2021 COMP3310/etc

Assignment 1 – The Last Mile

Intro:

This assignment is to develop a (short) technical report that deals with a variety of network design aspects relating to building a last-mile network, with the last section making a specific design recommendation for a semi-fictitious rural setting.

You are encouraged to research widely, then interpret and present your findings. More marks will be given for deeper analysis than just repeating lecture content. You will need to find more background information to answer all the questions in good depth.

- *This assignment is worth 10% of the final course mark.*
- *It is due by 23:59 Monday 5 April, Canberra time.*
  - *Note that Canberra time changes from gmt+11 to gmt+10 from Sunday 4 April!*
- ***Late submissions will not be accepted**, except in special circumstances*
  - *Extensions must be requested, via the course convenor, with appropriate evidence.*
- *Submission will be via TurnItIn through the link on the wattle page for this course.*
  - *You can work together on the research, but your submission must be entirely your own work, with appropriate citation of your sources. You should look at the feedback from TurnItIn to ensure you have properly referenced external materials.*
- *Reminder: There are **four questions**; please check you attempted all four before you submit.*

For the three brief questions Q1-Q3, each answer should be about 0.5-1 page long. These questions help set the scene for your analysis in Question 4 – you can reference your Q1-Q3 answers there.

[The percentage in brackets indicates the available marks]

Q1: Why is the Last Mile an important and complex issue in Networking and Communications? [15%]

Q2: What are the main, typical, options for delivering Last Mile networks in Australia? [15%]

Q3: What are the inherent (physical) limitations on data-rates across typical Last Mile networks? [15%] 在典型的“最后一英里”网络中，数据速率的固有(物理)限制是什么

The above answers are input to the following design challenge. Your report for Q4 should be about 1200 words long. You are strongly encouraged to include appropriate diagrams and tables, to help explain your arguments.

Q4. Develop a basic network design to meet the following needs of a rural community [55%]: Home broadband can be delivered through a range of cabled and wireless methods, each with their own costs, limitations and benefits. For this part of the assignment you need to provide a brief technical report for a rural community network organisation. Please write to a reasonable level of technical understanding, but don’t blind them with jargon.

The community wants to build their own shared network for 256 farms, across their interestingly-laid out region, through a common infrastructure – i.e. everyone gets the same connection, if not

the same performance, to keep the maintenance simple. The minimum requirement is that every farm gets 50Mb/s down and up, though of course anything better is welcome.

The sketch below shows the layout of the farms. They are conveniently laid out on two touching concentric circles of roads, each with four ring roads (radius of 0.75, 1.5, 2.25 and 3km) and four cross-roads at 45degrees as shows. Along each segment of each ring there are four equally-spaced houses (only the outer ring houses are shown in the diagram).

Every home has a 50m driveway connecting it to the ring road just outside of it, and every home has a working phone landline (POTS) from one of the two centrally-located exchanges. There's also a 4G mobile phone tower on each exchange. Both the exchanges and the 4G phone coverage provide connectivity back to the wider internet.

Fortunately the local Council is very supportive, you can build what you want, but would prefer any new infrastructure to be along the roads and house driveways only, i.e. don't go through backyards. You can also use the existing towers at the exchanges.

a) Describe the various FTTx/HFC cable approaches that could be deployed and what a deployment would look like in this situation – what kind of equipment and cables (copper/fibre) are needed where, and how much is needed. Simple diagrams will be very helpful! Contrast the cabled results, and compare them to some reasonable off-the-shelf wireless options. Your analysis should include expected downstream/upstream performance, any limitations, as well as describing any capital and operating cost concerns for the whole system. Explain what it would take to run your network for the next 30 years.

b) Explain what you would recommend, and why. Highlight any assumptions or simplifications you need to make. It's only a first report for the organisation, they'll need to go get a lot more data based on your advice, and detailed quotes for the actual network elements.

c) Use the following indicative pricing to estimate what each design you propose would cost to **deploy**. Note that not all the necessary equipment is priced here, so you should flag anything else that is needed, as well as what **operational** costs you might expect longer term (people, electricity, protection/repairs, etc.):
    a. Fibre: $10/meter for the cable (1 pair of fibres), and $500 for terminating each end
    b. Copper: $3/meter for the cable (1 pair of copper), and $150 for terminating each end
    c. Wireless transmitters:
        i. Omnidirectional = $20,000 each to cover a circle 4km wide, plus $500 per house.
        ii. Point-to-point links with 5km range = $600 at each end.
    d. Converting one fibre to one copper cable (and vice-versa) is a simple $50 unit
    e. Converting one fibre to 16 copper or fibre cables is a more expensive $1,000 cabinet.

*(Yes, these numbers are **extremely** rough, but they do cover outdoor grade coax/UTP/fibre, they include the active equipment at each end, they magically support whatever kind of LAN-protocol-specific equipment is needed for each technology, and they are powered by a hidden electricity grid that is conveniently available everywhere all the time. It's a start!).*

Note, there is no single 'right' answer, and without a specific site survey and more detailed pricing it is hard to define the 'optimal' answer. The aim is to analyse the problem, develop potential solutions, and make a strong argument as to which options lead to the best outcomes.

For all questions, ***cite all your sources*** *appropriately (use whatever citation style you are familiar with) and be clear where you are quoting and/or paraphrasing your sources.* ***Lectures are not citable sources.***