

TEACHERS INSTRUCTIONS FOR 'HUNT THE TRANSMITTER' WORKSHOP

Background

This workshop is designed to help students think about how mobile phone signals reach their handset and what sort of difficulties face telecommunications planners. All sorts of elements in the urban environment can get in the way of the radio signals that carry our conversations - tall buildings, trees, hills even heavy rain and snow.

In this exercise, students are asked to work in small teams of 4 or 5, each team representing a different fictional mobile phone company eg Banana, Vodkaphone, TB Sellnet, Two One Two, Shokia, Rollermotor or Eric'sdaughter. Each team must decide where to place mobile phone transmitters on a map of Phoneville to ensure that all the potential customers receive a good signal. They need to avoid tall buildings or heavily wooded areas, to minimise interference between transmitters and keep to a budget of £250,000. Depending on age, students usually take 20 to 30 minutes to complete the task to their satisfaction.

The Equipment

Each team will need:

- **An instruction sheet** This is marked with the name of their chosen mobile phone company eg Banana, Vodkaphone etc., the scenario describing the workshop and a set of pointers to help them with the task.
- **A sheet of antenna specifications** There are three types of antenna or transmitter available to each team: long range, mid range and short range. Each has a different height, range and cost. This sheet also has an equipment list.
- **A map of Phoneville** This should be printed on card or ideally on laminated paper. The map is schematic, showing how different areas in the town are used eg residential, light industry, shops and offices, parkland, woodland. The average height of the features in each area is noted eg residential 5 metres, woodland, 10m. Roads and railway lines are also marked on the map. The map is divided into one kilometre squares, labelled with letters and numbers for grid references.
- **A set of brown relief contours lines** These lines should be printed on overhead transparency, to lay over the map of Phoneville. The edges of the contour lines match the edges of the map. The highest hill is 30m, located in the top left hand corner; there are smaller hills in the bottom corners of the map.
- **A set of transmitter ranges** Each red circle represents one of the three different sizes of transmitter. The black dot in the centre shows the location of the transmitter, and the red area inside the circle represent its range ie 4km, 2km or 1km. Each team should have two of each size, printed on overhead transparency. The teams cut these out and can lay them over the map to check for overlaps, gaps in signal coverage or the presence of obstacles.
- **Land profiles 1-6** These profiles show cross sections through the terrain at key points on the map. The second map of Phoneville marked with lines labelled 1 to 6

shows the location of each cross section. Students may find these profiles helpful to assist them to read the relief contours and to locate convenient areas of high ground or valleys where the signal might be blocked by surrounding obstacles.

- **Scissors to cut out the transmitter ranges**
- **Blue Tack to stick the transmitter ranges to the map**
- **Ruler to measure distances on the map**

The Solution

One suggested solution is laid out on a third map of Phoneville. The small red dots show where the transmitters are located, the red circles illustrate the range of each transmitter. A long-range transmitter, costing £90,000 is placed in the top left-hand corner of the map in square 3B. This transmitter gives coverage to the residential areas to the south and the shops and offices to the south east. A second mid-range transmitter, costing £70,000, is placed by the road at the edge of the area of light industry in 2G. This transmitter covers part of the light industry area to the east, and the residential area to the west. The signal from the second transmitter overlaps the signal from the first transmitter, creating a potential interference problem in the area covered by both circles. However, the signal from the transmitter in 3B will be blocked by the large area of woodland next to it, so interference problems should be minimised.

The final long-range transmitter, again costing £90,000 is located next to the railway line to the south of the town in 7H. This transmitter covers the two southern residential areas, the agricultural land and some of the railway line passing through the town. Again, there is some overlap with the signal from transmitter 2G, but this is blocked by woodland to the south of that transmitter. The total cost of these three transmitters is £250,000, the target budget. However, not all areas of the town are covered by this plan, for example there is no signal to the power station in the south west. The eastern edge of the light industrial area in the north is also not covered. Two more short-range transmitters, one on the power station and one in the light industrial area would rectify this problem, but of course at extra cost.

Feedback

The workshop ends with a feedback session, where a spokesperson from each planning team describes where they put their transmitters and why. It often quickly becomes clear that there is no real definitive answer to this task - each solution will be correct by the criteria the individual teams considered important. For example, one team may decide that residential customers are not a priority as most have land lines, and concentrate on providing signals to commercial areas eg light industry, shops and offices, railway lines and the power station. Another team may decide not to place their transmitters near schools or in parkland for environmental reasons. The transmitter locations outlined above can be offered as a potential solution, but with its drawbacks and the implications made clear.

In reality, mobile companies face these dilemmas on a regular basis, particularly since the next generation internet-access phones require tens of thousands of extra

transmitters across the UK. Companies must take into account dozens of factors affecting coverage: building height and materials, location and type of vegetation, land profiles, seasonal weather variations, planning restrictions and so on. Planning teams often use sophisticated software tools to make the task easier - after attempting to go through this process the hard way, the students may now understand why!