC Press.

[2] Lay, M. G. (2004) *History of Traffic Signs* in Castro, C. and Horberry, T. (Eds.) (2004*) The Human Factors of Transport Signs,* Boca Raton, Florida, London, CRC Press

[3] Castro, C., Horberry, T. and Tornay, F. 'The Effectiveness of Transport Signs' in Castro, C. and Horberry, T. (Eds.) (2004*) The Human Factors of Transport Signs*, Boca Raton, Florida, CRC Press

[4] Castro, C. and Horberry, T. (Eds.) (2004*) The Human Factors of Transport Signs*, Boca Raton, Florida, CRC Press

[5] Personal communication between transport and logistics staff at RMIT and Chris Kissling, November, 2003.