Clearview Intelligence

making journeys work

The evolution of magnetometers from traffic signals to MIDAS and beyond

JCT Symposium 2019

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Inductive loops have long been the 'go to' option for vehicle detection at traffic signals, as well as being used to provide operators with information on the direction, speed and classification of passing vehicles. In the past decade, the monopoly that loops have held on the market has been challenged by the introduction of wireless vehicle detection, specifically magnetometers.

The like-for-like detection performance coupled with increased installation and cost benefits has led to magnetometers becoming a viable option for vehicle detection, particularly at traffic signals. But as the performance of wireless vehicle detection has evolved to become a genuine alternative to loops, so has its flexibility for use.

Contents **Page**

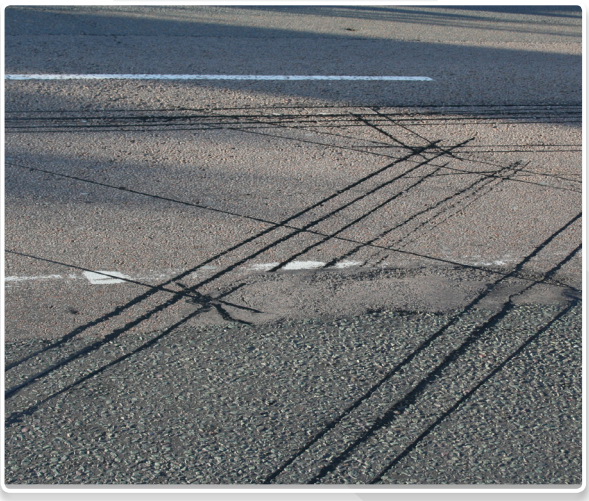
Introducing the benefits

The installation of inductive loops requires time consuming lane closures to enable slot cutting, ducting and trenching as well as access to a power supply. This means that when installed across multiple lanes, such as major junctions, dual carriageways or motorways, all lanes must be closed simultaneously to ensure the continuation of cables.

Once installed, loops are then prone to damage; heavy traffic, potholes and utility repairs can all lead to deterioration in the road surface and the exposure and failure of loops. This then leads to further disruption and expense as repair works are undertaken.

In contrast, Clearview Intelligence's M100 wireless vehicle detection can be installed up to five times faster than inductive loops by coring a single hole in the centre of the carriageway, which helps to maintain the road surface integrity. This rapid approach - taking an average of 15 minutes to complete - means a reduction in installation and maintenance costs compared with inductive loops, while the magnetometer's battery eliminates the need for mains power.

The lack of cables, coupled with the centre-of-lane installation, means each magnetometer can be installed independently of each other so that on multiple lane roads only part closures are required and routes can remain operational. Coupled with the faster installation, this reduces the disruption to motorists and the expense to operators, making the installation process far more cost effective.



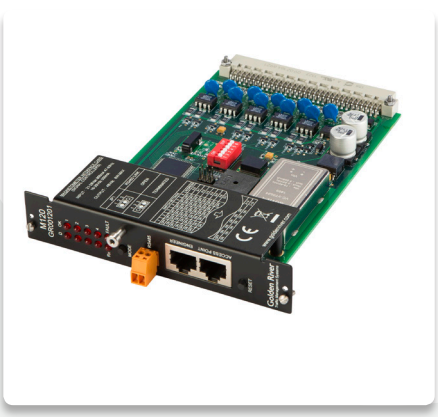
The M100 family

The M100 magnetometer does not work in isolation; it is part of a wider product range including:

- M100BR (radar for bicycle detection)
- M110 Access Point
- M115 Repeater Unit
- M120/150 Interface Card
- M160 Interface Card

The system can also be used by installing sensors in NAL chambers and is compatible with integrated signal systems such as Dynniq's RLCS.

M100 sensors have a battery life of 10 years. It can be installed just below the surface to a depth of 65mm, or deeper at 165mm to enable future resurfacing to take place without the need to remove and redeploy the sensor. It can be secured with resin or alternatively, can be positioned within a NAL Chamber which provides a watertight casing that enables the M100 to be removed during resurfacing works by unscrewing the cover. It is essential that for either installation, the magnetometer is installed correctly as per the manufacturers' guidelines to protect from water ingress or ineffective transmission.

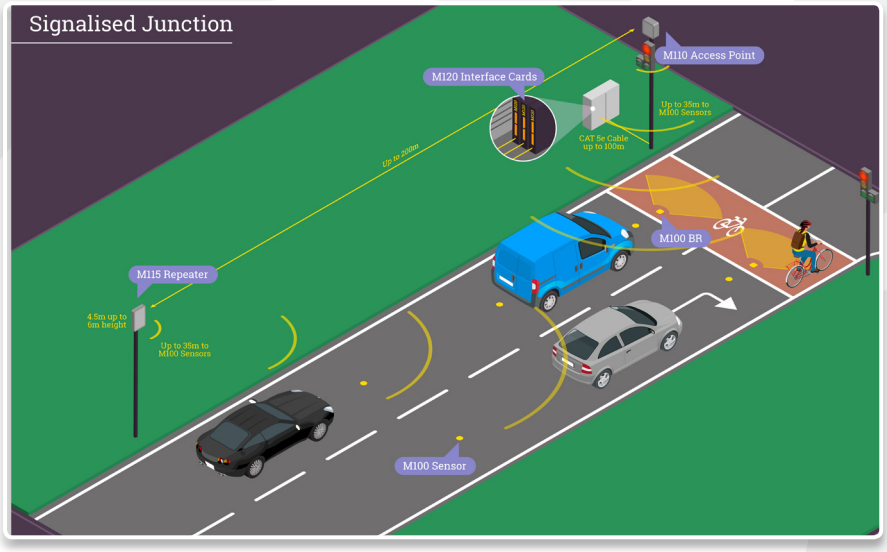


How it works

In the same way as loops, M100 sensors use changes in the earth's magnetic field to detect vehicles passing overhead. Sensors can also be installed in a primary and secondary configuration to establish speed, direction and length of passing vehicles.

Once detected, the data is wirelessly transmitted in real-time via low power, secure radio to an M110 Access Point. This needs to be located within 35 metres of the magnetometer and can be positioned on street furniture, between a height of 4.5 metres and 6 metres.

Should the magnetometers be outside of the 35 metre radius of the access point, or if the detection is being used for solutions such as SCOOT, MOVA or queue detection where a greater distance is required, then a M115 repeater unit can be used. Data is transmitted from the magnetometer to the M115 in the same way, but then transmitted from the repeater directly to the access point, extending the reach of the solution. Solar Repeater units have a battery life of up to 10 years and a maximum range of 200 metres from the M100 Access Point, forwarding detection messages from sensors installed 35m away from the repeater. Up to two units can be used in tandem to extend the network. All repeater units are battery powered, requiring no mains connection.



Once the data has been received by the M110 Access Point, it uses a wired CAT5 connection to relay the sensor detection data to one of three interface cards. The M120 Interface Card is used to relay information to a roadside traffic controller; the M150 Interface Card is used to communicate with a MIDAS outstation and an M160 Interface Card provides the facility to include additional logic around the system output and, as part of a bespoke solution, can communicate with other technology on the network, for example Vehicle Activated Signs (VAS).

In line with the promotion of active travel, Clearview also supplies a radar solution (M100BR) specifically created for the detection of bicycles. With a battery life of up to eight years, the sensor is installed inground, flush to the surface, to emit radar pulses to detect presence at a bicycle approach lane or stop sign.

High frequency radar pulses are transmitted, bounced off a target object, and the return pulses are measured by a time-gated radar mixer to indicate presence. When a detection is acknowledged, the sensor sends a signal wirelessly to an M110 Access Point which feeds detection information directly into the traffic controller through a wired connection. This can then be used to introduce a green phase of traffic signals specifically for cyclists to give them a dedicated crossing period or headstart on motorised traffic.

All of the Clearview Intelligence M100 system equipment, including sensors, access points, interface cards and repeaters, come with a five-year warranty.

Traditional use

Traditionally the M100s have been installed at traffic signal junctions, with the magnetometer detecting the presence of traffic. The system can be used at multiple junctions, compatible with adaptive control systems such as SCOOT and MOVA for effective traffic flow.

To date (August 2019), Clearview has undertaken more than 1,500 installations on behalf of local authorities including:

- Shrewsbury County Council – 20 junctions – MOVA
- Aberdeen County Council – over 30 junctions – SCOOT
- Hertfordshire County Council- 14 junctions – MOVA, SCOOT and queue detection

Following two-and-a-half years' in-house testing of the M100 system by Transport for London, the results showed direct comparisons with loops and radar. As a result, the system has been adopted as standard for detection on the TfL network with more than 1,000 junctions – including SCOOT –upgraded.

The ongoing evolution of the magnetometer

Since becoming a trusted alternative for inductive loops, the use of magnetometers has evolved beyond its traditional association with traffic signals to incorporate other applications such as ramp metering, MIDAS, queue detection and hazard warning.

Queue Protection

The use of magnetometers for queue protection has proved to be a simple upgrade from traffic signals as the solution is based upon a similar process using the M100, M110 Access Point and M115 Repeater Units but combined with Vehicle Activated Signs (VAS).

M100 sensors are installed at a roundabout, slip road or junction and, once queueing traffic is detected, a Vehicle Activated Sign positioned in advance of the magnetometer alerts approaching drivers to congestion ahead. This allows for additional time to adjust their speed and reduce the risk of rear-end shunts.

On routes where traffic is known to back up, such as motorway slip roads, additional sets of magnetometers and Vehicle Activated Signs can be installed further down the road to give increased warnings to motorists.

Such schemes have been successfully implemented by Highways England on routes including the M606 in Bradford; the M5 junction 12 (Quedgeley) and the M25 junctions 18 (Chorleywood Interchange) and junction 24 (Potters Bar).

MIDAS

In 2018 a 12-month trial of M100 showed that when compared with inductive loops, they delivered like-for-like results with additional benefits for MIDAS. When installed with primary and secondary sensors per lane, the M100 magnetometers were able to output detection information to the MIDAS outstation where vehicle speed was calculated. Using this data, operators were informed of slowing or stationary traffic, not only enabling them to identify the location of the problem but dispatch any required resource and inform drivers of congestion using MIDAS.

Undertaken by a project group comprising representatives of Highways England, A-one+, Connect Roads, Mway Comms and Clearview Intelligence, the study was carried out on the A1/ M1 connect DBFO linking to a MIDAS site.

The investigation compared the performance of magnetometers and loops when monitoring speed, traffic flow and classification of vehicles and concluded the magnetometer trial to be a “success”. This data was later submitted to, and accepted by, the National Information Service which confirmed “the magnetometer would pass our validation against the loops”.

Jacobs, who compiled the findings report on behalf of A-one+ stated: “There are many benefits of installing magnetometers at MIDAS sites over the traditional inductive loop technology. The conclusion of this report is that under similar circumstances and with the same installation methodology, the magnetometers are a suitable alternative to inductive loop detection.”

Ramp Metering

MIDAS and ramp metering often work in close collaboration as ramp metering solutions allow operators to measure the demand of traffic joining the motorway and analyse real-time MIDAS data. This joined-up intelligence provides an accurate overview of demands and challenges facing the network, helping to identify suitable points at which to allow traffic to join the motorway.

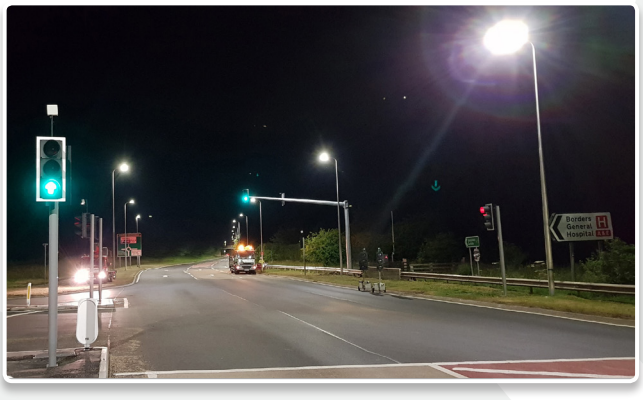
The M100 solution integrates into a 2nd generation ramp metering scheme with sensor detection points on both the slip road and the motorway network. Sensors measure the level of demand for traffic to join the motorway from the slip road and marry it up with data from the MIDAS network to "inject" traffic into the motorway flow with minimum disruption to improve driver journey time and experience using traffic signals at the motorway junction

Hazard warning

The ability to detect the presence of passing vehicles has enabled magnetometers to enter the realms of delivering road safety solutions, including hazard warnings and speed compliance.

On roads where junctions or turnings are on a blind approach, such as a bend or hill brow, magnetometers can be used in collaboration with Vehicle Activated Signs to give advance warnings to approaching drivers. The magnetometers can be used to detect traffic waiting to turn onto, or cross, a main road from a side road and use this data to inform a VAS and advise approaching motorists travelling on the main road to slow down ahead of an impending hazard.

A successful example of this approach in use is at the junction between Borders General Hospital and the Melrose Bypass (A6091) in Scotland which is used by 11,400 drivers each day and had been an accident hotspot for the past decade.



The location and topography of the junction with its proximity to the village of Darnick, location of the ambulance station serving the hospital and existing infrastructure meant changing the junction to a roundabout was not feasible. Instead, traffic signals were introduced, to control the flow of traffic. This approach also enabled traffic exiting the hospital to turn right at what had previously only ever been a left-turn-only junction.

M100 sensors are used to detect queuing traffic and inform the traffic signal sequences across the junction. However, the sequence can be overridden with the use of a hurry call button, which prioritises ambulances exiting the hospital by forcing a green light sequence.

For drivers travelling along the A6091 they are informed of responding ambulances by Vehicle Activated Signs (VAS). The same signs also warn drivers travelling above the newly reduced 50mph limit to slow down by communicating with magnetometers on the A6091.

By using magnetometers instead of inductive loops, road closures and traffic disruption was kept to a minimum at the Border's busiest junction. Additionally, the introduction of the hurry call system ensures exiting ambulances are not delayed by the new traffic lights when responding to emergencies.

The work at the Borders junction follows the installation of magnetometers on Scotland's A78 on the approach to the 30mph village of Fairlie, which was blighted by speeding drivers. Motorists detected travelling in excess of the limit trigger a 'slow down' Vehicle Activated Sign and red-light sequence at the impending traffic signals, which forces drivers to come to a stop. More information was presented on this at the JCT Symposium in 2015.

Conclusion

In the same way that roads and vehicles have evolved over the years, so have the challenges facing them. It is therefore only right that the solutions to these challenges evolve with them.

There was once a time when people were responsible for manually directing traffic. But the increase in demand required a more efficient solution, leading to traffic management solutions such as roundabouts, traffic signals and rights of way.

The same situation is now being reflected with inductive loops and magnetometers; what was once considered to be the most reliable method of detection is now being challenged by a more cost effective alternative.

Compared with inductive loops, magnetometers are faster to install and better protected from damage whilst proving flexible to the challenges of the road. For operators this means reduced installation and maintenance costs, better value for money and improved solutions to their problems whilst for drivers, it means a more efficient network with less disruption.

Inductive loops were once considered the best form of vehicle detection and magnetometers were only associated with traffic signals. But with evolution, magnetometers are now offering proven performance with vehicle detection across MIDAS, ramp metering, queue protection and hazard warning.

With installations spanning urban, rural and the strategic road network, wireless vehicle detection has now evolved to become a credible and cost-effective solution to consider on schemes, with a five-year warranty to guarantee it.

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