

Wireless data

Dual strategy to boost underground Wi-Fi

Combining two different signal systems promises to enable clearer Wi-Fi reception in underground commuter trains

Underground train passengers may soon be able to access Wi-Fi wherever they are, thanks to the discovery by NAIST researchers that leaky cables can be stacked up in tunnels to transmit and receive digital signals.

Several major cities, including Tokyo and London, offer Wi-Fi to commuters at underground stations by installing antennas at various locations in public areas. However, it is much challenging to obtain a signal inside a tunnel. This is because solid objects like trains block the high-frequency radio waves that Wi-Fi uses to transmit information when the waves are funnelled down a tunnel.

Underground train passengers may soon be able to access Wi-Fi wherever they are, thanks to the discovery by NAIST researchers that leaky cables can be stacked up in tunnels to transmit and receive digital signals.

One way to overcome this problem is to run a 'leaky coaxial cable' down a tunnel. Such a cable resembles a hose pipe in that it has many small holes drilled in it. But instead of leaking jets of water, the cable releases — and can receive — digital information through the tiny holes. Such cables have already been installed in some underground systems, but because they transmit limited amounts of data, the Wi-Fi signal tends not to be very strong. Consequently, the amount of data that can be downloaded and uploaded is limited and transfer speeds are slow.

Now, Minoru Okada and his colleagues at NAIST in Japan have proposed overcoming this problem by combining leaky coaxial cables with another system known as multiple-input multiple-output (MIMO), which is used in many home Wi-Fi systems¹. In a classic radio system, one antenna transmits a signal and another antenna (for example,



Passengers on underground trains may soon be able to access fast Wi-Fi thanks to a strategy proposed by NAIST researchers.

one in a laptop computer or a smartphone) receives it. In MIMO, multiple antennas are used at each end and different data streams are sent simultaneously; this strategy enhances both the speed and the amount of data that is transmitted. Processors at either end then detect tiny differences in the signals, which are caused by distortions as the signals bounce off different objects, and use these differences to disentangle the different data streams.

Okada and co-workers have mashed these two systems together by combining two leaky cables to create an underground MIMO system. So long as the holes in the cables release

the Wi-Fi signals in different directions, the differences in the data streams should be large enough to distinguish the different data streams.

The additional capacity that MIMO adds to the system means that if multiple people wanted to download an attachment from their emails at the same time, they could do so more quickly.

Reference

1. Hou, Y., Tsukamoto, S., Ariyoshi, M., Kobayashi, K. & Okada, M. 4-by-4 MIMO channel using two leaky coaxial cables (LCXs) for wireless applications over linear-cell. *2014 IEEE 3rd Global Conference on Consumer Electronics (GCCE 2014)* 125–126 (2014).