**Project Overview**

The project is to design a variable gain narrowband low noise amplifier for WLAN application with minimized power consumption. A variable gain LNA, which plays an important role in the implementation of power control in wireless communication, can adjust the output signal power by processing the output signal with different gains.

**Background**

- **Direct-conversion receiver architecture**
  
  The receiver contains several RF and analog building blocks. The LNA is in the front end, operating in radio frequency. LNA performs the functions of amplifying minimum signals for mixer and reducing effective noise contribution from mixer.

- **WLAN**
  
  Wireless Local Area Network that gives users the mobility to move around within a local coverage area, with standard IEEE802.11a/b/g.

**Design Specification**

<table>
<thead>
<tr>
<th>Design</th>
<th>Frequency (Hz)</th>
<th>Supply (V)</th>
<th>Gain (dB)</th>
<th>NF (dB)</th>
<th>IIP3 (dBm)</th>
<th>Power (mW)</th>
</tr>
</thead>
<tbody>
<tr>
<td>High Gain Setting</td>
<td>2.4G</td>
<td>1.8</td>
<td>&gt;18</td>
<td>8</td>
<td>&gt;15</td>
<td>&gt;10</td>
</tr>
<tr>
<td>Low Gain Setting</td>
<td>2.4G</td>
<td>1.8</td>
<td>&gt;10</td>
<td>8</td>
<td>&gt;14</td>
<td>&gt;10</td>
</tr>
</tbody>
</table>

0.18μm CMOS technology will be used in the design. Simulation will be undertaken using Cadence.

**Methodology**

- **Cascade design**
  
  Current reused technique to increase gain and lower power consumption.

- **Input matching**
  
  Inductive degeneration input matching to maximize power transferred, minimize noise and maintain stability.

- **Output loading**
  
  Simple RLC resonance network to preserve filter characteristic.

- **Output matching**
  
  Simple output matching network to match to 50 ohm output port for maximum power transfer.

- **Current steering**
  
  With fixed $V_{ctrl}$, the currents of M1 and M3 change as $V_{ctrl}$ changes, and thus the gain changes. Current steering has the advantages that the bias, noise, bandwidth, and linearity are independent of the control current.

**Result and Conclusion**

- **LNA with high gain setting**
  
  Gain 16.3dB, Noise Figure 4dB, IIP3 19.8dBm

- **LNA with low gain setting**
  
  Gain 10.1dB, Noise Figure 8dB, IIP3 12.6dBm

**Summary of LNA performance**

The performance of the LNA depends on several factors, such as gain, NF, and stability. The simulation result presents that the 1V-supply low noise amplifier with high gain and low gain settings. The low gain mode requires more power, which provides larger noise figure, but better linearity than those in high gain mode.