Notes on telecom claims and confirmation of a network modelling formula

Summary of a January 2021 LinkedIn post

February 2021

File reference: Notes_of_claims_06022021.docx

Details: A discusson paper

Author: R Steele

Telzed Limited UK. Consulting, Advisory and Interim Management Services
All correspondence: Lilac Cottage, Westerfield Road, Westerfield, Ipswich, IP6 9AJ, UK. Tel: +44 (0) 777 178 7607
Registered Office: Orchard House Park Lane, Reigate, RH3 8JX, UK

Table of contents

Document history

Ver 06022021 Initial version

1 Telecom claims and analyses can be misleading

1.1 Background

A number of Telzed papers have highlighted "odd" or misleading claims. This is a serious matter as some readers may not be aware of the source's weakness. There is a finite possibility that this leads to bad business decisions and major investment write-offs. This is not fanciful as telecoms has seen many failures. This includes worthy ideas that competition or technology advances weeded out. But it includes failures that ought to have been foreseen as almost certain, i.e. the busines premise was flawed, and should have been seen as such at the time. Flaws might be missed or other deficiencies can be obscured by questionable claims and poor analysis, creating false beliefs. This may have contributed to past problems.

Claims may lead to beliefs that a business plan is more promising than it really is. Not every investor is able to do detailed due diligence (though they ought to have that done). The unwary and their money are easily parted. Deficient work may also degrade the reputation of good firms as "all consultants and analysts" can be dismissed as being the same.

Roger Steele (Telzed) and author of this report posted a LinkedIn conversation in January 2021 that was widely read and positively received. This highlighted some odd claims and provided evidence to show how a simple analysis formula, as used in many other Telzed papers for evaluating networks and businesses at a strategic level, fits closely with measured data in the public domain. The formula is therefore further verified as a simple but effective approximate tool to verify modelling and demand data.

1.2 Messages from this report

This report includes the content of the LinkedIn posting[1] but in a more readable format, with some additional insights and discussions.

The following messages are provided:

- Everyone should be wary of common dubious and false claims. These may be masked by other good work in the same source
- Business leaders and investors must have the technical skills to evaluate claims, business models and business plans, in order to verify if the numbers are at least "roughly correct." A complex business model will be more detailed (and accurate, if robust) but it should still fit with known rules of thumb and with known relationships of customer demand, network-capacity and costs

[1] https://www.linkedin.com/posts/roger-steele-b44b101_broadband-isp-talktalk-sees-uk-traffic-surge-activity-6757686524109754368-tLqv

- Decision makers should have the skills, experience and knowledge to decide if an idea is at least plausible. Effort can then concentrate on the detailed risks and options, unburdened by hopeless/unlikely schemes
- It is the *traffic demands* that primarily drive network capacity needs. *Speed of the service* is usually a secondary factor and often it is not the key driver in cost or network dimensioning, especially in packet-based networks. Of course speed matters, but its relevance and connection to traffic must be understood
- Be careful of thinking of networks as delivering a switched circuit type service to customers at say 20Mbit/s or 100Mbit/s. Most networks are packet-based and share a finite capacity of (say) a router, mast or satellite. Sharing is then not a switched circuit service delivering a specified speed
- Switched circuit thinking was valid for voice networks. It can be adapted to packet based networks only with care and with proper re-use of Erlang type calculations
- Erlang type calculations and switched circuit thinking needs a definition of *traffic*. Not just a measure of the circuit speed. This is often missing which can invalidate some switched circuit type analyses so that they give false results
- If you do not know some basic telecom traffic theory and statistics perhaps one should not publish papers, or make recommendations, on the matter without having consulted other experts. This may be counter to some consultants' and analysts' thinking as they "are experts" and so do not need to confer with other parties. Real professionals do confer and do doubt their work, at least initially
- Market data publications and bottom-up calculations of traffic and capacity are shown here to align. This verifies the solidity of Telzed formulae. This gives a sound strategic level insight to how network capacity and customer usage are aligned. This is essential understanding for all managers and decision makers. Leaders should understand key market trends and values – download amounts, total capacity in Gbit/s, peak and average levels, growth rates, fixed versus mobile markets, developed versus emerging markets etc.
- Lack of proper understanding can lead to an acceptance of false/odd claims and this can result in wasted investments.

2 Claims and some basic analysis applicable to many networks

2.1 Should false/dubious claims be called out?

The original posting is reproduced (with text enhancements and paraphrasing) in the following. The post's basis was a light-hearted rhetorical request to call out claims, especially crazy ones. None were given by readers, but some "interesting" ones were supplied by Telzed.

R Steele is not alone when despairing at industry claims [even excluding Covid and 5G-causal type nonsense – these are not worthy of discussion]. There are some "odd" numbers and claims for satellites, mobile and fixed markets.

Key false[2] ideas include:

- Mobiles devices. Some seem to claim that they use ~10Mbit/s on average. They do not. They currently use say 40Mbit/s briefly and average c0.1Mbit/s in the busy hour. So, c1-2000+ devices per mast (less in city hot spots) are likely
- Satellites. Some seem to claim that they can mass-replace fixed lines (in UK/EU et al). This is not the case: elementary traffic analysis shows this. Elon Musk confirms this, and challenging mobile networks, are not in Starlink's plan
- 5G. Some seem to think it will mass-replace fixed lines in UK-like countries (those with high Internet usage and developed fixed broadband). Why is this claim made when elementary analysis shows huge numbers of mast sites would be needed and fixed line broadband already exists to most premises? It has a huge role but not in mass fixed line-substitution.

2.2 Real data and basic analysis are in alignment

The strategic-level calculations are simple. Average traffic (Mbit/s) = N x 0.01 x Gbyte per month per customer. Roughly. N is the number of customers. This aggregate traffic has to fit through the mast/satellite/router. It is simple to check – see Telzed papers. NB this is at the heart of many strategic level network analyses. Complex models will provide better results to include factors such as additional growth but must agree reasonably with this formula. NB real networks will likely have less customers or traffic per mast/satellite/router than defined by the mast-capacity limit. The formula is deliberately slightly optimistic in many situations when estimating customer numbers or possible traffic. Users may increase the 0.01 value to consider with other factors to get a larger effective traffic value.

[2] Certainly such outcomes are possible *if* a number of assumptions are made. These are considered unlikely enough to assume they are false, for this discussion

See real data, if in doubt. ISPreview[3] shows December 2020 data of 7.6Tbps in TalkTalk. With 2.84M broadband subscribers (Ofcom value). This means about c2.7Mbit/s per subscriber. This is in line with average UK downloads of >300Gbyte/month, assuming TalkTalk subscribers are below UK-average users and CDN[4]s may have an impact. This is shown by applying the Telzed formula above. Other reports on #Gbit/s and customer numbers give similar results. Telecoms technical rules apply to both fixed and mobile networks.

Note that average UK downloads were over 300Gbyte per month in 2020, but it is likely that TalkTalk average customers will be less-heavy users. The UK average usage includes a few heavy TV streaming premises, SOHO or filesharing "internet warriors." So the median usage is < average usage. TalkTalk probably appeals to lower volume users. Therefore the Telzed formula and public domain traffic data are in good alignment.

2.3 Other data complies with the Telzed analysis and provides insights for making assessments

Real data and networks follow the same rules. ISPreview[5] noted BT late 2020 fixed network traffic peaks of about 15Petabyte (assumed per hour).

This means 3.6Mbit/s per customer (using 9.1million fixed line customers on BT – sourced from Ofcom). This again fits with the above engineering guide rules. It corresponds to 360Gbyte/month. This is close to reported average UK fixed line downloads.

The total UK fixed broadband peak traffic is therefore c98terabit/s (26.8million lines). UK mobile has less than 4% share (UK mobile usage is lower than in many countries) of UK traffic. There are about 95million devices. Using a 3.2% traffic share (Ofcom) by mobile this means about 0.033Mbit/s per mobile device. This means mobile usage of about 3.3Gbyte per month [using the above formula]. This is in close alignment with reported values, see recent Tefficient or Ofcom data showing average UK 2020 mobile usage about 3.5Gbyte/month per device.

This type of market understanding should be basic to ***anyone in senior positions***, even if they do not use the same formulae. The general insights should be basic knowledge. Else: those in such a position might need to consider some actions...

Peak traffic of UK mobile is roughly 3 terabit/s. See calculations based on total market traffic or bottom-up calculations based on the above formula (they should give similar values in all countries). In the UK there are c50k mast sites. This is approximate for illustration as the exact number seems to be no longer reported. The reasons for this are worth investigating.

---

[3] ISPreview https://www.ispreview.co.uk/index.php/2020/12/broadband-isp-talktalk-sees-uk-traffic-surge-50-in-2020.html

[4] Content Delivery Networks are created mat major internet payers to ensure their sites traffic gets to customers rapidly. Therefore the CDN brings in traffic over a separate network and this might not be counted in the IPS's own gateway traffic

[5] https://www.ispreview.co.uk/index.php/2020/12/openreach-see-uk-broadband-usage-double-in-2020-to-50000pb.html

Therefore this means about 60Mbit/s of traffic per mast[6]. This may seem low, but many masts are 2G and 3G (with low traffic). Most new 4G & 5G masts are built for growth and to cope with freak traffic-peaks. 40% pa growth means low current utilisation to avoid short term upgrades. Utilisation must be less than the maximum capacity. Many masts are for coverage or used in part of day only, again low traffic levels. The result is many customers/mast on average, yet a city mast has ~500/mast and many masts' physical capacities may be >100Mbit/s. If we ignore the little used 2/3G masts this means many are on a mast with well over 100Mbit/s capacity and this fits with actual measured speeds seen [20-60Mbit/s]. NB this is often less than 1/3 of maximum total mast capacity, due to three sectors commonly used per mast and the speed is reduced by other users' traffic.

Key messages are: the formula is consistent with real networks[7] and it is a solid basis for strategic evaluations.

Notes:

- Calculations and data should always give sensible answers [these do] and should fit reasonably with market data. This is an approximate calculation to show how a basic analysis can verify source data
- Please understand that mobiles or satellite dishes and fixed broadband routers *et al* do not deliver "100Mbit/s" clear channels. Switched circuit thinking is usually wrong. Who could think that as OK? Telecoms is now mostly packet based. Contact Telzed, if needed, for help on how to use such Erlang/circuit theory to give results similar to real packet-based networks. The above Telzed formula is based around packet type thinking.

This analysis should "put a wooden stake" into claims that mobiles or satellites need or use 100Mbit/s as a switched circuit type service. They use well less than one Mbit/s in an average busy hour (mobile) or around 1Mbit/s if using fixed line type downloads of c100Gbyte per month. Elementary traffic understanding is essential for strategic decisions. Maybe this is missing in some papers/claims.

Of course the traffic is downloaded at say 20Mbit/s,100Mbit/s or even 1Gbit/s, but in many short bursts. It is the *average* traffic and hence the total traffic from many customers that overloads the network and is what network engineers and investment planners focus upon. Due allowances for growth and statistical peaks are also used.

It is emphasised that use of Erlangs, over-sell, usage factors, contention ratios *et al* methods can give very wrong answers *without due understanding*.

---

[6] A figure of ~75Mbit/s per mast is the average used capacity in Ireland using annual downloads of 1billion Gbyte per year and just over 11,000 masts. See recent Plum report (Fig 6.4) for Comreg and mast data. This aligns with higher mobile traffic levels in Ireland c.f. UK (see Tefficient). The two countries show that if existing mast capacities can rise to several 100Mbit/s, (say with 5G) then existing sites could cope with several years; growth if the additional spectrum can also cover existing area (uncertain as more capacity-spectrum is likely to be higher frequency and more "line of site" limited

[7] The formula has also been verified by Telzed to give results close to operators' data on traffic per mast in mobile models

2.4 Examples of "interesting" claims

The following claims are noted:

1. One analysis[8] of mobile demand seems to predict 100Mbit/s is needed for 5%, 10%, etc. of devices (or all customers are active 10% of the time – the impact is the same). This implies about 10Mbit/s average usage. This is ~100x real mobile usage using the above Telzed analysis and using real data. This paper is GSMA endorsed

2. 5G " ..could "replace traditional connections" for 85% of the UK's 26 million fixed line ISP customers, with "equal or better speeds.""[9] How realistic is *could*[10]?

3. Starlink cannot have many customers and delivers a 100Mbit/s type switched service. This source[11] seems to imply Starlink is doomed. 100Gbyte per month usage actually uses about 1Mbit/s on average, at 20Mbit/s, 30Mbit/s or 100Mbit/s speeds as available from the satellite (see Telzed analysis). This source uses oversell factors - is this really applicable? It suggests that customers get 100Mbit/s as a switched clear channel and perhaps this is oversold 3x. So a 20Gbit/s satellite could have only 600 customers (200 x 100Mbit/s channels with x3-oversell). This does not fit with conventional traffic analysis that means the satellite can really deal with up to 20,000 customers using on average 1Mbit/s (resulting from ~100Gbyte per month) in the busy hour

4. With 5G... "Every household will be £450 better off a year – £145 will be shaved off their energy bills through super-smart grids and their council bills will be £66 cheaper thanks to connected refuse collection and smart fridge 'shelfies' will allow them to cut food waste by £236 a year". There is much more "of interest" on this source[12]. Where are the services that a telecom operator can access and bill for, to pay for the masts and transmission?

5. Home working will/could overload the Internet. This was a major claim circa March 2020. It was a legitimate worry, but generally it did not happen. BT for example said there was capacity enough. Basic knowledge of networks shows that ~2x more traffic in the day has little risk as the peak is early evening. Networks cope with c40% pa growth anyway and with freak days, so normally a lot of headroom exists anyway. The point was valid, but in reality it turned out to be no disaster. Most industry leaders should have known that or checked with technical departments. At the time, doom-predicters gained significant press coverage (adding another layer of doubt),

---

[8] https://www.coleago.com/app/uploads/2021/01/Demand-for-IMT-spectrum-Coleago-14-Dec-2020.pdf

[9] https://www.ispreview.co.uk/index.php/2018/11/three-uk-study-5g-to-do-100mbps-broadband-replace-fixed-lines.html

[10] Bertrand Russell noted there could be a tea set orbiting in the asteroid belt and we cannot disprove it, but it is reasonable to dismiss the idea

[11] https://www.ispreview.co.uk/index.php/2020/09/analyst-probes-speed-claims-of-starlinks-broadband-satellites.html

[12] https://d10wc7q7re41fz.cloudfront.net/wp-content/uploads/2018/03/Smart-Cities-Report.pdf This has many claims about the wider impact of 5G. Readers can make their own assessments whether they realistic and more significantly what revenue can accrue to the telco operator? This remains critical and such discussions continue in 2021. This is akin to contemplating that any internet service or content is a relevant potential financial source to a telco. This is fanciful. Telcos have almost no ability to get value from the content and any movement be a content or on-line service provider themselves is hugely risky. Telcos trying to be TV companies or to create a new Facebook or to own search engines?

and the likes of BT network leaders were given less coverage. But, they were proven right as, of course, they *do* know their own networks and traffic trends

6. "[In the context of Telenor's truly unlimited smartphone data plans in Hungary and 5G] Bandwidth will grow hugely. I think fixed-line internet won't be needed anymore" – Telenor Hungary CEO and group EVP[13]. How many really claim or can justify a reason why fixed broadband can even be *significantly* substituted, never mind almost completely replaced? NB larger substitution is possible in some countries and in some localities but in EU-type developed Internet economies, this mass replacement surely unrealistic. Elementary traffic analysis and business ratiocination should supply the answers

7. Huge consumer/business/society benefits from using the Internet can accrue to the telecom operators and hence pay for 5G or 4G or fixed broadband. This is mostly fanciful. This revenue is controlled by the user and "app" in the device and by the service supplier. Else, the economic gains are even more indirect (less time on travel or fewer $s on petrol). Since 3G licence-bid days such revenue aspirations have almost all failed, to then leave "just" voice/data/SMS plus ring tones. Net neutrality now further reduces possible revenues based on traffic types. "Use cases" are rarely chargeable by the telco[14].

Most of these claims are not worth further analysis and readers can add them to the wider list of dubious telecoms issues to be wary of. Note that there are many areas of truly worthy debate: can private mobile networks be significant; can satellites help in rural Europe; how can they help the huge numbers of unserved in developing countries; what are the roles and market sizes for FWA; how much more traffic is stimulated on fixed broadband by 5G devices than on the mobile network; why a TV business is not vital for a telco (and is possibly a value-dilution choice)[15] etc. This is entirely different from claims that fixed lines will not be needed or FWA makes most FTTH irrelevant.

Item #1 above is worth some further discussion as the debatable areas are less transparent and the overall claim that more spectrum is needed is for mobile expansion *is* quite reasonable. Is that why it was endorsed by the GSMA? The paper may be quite correct and this Telzed enquiry is not valid – readers may decide. In S4.2 the key requirement is for a 100Mbit/s user experience for a customer and this defines the total capacity needed (numbers of Gbit/s) in Exhibit 8. The traffic per customer is assumed to be similar hence the traffic demands vary linearly with city customer density and total area (or total customer numbers). It seems to assume 5/10/20% of customers simultaneously getting 100Mbit/s. Taking a 10% factor then this shows ~180Gbit/s/km^2 needed for Paris. This is slightly less than the 250Gbit/s resulting from 10% of 25,000 population/km^2 each having 100Mbit/s for 10% of the time. We can speculate this is due device penetration per capita, other reasons are possible for the relatively small difference. Using the 180Gbit/s value means about

[13] https://www.linkedin.com/pulse/volume-based-mobile-data-monetisation-unsustainable-pal-zarandy/

[14] This item was not posted in LinkedIn, but added here as part of a wider problem where many seem to suggest economic gains in other downstream markets are accessible to the telcos. With some possible exceptions this is unlikely to happen. Gaming, Facebook or advertising revenue transfers to the bit-carrying telco, are *unlikely,* even if readers can think of convoluted methods to close the revenue loop back to the telco

[15] 5G traffic and TV comment are added to stimulate thought. See traffic evidence and market history. Contact Telzed if needed

7.2Mbit/s average usage per person (180,000/25/000). This is far more than mobile customers use on average today, indeed it is more than the traffic usage of almost any country's average fixed broadband line (300Gbyte per month uses about 3Mbit/s).

Readers might wonder how many Gbit/s-type masts are needed to carry 180Gbit/s. In just one km^2? Is such mast-investment commercially viable?

180Gbit/s per km^2, implies about 216 petabytes per km^2 per year. This is very different to McKinsey[16] that predicts Paris demands of up to about 3 petabyte in 2025.

The source is assumed to use correct calculations, but results are correct only if the key assumption is valid: using 100Mbit/s as a clear channel for 10% of the time or for 10% of customers. If accepted, then the results are of course correct. This is counter to normal networks that are driven by the traffic used (#Gbytes per month and resulting busy period Mbit/s). A 10Gbyte/month mobile user consumes on average about 0.1Mbit/s in peak time. This is c70 times different. Tefficient data for 2020 shows average France mobile subscribers consume c6Gbyte/month.

It is also noted that a number of countries already have 100Mbit/s mobile speeds observed by users[17], which implies that 100Mbit/s user experience is already obtainable with current spectrum and current traffic levels. Of course the average use of this 100+Mbit/s service over an hour is much less. Downloads are each done in a few seconds at this high speed. The mast capacity is shared but not in 100Mbit/s channels dedicated to a customer.

Readers are invited to clarify real traffic needs. The concerns raised here by Telzed may be based on a wrong interpretation.

Telzed notes ITU sources that identify a mobile "user experience" of 100Mbit/s. Has the ITU defined this as a dedicated clear channel to customers, even if only used for 5% or 10% of the customers at the same time? Surely an experience depends on how often the 100Mbit/s is used over (say) an hour and so on the traffic (#Gbyte and effective #Mbit/s) that causes this usage, plus the total available capacity (total number of Gbit/s) and on the acceptable probability of slow-downs. This is normal/classic network dimensioning and design[18].

---

[16] https://www.mckinsey.com/industries/technology-media-and-telecommunications/our-insights/the-road-to-5g-the-inevitable-growth-of-infrastructure-cost Past Telzed analysis of the same demand problem gave similar values to the McKinsey report

[17] https://www.speedtest.net/global-index

[18] Pedants may note that the Telzed formula does not include any factors for probability of a service being slowed down. For simplicity it slightly over-estimates the number of customers and traffic possible in the mast/router by assuming it is 100% filled. A 0.01 factor is a reasonable guide and can be varied based on other network statistics or future demands. In reality shared resources are often used at less than c80% of the maximum. Often far less. In turn that usage value is based on an engineering calculation of that average having random peaks exceeding 100% and so resulting in slow downs and lost packets. The Telzed approach is simplified for easy strategic evaluations which is possible in packet-based networks (circuit-switched Erlang calculations *do* need blocking/slow down probabilities, but this method is often incorrectly applied). The Telzed approach is verified by the evidence in this paper

3 Summary of messages

This paper summarises a few claims. These may be justifiable. That is left to the reader to judge. The key point is that readers and the authors need to have the ability to check the technical and commercial aspects. Experience of telecoms markets and customers is vital to enable sanity checks of claims. Everyone should be aware of the potential for incorrect assumptions or even erroneous analysis.

As noted in other work[19], it is possible for analysis to be factually correct yet also misleading. This emphasises the need for careful assessment of papers and claims and also the need to have in-depth understanding before critical decisions are made. Just because a seemingly reputable source or factual-numbers show a good outcome, it does not mean that it is realistic.

Investors without solid technical/commercial/telco-regulation knowledge could make mistakes. Due assessment is vital. A degree of mistrust is required of claims. Questionable ones need to be distinguished from the fair/reasonable ones. Hype and hope do not stop a poor business plan failing. Could firmer assessments say 20 years ago have reduced the number of failures in the industry? Is more money about to be lost again on major ventures? Just because someone believes in something (possibly passionately) and has evidence, does not always mean it is a worthy venture – think of the current global political zeitgeist of beliefs and "alternative facts." What if these "facts" contradict rational analysis and basic telecoms traffic theory? Experience is always a valuable input to an assessment.

Obviously many papers and analyses can be mostly correct and only have a small areas that are debatable. An error does not make other good work invalid, but questions naturally follow. Lawyers could note crazy/bad/weak claims to test those sources on other claims.

Are claims robust or have "lazy" errors or biased to meet a client's wishes? This is different from say small Excel function errors or complex predictions made with limited data – consulting *is* difficult and many problems have no past examples – this is where "acceptable errors" may arise. Acceptable errors are surely different from "crazy claims."

The Telzed formula is shown by real data to be a solid foundation for assessing how customer demand and network capacities are related and so it provides a useful tool to assess many claims or business models.

Please contact Telzed for further advice and help if needed

See Telzed web site for additional papers

[19] http://www.telzed.com/sitebuildercontent/sitebuilderfiles/basic_guide_to_fwa_17122020.pdf Section 2.3