80M transmission dropping out the NBN

By: VK2JMJ, Albury. August 2021. Michael Harvey

The situation:

I use a fibre to the node type NBN service, (ie: old twisted cable pair from the house to the node at the green box, just down the street) with a speed test result ranging from 17 -> 24 down and 4 -> 6 up depending on the time of the day. The provider is Optus, with the black wifi modem. Internet is good until some crazy close by amateur radio operator transmits on the 3.5xx Mhz band (80m), causing the NBN to disconnect from the Internet. With the XYL in my ear, something needs to be done.

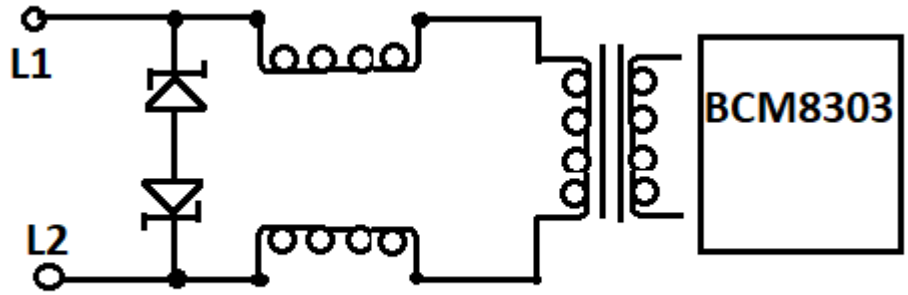
The useless solutions:

(1) Call the provider for technical support. I ended up with Rajah. Where ? Will never know. There is no support, I am pissing into the wind.

(2) Read forums? Not only facing the wind, now it blows back with a lot of poo attached.

The research:

Attacking the modem with a Phillips head showed the NBN modem uses an ADSL transceiver chip by Broadcom BCM8303 KMLG. It is very hard to find a specification PDF on this chip. A rough circuit trace of the line interface on the modem showed it is fully isolated with no connection to ground, no connection to frame or house Ethernet cabling or power supply and no suitable RF path either. This means that any attempts at attaching ferrite chokes to the line cord or power cord or house cat5 cabling to suppress the RF will not produce a result.



I started reading at Wiki for ADSL and ADLS2+ and at the bottom in the references, took the link out to International Telecommunications Union for specification G.992.5 Licking the inside of the battery compartment of a scientific calculator I came up with a theory and then passed out from information overload.

The Theory:

Some of the documentation suggests the ADSL2+ uses many carrier frequencies from 20Khz upwards to 50Mhz. The distance the modem is away from the node will limit the useable upper frequency range of carriers and therefore the overall link speed. A data stream is established on each of the many carriers (who cares what it is and what modulation scheme QAM ,16QAM or higher or whatever).

Each established independent data stream is aggregated at both ends (modem and node) to form the single data streams of the UP and DOWN links. The more data streams (carriers) established, the higher the link speed. Then along comes a big fat SSB blast that saturates one (or more) of the data streams that eventually breaks the aggregated link and thus causing the disconnect.

So the theory is "what if the modem is denied the ability to establish a data stream on the carriers within the 80M band (3.5Mhz)"?

Design #1

I made a band trap using four LC tanks and a series LC in a H bridge format to trap the entire 3mhz to 4mhz range and connected the trap across the incoming line. The modem connected but the speed test was slow. A few big fat blasts of carrier and SSB voice on 80m showed no signs of the drop out of the NBN. Design #1 is a good start, but it is now at the bottom of the pool.

Design #2

I made a single LC trap to short out 3.600Mhz at the incoming line. The modem connected and the speed test reported the normal range. I set up a few PING streams to somewhereoutthere.com and also streamed some music and ran the speed test, while transmitting big fat carriers and SSB voice at various frequencies on 80m. At best I saw a few of the pings fail a single packet and a few pings taking a longer response. The speeds test remained in the high range and the music rocked.

To prove the theory:

I coupled a HF receiver (FRG-7) to the incoming cable pair with an inductive loop. After the link is up, the main energy is in a wide band from 3.800Mhz - > 5.15Mhz. When the receiver is on LSB, this energy presents as white noise over the frequency range. During the establishment of the link there are lots of different song and dance routines with tones and pulses over this range. However, other low level white noise carriers were also found at 3.3Mhz and 3.5Mhz. Is the theory correct about denying the modem by design #2, or is the trap suppressing the RF?. To prove all the white noise at various frequencies are from the NBN activity, I turned the modem off.

During start up of the NBN router, lots of carrier and tone activity is spread over 3Mhz to 4Mhz to 5Mhz. The tones heard from 3Mhz to 3.8Mhz could be sub tones of the main ones within 3.8Mhz -> 5.15Mhz, It could also be the far end doing it's thing so it would be at a lower level to the HF receiver. It is hard to say, but the levels are very strong and evenly spaced when the modem is training up within the band of 3Mhz - > 4Mhz.

Design #3

I say the theory stands, but as a combination of both.

(1) denying the modem

(2) suppressing the RF

Replace the trimmer capacitor with a shafted variable. Calibrate the dial face using the NanoVNA. When it is planned to join a 80m net and keep the wife on the couch, move the capacitor to dip the notch filter to the required frequency. The theory will be further proven if the link breaks when the capacitor is moved.

The solution:

It seems so simple. Deny the NBN modem the ability to establish a data stream on the cable pair to the node on the frequency (s) that the amateur dude is using. Build a trap to short out a thin frequency range. Deny the modem and suppress the expected RF within a fine band.

VK2JMJ has not been back in the active state long enough to be transmitting on other HF bands and I am limited to a small back yard using a 80m loop antenna. The assumption will be to design a trap that shorts out lumps from the other bands, with the penalty of the more frequency traps added, the lower the possible link speed. However, no other white noise frequency ranges were found. The main energy remains in 3.80Mhz - > 5.15Mhz.

The build:

I used Veroboard to stop the bits moving about. Veroboard is far from ideal at RF. I used the NanoVNA to display the sweep of the trap. L1 is about 20uH and C1 about 100pf. L1 is wound 20 turns on a ferrite bobbin pinched from a plasma TV driver board. C1 (100pf) pinched from a old CRT TV board.

The Veroboard added extra capacitance and inductance so the solution was to reduce a turn or two and add a trimmer capacitor. It would not matter where the trap is installed on the incoming cable pair. It could be at the modem itself or at the building entry point. It's only function is to short out a single frequency (range) to deny the modem establishing a data stream at that frequency. The easiest location is at the RJ socket at the modem router.

Pico = 10^{-12}

Mico = 10^{-6}

Mhz = 10^{6}

Tune to dip somehere in the 80m band, say 3.600 mhz

$$XC = \frac{1}{2\ TT\ F\ C}$$

I found plenty of 100pf caps from the TV

$$XC = \frac{1}{2 \times 3.14 \times 3.6 \times 10^{6} \times 100 \times 10^{-12}}$$

XC = 442 Ω (at 3.600 mhz)

Where at resonance, XL = XC.

$XL = 2\ TT\ F\ L$

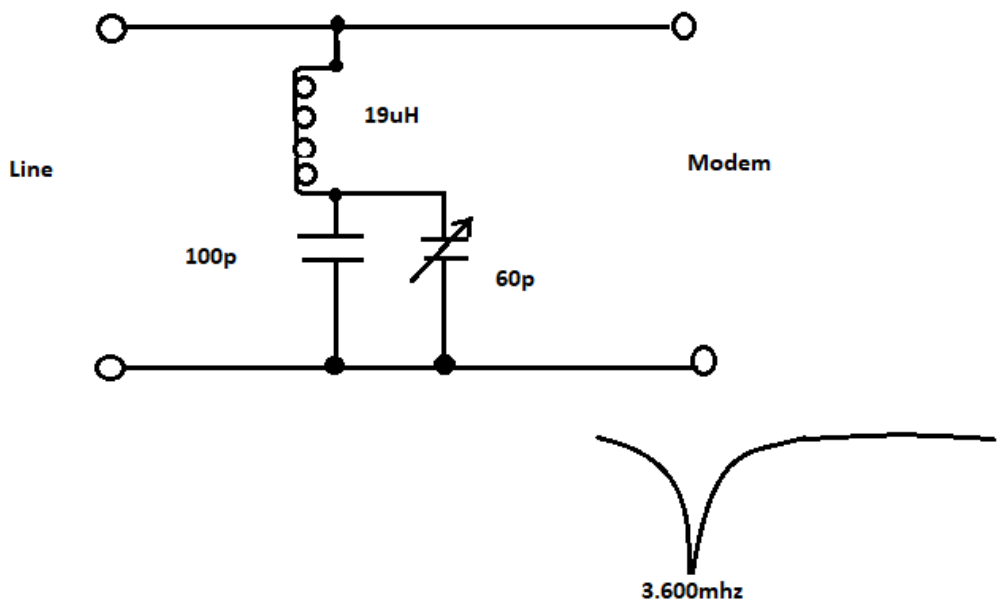
$$L = \frac{442}{2 \times 3.14 \times 3.6 \times 10^{6}}$$

$L = 1.95 \times 10^{-5}$ Henry

$L = 1.95 \times 10^{-5} \times 10^{6}$

L = 19.5 uH

About 20 turns on Ferrite produced about 20 uH



(END) VK2JMJ, Albury. Michael Harvey. August lockdown 2021.