

Tunable Antenna for Global NB-IoT and LTE Coverage

Tomas Rutfors
Proant Director- Engineering
Abracon, LLC

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Introduction

The market demand for wireless communication with multiband NB-IoT and LTE coverage is increasing. Further, products tend to decrease in size, which implies less available space for the antenna. To meet these demands, Proant presents a tunable antenna solution using the patented Niche antenna concept with active switching.

By utilizing the method of active switching, Proant has reached a return loss of better than -3dB and maximum efficiency of -3dB over the global NB-IoT and LTE ranges. Employing this approach, Proant has validated that the Niche antenna concept is suitable to be used with active switching to achieve extended frequency coverage.

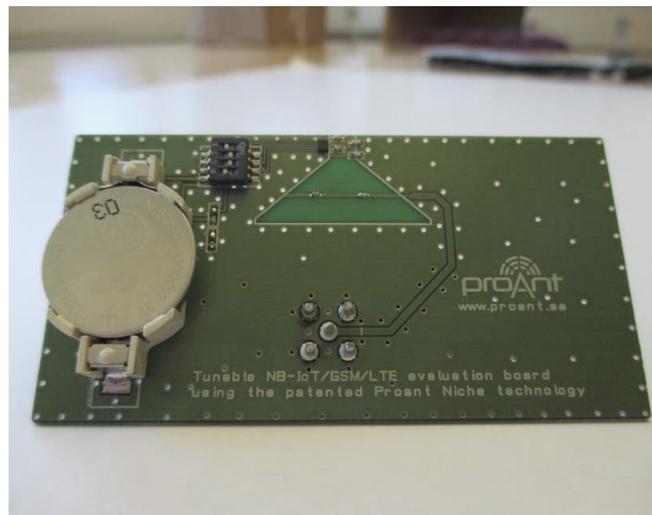


Figure [1]

The Niche Antenna

The Niche antenna concept is a patented antenna technology by Proant.

The antenna is a triangular cutout with two reactive loads crossing the cutout, the feed and the top load. The unique shape and reactive loads give the antenna magnetic radiation properties.

In implementation, the antenna should be “open” towards an edge of the application board and the preferable placement is in the center of the longest side.

The size of the application board and the Niche antenna cutout together with its reactive loads, determine the operational frequency, bandwidth, and efficiency.

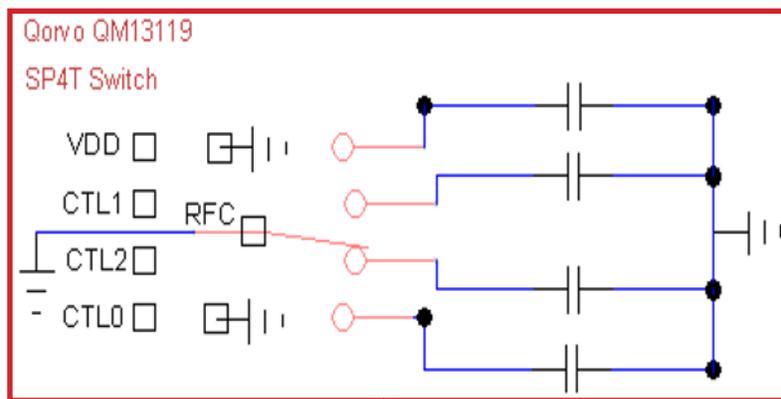
Solution

The operational frequency of the Niche antenna is determined by the capacitance on the top load. A viable solution is to use a single SP4T switch to change the capacitance value, hence tuning the antenna to extend the frequency range, while maintaining the overall performance.

The complete evaluation board is shown in Figure [3]. The antenna tuner, including the SP4T switch and the antenna top load, is marked in red.

A detailed electrical schematic of the top load tuning functionality is displayed in the top right of Figure [2], showcasing four capacitors in parallel, each connected to an output of the switch. The switch can combine the capacitive loads in different combinations or states. In this study, five states were utilized to cover the intended bands.

Figure [2]



Antenna tuner

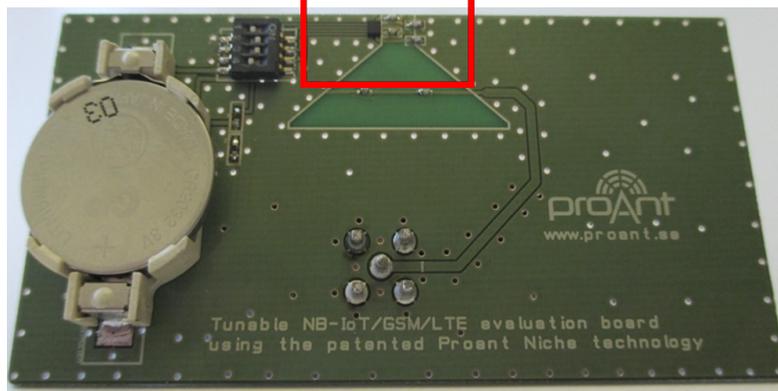


Figure [3]

Results, Active Switching

Figure [4] outlines the return loss for different output states of the SP4T switch, and is tabulated in Table [1] for clarity.

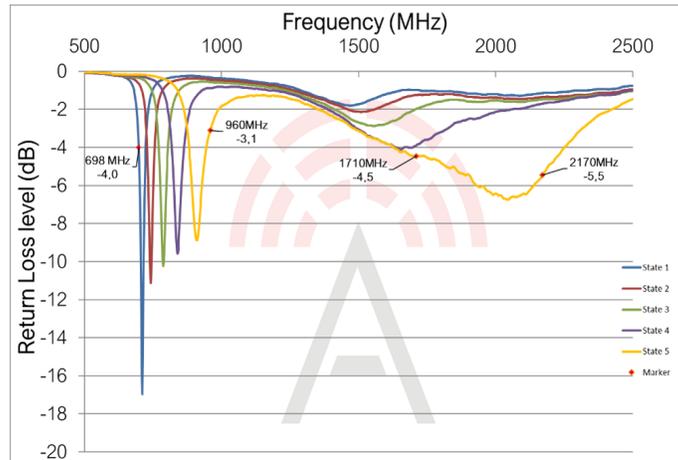


Figure [4]

| Output (color code) | Center Frequency (rounded to nearest MHz) | Bandwidth (at -3dB return loss) |
|------------------------|---|---------------------------------|
| State 1 (Blue) | 711 MHz | 32 MHz |
| State 2 (Red) | 743 MHz | 35 MHz |
| State 3 (Green) | 788 MHz | 42 MHz |
| State 4 (Purple) | 842 MHz | 59 MHz |
| State 5, low (Yellow) | 917 MHz | 87 MHz |
| State 5, high (Yellow) | 1901 MHz | 830 MHz |

Table [1]

Table [2] shows which NB-IoT and LTE communication bands that are covered with a return loss of at least -3dB utilizing the presented approach.

| Protocol | Communication Bands (within -3dB return loss frequency range) |
|---------------|---|
| NB-IoT | 1, 2, 3, 4, 5, 8, 12, 13, 14, 17, 18, 19, 20, 26, 70, 85 |
| LTE | 1,2 ,3 ,4 ,5, 8, 12, 13, 14, 17, 18, 19, 20, 24, 25, 26, 28, 68, 70, 85 |

Table [2]

Results, Performance

Figure [5] outlines the total efficiency for the lowest (State 1) and the highest (State 5) output state of the SP4T switch. Performance at key frequencies is added to indicate points of importance.

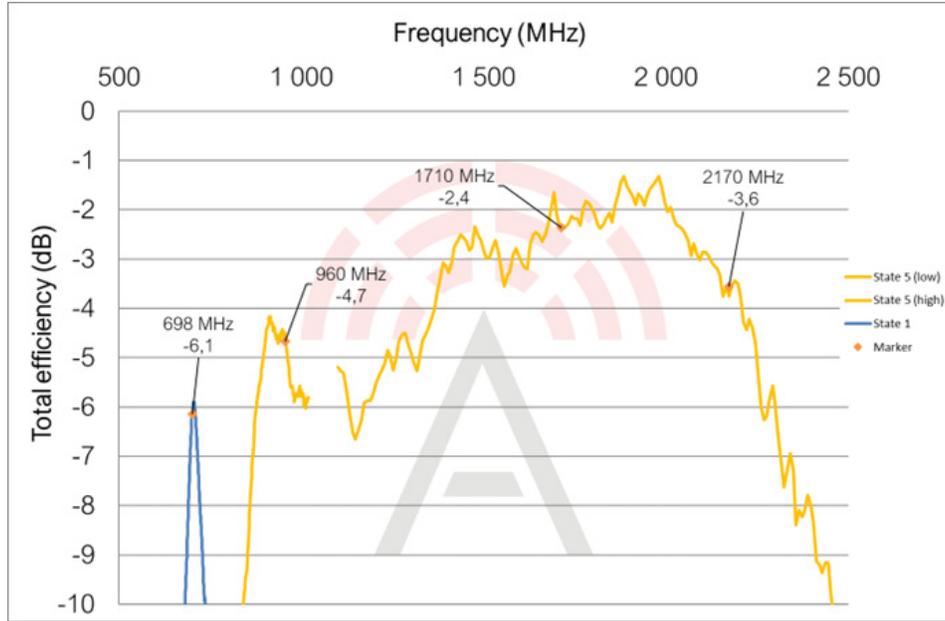


Figure [5]

Conclusion

In this white paper, active switching of the Niche antenna concept is a viable method to extend the antenna frequency range was validated.

The Niche antenna is highly efficient, requires a small area and has unique placement options. Due to its magnetic radiating properties, it is very frequency stable when positioned close to dielectric materials such as potting or plastic.

The Niche concept is a Proant patented technology available for a variety of end-applications such as Bluetooth, WiFi, GNSS, LoRA, 868 MHz, 915 MHz, 2G, 3G, LTE, NB-IoT and 5G and is available via a licensing agreement with Abracon.