How Lavinet bridges the wireless distance

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THE CURRENT MEN'S world record for the long jump is 8.95 meters (7.52m for women), while the triple jump record is 18.29m (15.5m for women). More hops mean a bigger distance can be covered.

The same can be said about our wi-fi connectivity. We can cover a longer distance if our wi-fi network, currently based on a single hop, can be extended to multiple hops.

Nowadays, many mobile devices use wi-fi to connect to the internet using radio waves.

Driven by many popular mobile applications such as Facebook, WhatsApp and Twitter, we often take wi-fi for granted and expect it to be available anytime and anywhere. We expect wi-fi coverage to be ubiquitous and pervasive 24 x 7.

Currently, the most common deployment method is called wi-fi hotspot, which offers internet access by wirelessly connecting the user directly to an access point, or AP.

Similar to a long jump based on a single hop, such hotspots have a limited coverage range. If you are outside the AP coverage, you have no signal and you cannot access the internet.

The situation is similar to wanting to cross from one side of a river to the other. If the river is narrow, you can simply hop over.

However, if the river is too wide, you need rocks in between so that you can cross the river in multiple hops.

This analogy is the same for wi-fi coverage.

If the AP is too far from you, putting some intermediate devices in between to relay the signal can extend its coverage to more users.

At HKUST, we are designing such devices to form a multi-hop wi-fi network called Lavinet. And the device to hop is called a Lavinet node.

Lavinet allows the user to connect to an AP that is a long distance away by relaying signals from one node to another in a multi-hop manner. Wi-fi coverage can then be extended with low cost.

But let's suppose that the river bank is wide and it has many rocks in between.

Given your hop stride, there could be many possible paths to cross the river, with some paths being faster than others. The problem is how to choose the best set of rocks to hop across the river.

Further consider a scenario where there are many users scattered along the edge wanting to cross the river through hopping between rocks. Each has a different hop stride.

If each rock at one time cannot hold more than a certain number of users, the task is then more complicated – which path should each user use so that everyone can cross the river in the shortest possible time?

The innovation of Lavinet is how to design paths so that the data traffic from many mobile devices can be efficiently connected to the AP.

Each of the nodes can intelligently decide which hop to forward its data to so as to achieve the maximum bandwidth experience.

Finally, imagine the most complicated situation in which various rocks are floating across the river.

In this case, designing the path to move all the users from one riverbank to another becomes very challenging, as the environment keeps changing and the decision has to be timely to move users from one rock to another.

Lavinet can be applied in a mobile environment by mounting the node inside a car or moving cart.

The situation is then like the above, with floating rocks.

My research team has been devising ways so that users can have reliable and good connections even in a changing mobile environment by means of multi-hopping.

Our approach takes into account many factors such as radio signal strength, interference and congestion. In this way, a user can stay connected even in a vast area, such as a golf course, with the Lavinet node in the cart.

The Lavinet technology has been successfully deployed in the industry so that users can enjoy uninterrupted and satisfactory wi-fi experience.

The project has received extensive support from the government and industry.

Lavinet is transforming our wi-fi experience to be more pervasive, faster and smarter. It allows us to live more freely than ever, wirelessly.

Next time you wade across a river, think about the multi-hop wi-fi that we at HKUST have developed.

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