THE FIBRE-OPTIC FUTURE

STUART LARGE EXPLAINS HOW A NEW FIBRE-OPTIC BASED TECHNOLOGY CAN PROVIDE CITIES WITH REAL-TIME POSITIONAL INSIGHTS ABOUT THEIR ROAD AND PUBLIC TRANSPORT INFRASTRUCTURE

Over the past century, the world has become increasingly urbanised, and this trend is only gathering speed. It is projected that by 2050, more than two-thirds of the world's population will live in urban areas.

This significant rise in the amount of people housed in towns and cities will undoubtedly lead to transport networks feeling the strain. Traffic congestion is already a huge issue, with the estimated total economic costs of gridlock in the US, UK and Germany amounting to almost US$461 billion in 2017.

The unfortunate truth is the impact of congestion, both environmentally and economically, could be even more stark. This means that reliable and efficient traffic flows are essential for sustainable growth in the future. Cities around the globe seem to be waking up to this fact, with new metrics such as 'Journey Reliability Time' – the percentage of journeys completed within 17% of the standard journey time during peak periods – already implemented in Sydney, London and New York.

Additionally, there's heavy investment in digital augmentation of city transport systems. In 2018, Smart City spending topped US$81 billion worldwide, as governments and city authorities attempt to come to terms with a problem that will continue to grow if action is not taken.

But the challenge is delivering the intelligent traffic management systems that are essential to modern cities, without rendering existing infrastructure completely obsolete. And this is an extremely difficult obstacle to overcome.

To fully realise the potential of transport monitoring in modern connected cities in an economically viable manner and in a reasonable timescale, a solution must be found that incorporates and builds on the infrastructure already in place.

Distributed acoustic sensing

Distributed acoustic sensing (DAS) technology is one such solution. DAS is a photonic sensing technology that essentially 'plugs in' to existing fibre optic cable networks and transforms them into sophisticated acoustic sensors.

All traffic activity produces large amounts of acoustic or seismic energy as it passes over roads. Crucially, certain activities and incidents produce unique acoustic signatures — with detectable differences between vehicle types for instance. DAS recognises these

DAS 'interrogators' plug in to standard fibre optic cable networks, converting them into sophisticated acoustic sensors to monitor traffic flows

events, helping to separate the signal from the noise when it comes to smart city data.

This gives city authorities a real-time overview of the whole road network and enables them to track road traffic and public transport infrastructure — determining the speed and density of traffic, locating congestion, and detecting traffic disruption events such as road accidents.

Most sensors are limited to particular points and GPS is affected by disrupted signal in urban canyons and tunnels or simply by the fact it is only available on a minority of vehicles. However, DAS can provide complete coverage, wherever fibre is laid, which also makes it ideal for validating and enhancing data from GPS, GIS and other geospatial solutions.

With the data presented via map-based graphical interfaces – or as overlays on existing data feeds, DAS can integrate with these systems, providing reliable, pinpoint accurate information that will facilitate better understanding of geospatial data.

How does DAS work?

DAS is an advanced variant of an optical time domain reflectometer that monitors the coherent Rayleigh backscatter noise signature in a fibre optic cable as pulsed light is sent into the fibre.

The coherent Rayleigh noise generates fine structure in the backscatter signature of the fibre cable. DAS focuses on the Rayleigh component to increase its prominence in the backscatter trace and is optimised to measure small changes in the coherent Rayleigh noise structure that occurs from pulse to pulse.

Since the coherent Rayleigh noise structure is generated interferometrically within the fibre by the relative locations and strengths of local scattering centres intrinsic to the structure of the glass, very small physical (acoustic or vibration) disturbances at a point in the fibre can make detectable changes in the interferometric signal. This enables DAS to have an extremely high level of accuracy when detecting traffic anomalies. Depending on the 'noisiness' of the environment, DAS can pinpoint incidents to 10m or even down to a couple of metres across an entire city network.

DAS operates with standard telecommunications-grade optical fibres. These optical fibres can be installed as an asset is being built or retrospectively on existing telecommunications infrastructure, such as the ubiquitous fibre networks in cities.

DAS uses optical fibres as the 'sensor'; the DAS itself being the interrogator of the returning backscatter signal. By using DAS, you gain a 'sensor' that is immune to EM or RF interface – it's also inert and requires no power along the entire length beyond the DAS interrogator. And, depending on the quality of fibre among other environmental attributes, DAS allows for 50km of optical fibre to be monitored by one interrogator on a single channel.

As a result, DAS monitoring solutions can often be installed more quickly than other traditional monitoring technologies, at a lower deployment cost, and therefore result in a considerable reduction in 'through life' and maintenance costs.

Fibre-optic future

Accessing DAS-based insights, in combination with intelligent city infrastructure and other data sources, will enable cities to optimise the efficiency of their entire transport networks, from directing mass transit systems more effectively to raising collision alerts.

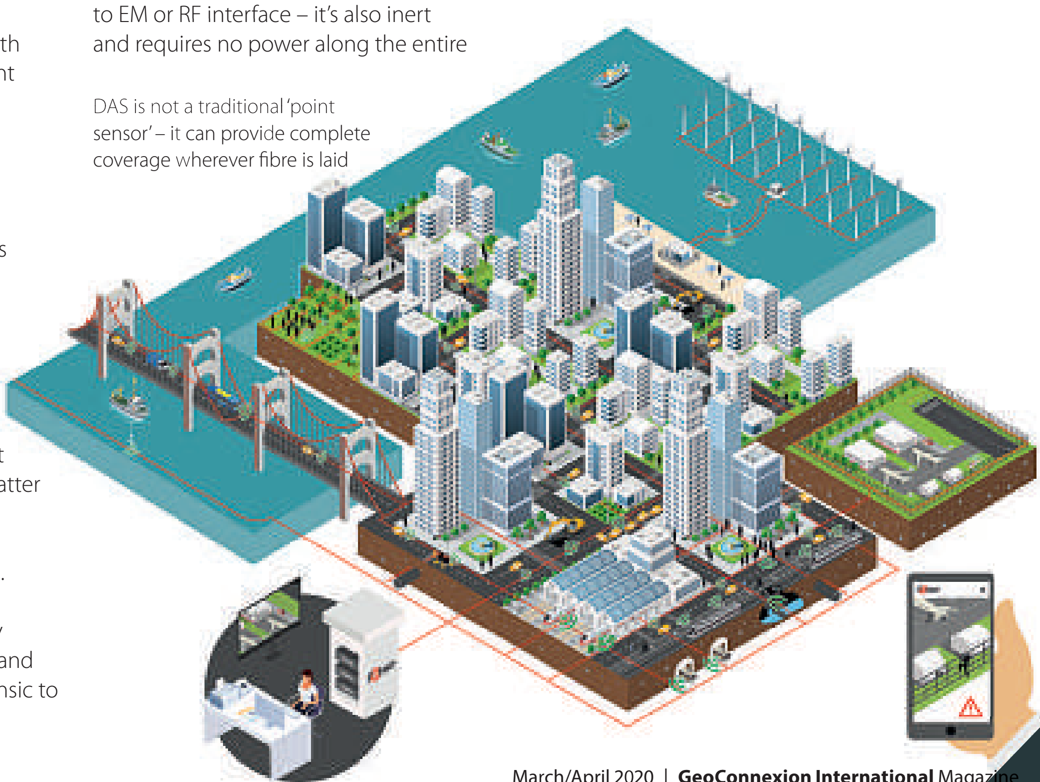
This technology could deliver levels of automation that are unimaginable using traditional traffic management systems alone. Cities authorities could dynamically adapt traffic controls and balance overall flows to avoid crippling congestion on major arteries.

Real-time insights that are accurate and rapidly implementable are what cities need to optimise their transport networks. With mass urbanisation this is a problem that requires urgent attention. With that in mind, it bears repeating that thousands of kilometres of suitable fibre are already in place under our streets.

Deploying DAS on these networks will not only realise new value in our fibre assets, it will also deliver the smart systems we desperately require – efficiently, cost-effectively and crucially, without adding more disruption to traffic systems already stretched to breaking point.

Stuart Large is a sales and product line director at Fotech (www.fotech.com)

DAS is not a traditional 'point sensor' – it can provide complete coverage wherever fibre is laid



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