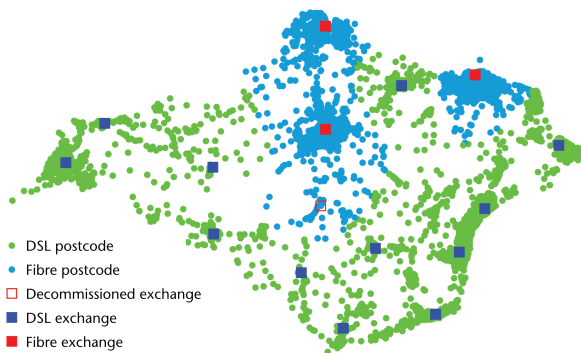


Can maths make the internet faster?



Mathematics and applied mathematics are used in everyday life. Stock markets, mobile phones, car manufacturing, Google, Hollywood special effects, digital TV and satellites all use cutting-edge mathematics tools in their basic functions. The Mathematical Modelling Series presents a number of applications of mathematics in domains as varied as the human body, volcanology, telecommunications or finance.

Many internet subscribers in Ireland get internet access over a digital subscriber line (DSL), which is transmitted over copper telephone cables. Replacing the copper cables with fibre optic cables would allow data (e.g., music and videos) to be uploaded and downloaded more quickly. The drawback is that this upgrade would be very expensive. Mathematics can be used to find a way to minimise this cost and make the upgrade practical and internet access much faster .



How it works

To solve the problem we need two ingredients. Firstly, we need a way of estimating the required investment in and possible revenue from a given upgrade. Investments include upgrading telephone exchanges to accept fibre optic cable, buying fibre

optic cables and digging tunnels for them to run through. Revenue includes additional fees that subscribers are willing to pay for a better service. Secondly, we require a way of sorting through all the possible upgrades to find the best one. Trying out all possible combinations is too slow, even with modern computers. Instead we use an algorithm called simulated annealing. It is the same procedure that we use to get sugar in a bowl to lie flat by tapping the side. At first, when the surface is very uneven we tap quite hard. Later, as the surface becomes more level, we have to tap more softly to avoid making things worse. Using this algorithm, a computer can solve the problem in a few hours. An optimal upgrade for the Isle of Wight in the UK is shown in the figure across.

Conclusion

An upgrade of the internet infrastructure can be profitable, but it requires a large initial investment. It may be necessary to target the most densely populated areas.

Parts of the curriculum used in this project:

- | | |
|---------------------|---------------------------|
| ■ Matrices | ■ Linear equations |
| ■ Lines and circles | ■ Transformation geometry |
| ■ Trigonometry | ■ Sequences and series |
| ■ Discrete calculus | ■ Statistics |

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If you want more information about MACSI and this project:

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