Implementation of different Modulations with layer mapping

FPGA Project

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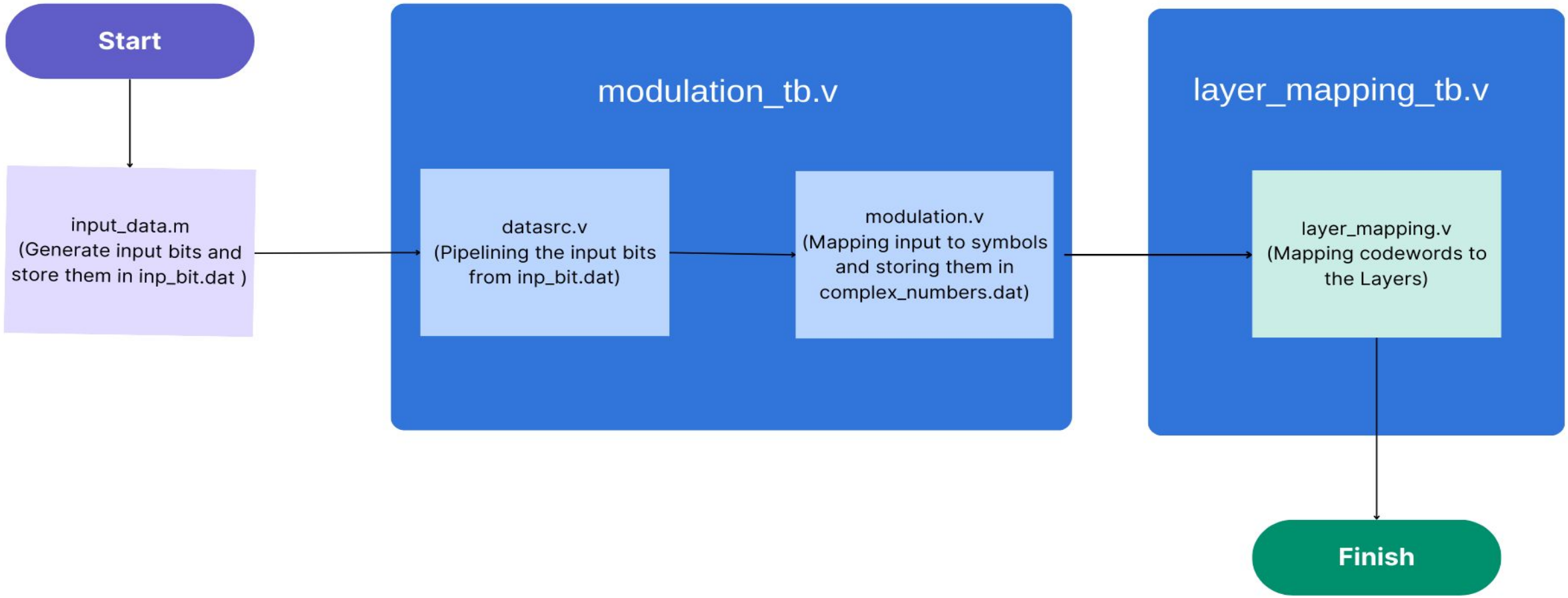
Block Diagram:



BPSK :

INPUT x=0	INPUT x=1

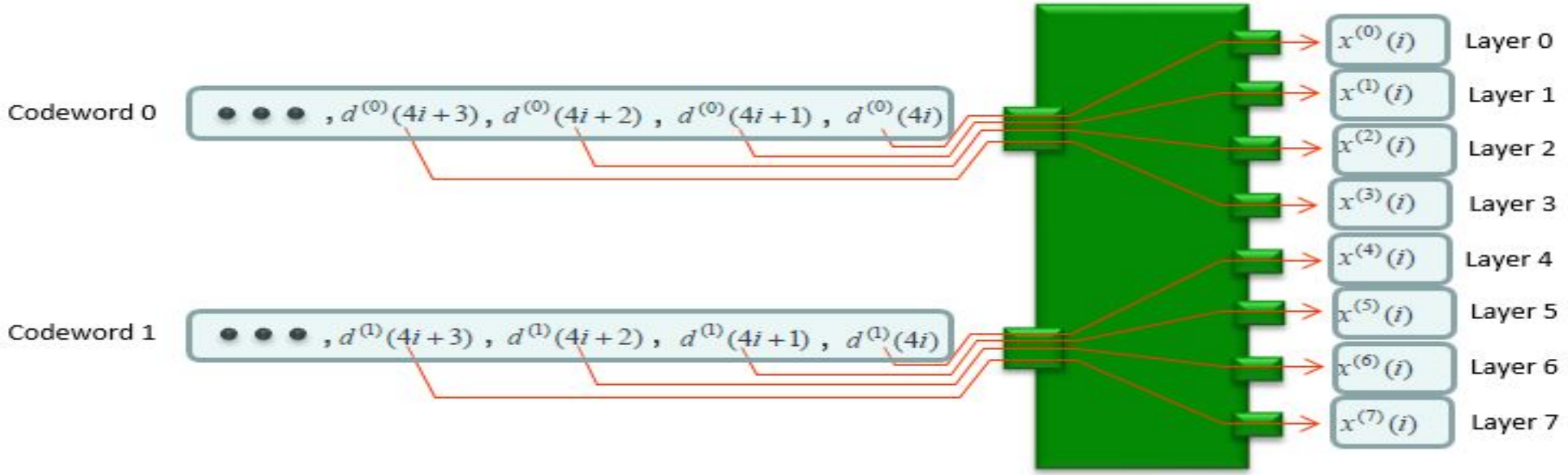
$\frac{\pi}{2}$ BPSK :

	INPUT x=0	INPUT x=1
Position i : even		
Position i : odd		

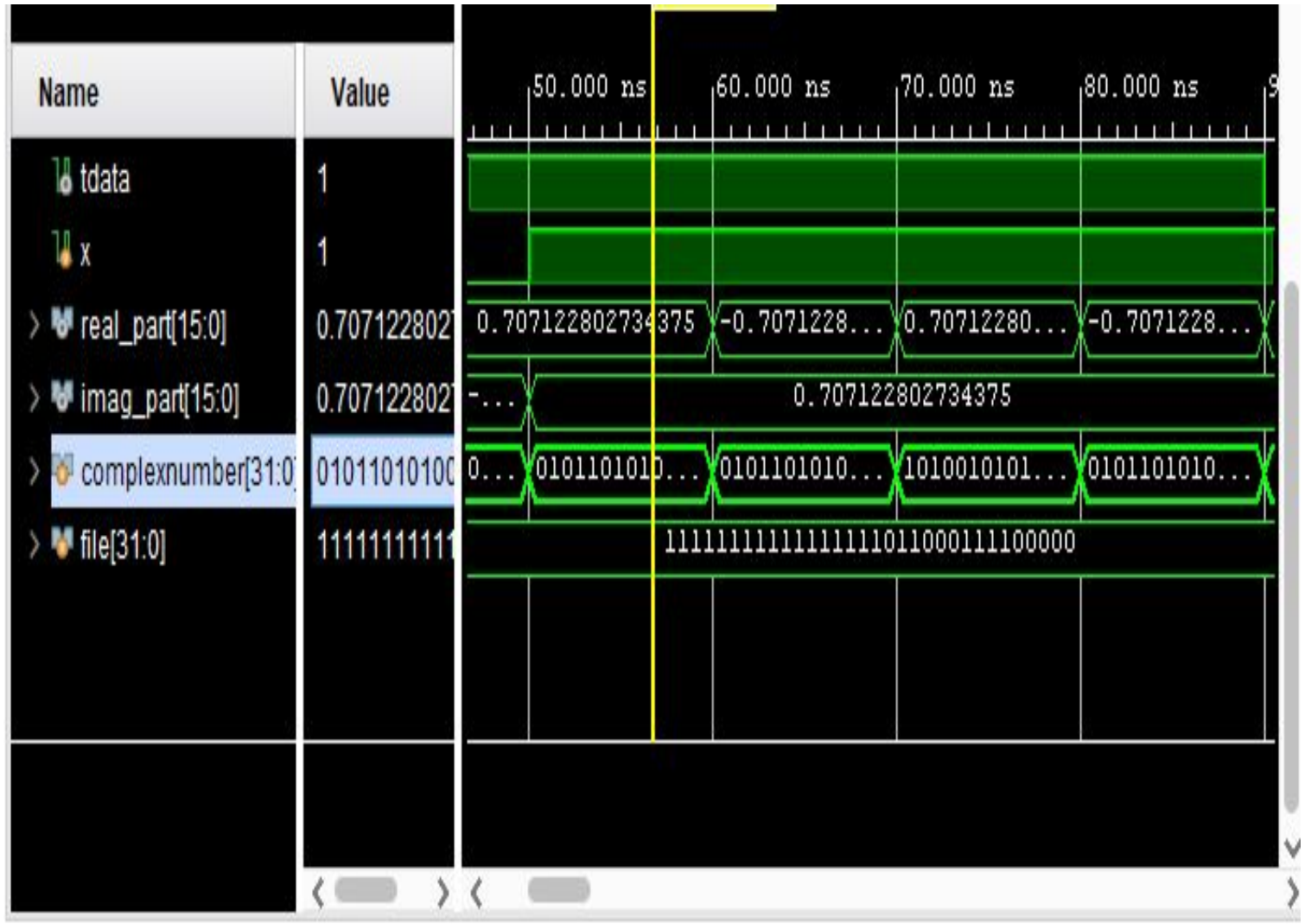
- **Modulation Mapper :**
  - The modulation mapper takes binary digits, 0 or 1, as input and produces complex-valued modulation symbols as output:
  - **BPSK:**
  - $d(i) = \frac{1}{\sqrt{2}} [(1 - 2b(i)) + j(1 - 2b(i)]$
  - **$\frac{\pi}{2}$ BPSK :**
  - $d(i) = \frac{e^{j\frac{\pi}{2}(i \bmod 2)}}{\sqrt{2}} [(1 - 2b(i)) + j(1 - 2b(i)]$

Layer Mapping:

Number of layers	Number of codewords	Codeword-to-layer mapping $i = 0,1,\ldots, M_{\text{symb}}^{\text{layer}} - 1$
8	2	$x^{(0)}(i) = d^{(0)}(4i)$ $x^{(1)}(i) = d^{(0)}(4i+1)$ $x^{(2)}(i) = d^{(0)}(4i+2)$ $x^{(3)}(i) = d^{(0)}(4i+3)$ $x^{(4)}(i) = d^{(1)}(4i)$ $x^{(5)}(i) = d^{(1)}(4i+1)$ $x^{(6)}(i) = d^{(1)}(4i+2)$ $x^{(7)}(i) = d^{(1)}(4i+3)$ $M_{\text{symb}}^{\text{layer}} = M_{\text{symb}}^{(0)} / 4 = M_{\text{symb}}^{(1)} / 4$



Simulation Result for $\frac{\pi}{2}$ BPSK Modulation:




```
tvalid=1 ,Input x = 1, Position = 0 :
Real part =  23171, Imaginary part =  23171
tvalid=1 ,Input x = 0, Position = 1 :
Real part =  23171, Imaginary part = -23171
tvalid=1 ,Input x = 1, Position = 0 :
Real part =  23171, Imaginary part =  23171
tvalid=1 ,Input x = 1, Position = 1 :
Real part = -23171, Imaginary part =  23171
tvalid=1 ,Input x = 1, Position = 0 :
Real part =  23171, Imaginary part =  23171
tvalid=1 ,Input x = 1, Position = 1 :
```

Simulation Result for Layer Mapping:


```
codewords:
codeword0 = 0101101010000011010110101000000111010110101000000111010010101111101010110101000000111010110101000000111010010101111110101011010100000111010010101111110101011010100000111010010101111110101011010100000111010010101111110101011010100000111010010101111110101011010
codeword1 = 1010010101111110110100101011111101010110101000000111010010101111110110100101011111101010110101000000111010010101111110101011010100000111010010101111110101011010100000111010010101111110101011010100000111010010101111110101011010
codewords:
codeword0 = 0101101010000011010110101000000111010110101000000111010010101111110101011010100000111010110101000000111010110101000000111010010101111110110100101011111101010110101000000111010010101111110101011010100000111010010101111110101011010
codeword1 = 0101101010000011010110101000000111010110101000000111010010101111110101011010100000111010110101000000111010110101000000111010010101111110101011010100000111010010101111110101011010100000111010010101111110101011010100000111010010101111110101011010
codewords:
codeword0 = 0101101010000011010110101000000111010110101000000111010010101111110101011010100000111010110101000000111010110101000000111010010101111110101011010100000111010010101111110101011010100000111010010101111110101011010100000111010010101111110101011010
codeword1 = 0101101010000011010110101000000111010010101111110101011010100000111010110101000000111010110101000000111010010101111110101011010100000111010010101111110101011010100000111010010101111110101011010100000111010010101111110101011010100000111010010101111110101011010
codewords:
codeword0 = 0101101010000011010110101000000111010010101111110101011010100000111010110101000000111010110101000000111010010101111110101011010100000111010010101111110101011010100000111010010101111110101011010100000111010010101111110101011010
codeword1 = 1010010101111110110100101011111101010110101000000111010010101111110101011010100000111010110101000000111010110101000000111010010101111110101011010100000111010010101111110101011010100000111010010101111110101011010100000111010010101111110101011010
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THANK YOU