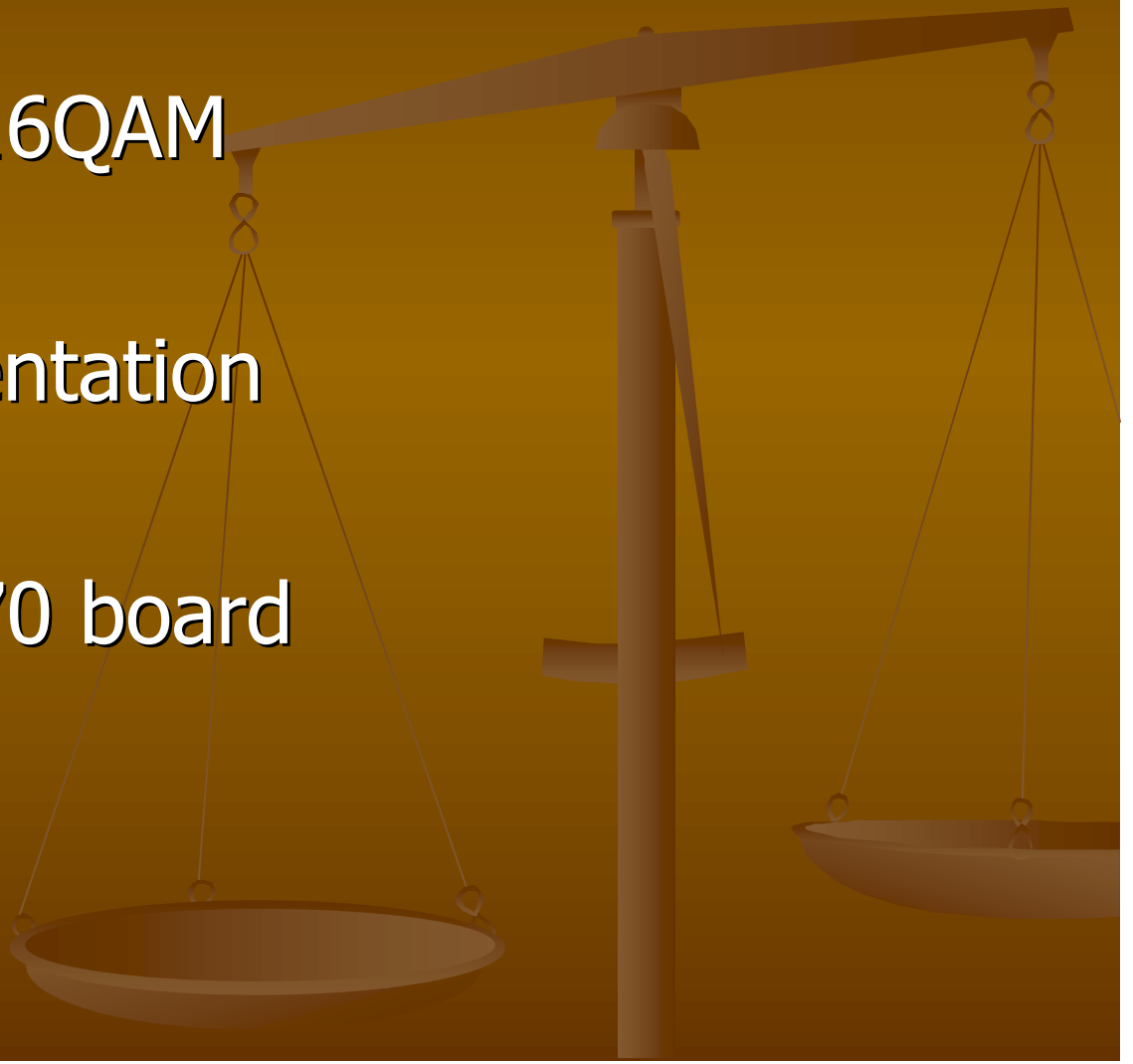
16QAM on FPGA

Designed by Xinyu Zhang



16QAM on FOGA

- Introduction of 16QAM
- Design diagram
- Specific implementation
- Output analysis
- DEMO on DE 2-70 board
- Reference



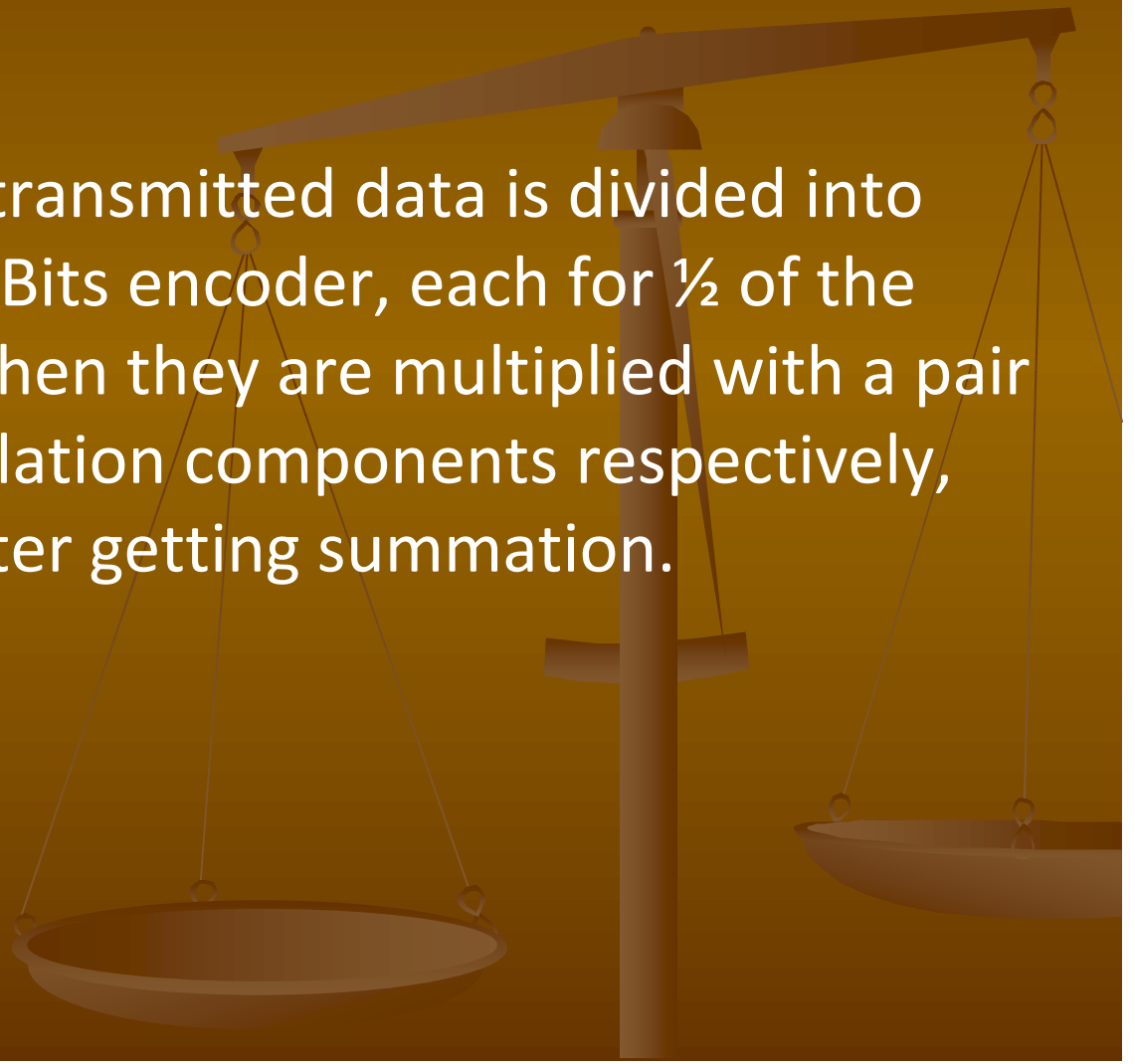
Introduction of 16QAM

- QAM (Quadrature Amplitude Modulation) is a new modulation technique, because of the use of phase and amplitude two-dimensional space resources in the modulation process, it has a higher efficiency than PSK (Phase Shift Keying) and ASK (Amplitude Shift Keying) modulation which use only a single dimension of space resources. Moreover, the QAM constellation points of PSK constellation points more dispersed, the distance between the constellation points is therefore, so it is able to provide better transmission performance.

16QAM on FPGA

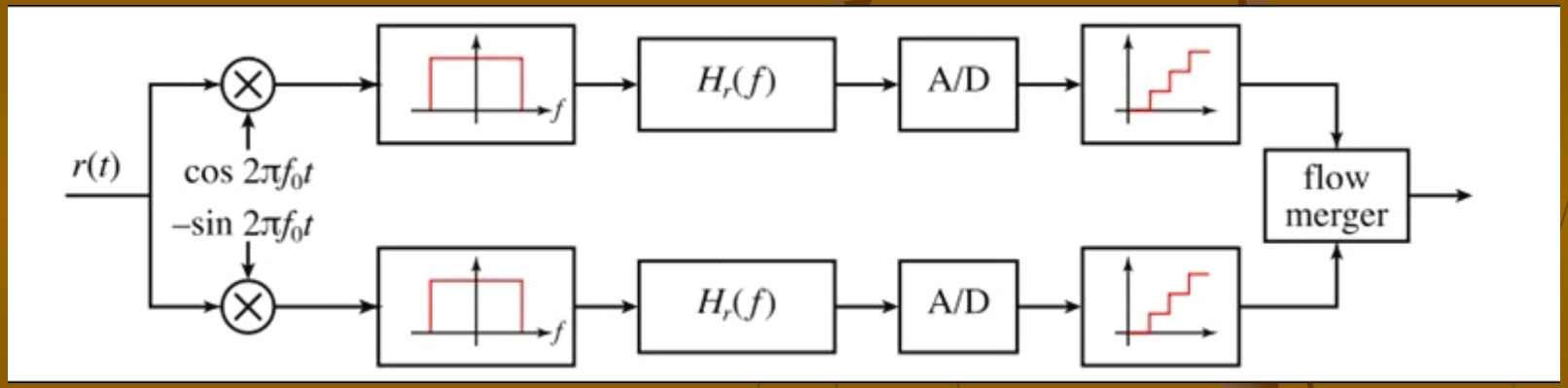
- The main idea:

  The main idea : the transmitted data is divided into two channels in the Bits encoder, each for ½ of the original signal, and then they are multiplied with a pair of orthogonal modulation components respectively, and being output after getting summation.



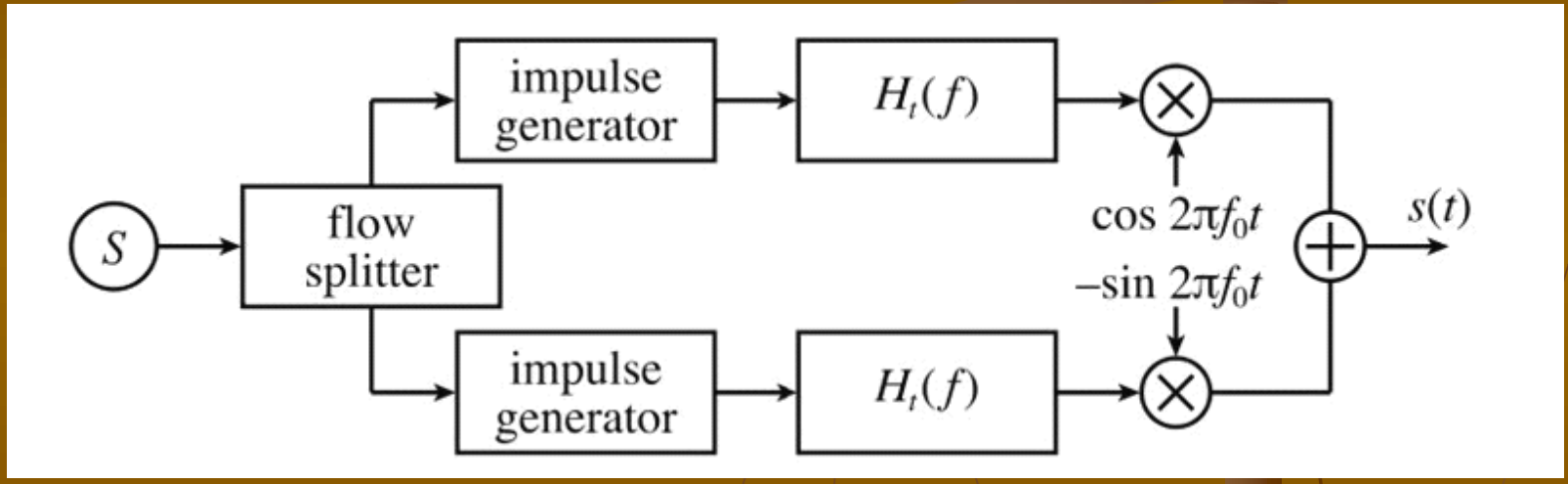
16QAM on FPGA

- Design diagram



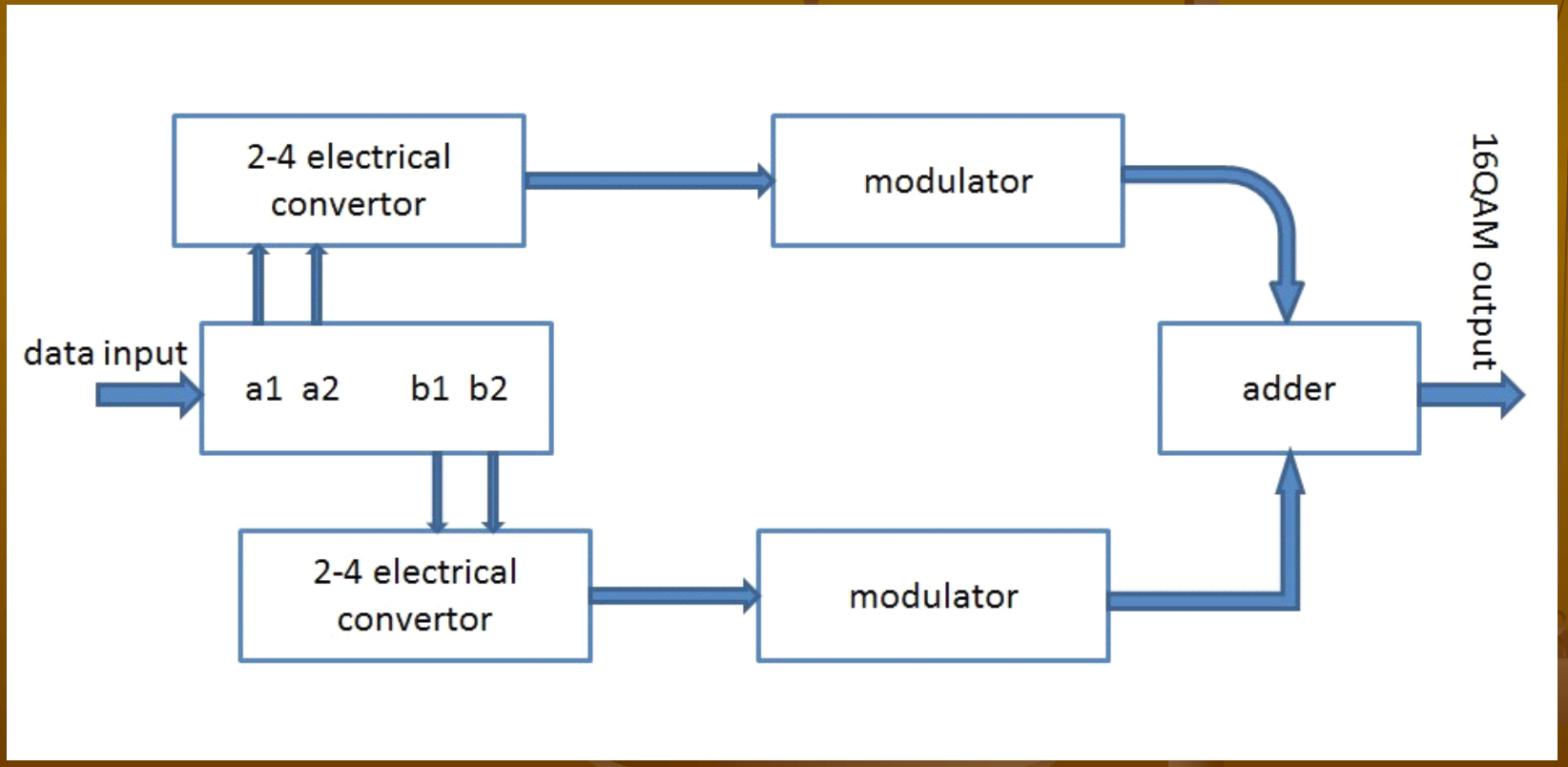
16QAM on FPGA

- Design diagram



Specific implementation

- Schematic of 16QAM



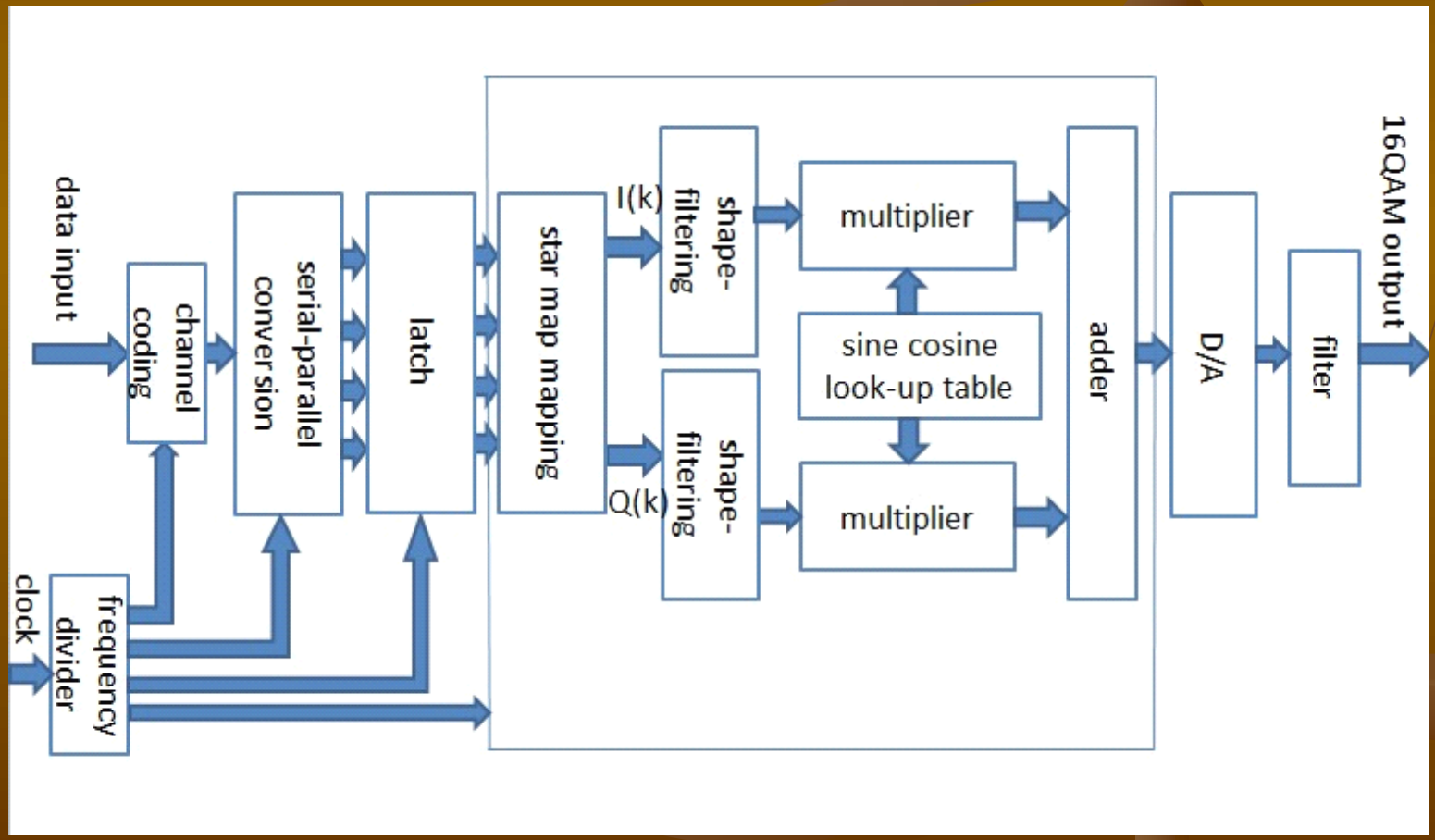
Specific implementation

- 16QAM Gray coded labeling schemes

0010	0110	1110	1010		a_1a_2
•	•	•	•	+3	10
0011	0111	1111	1011		
•	•	•	•	+1	11
0001	0101	1101	1001		
•	•	•	•	-1	01
0000	0100	1100	1000		
•	•	•	•	-3	00
-3	-1	+1	+3		
00	01	11	10	b_1b_2	

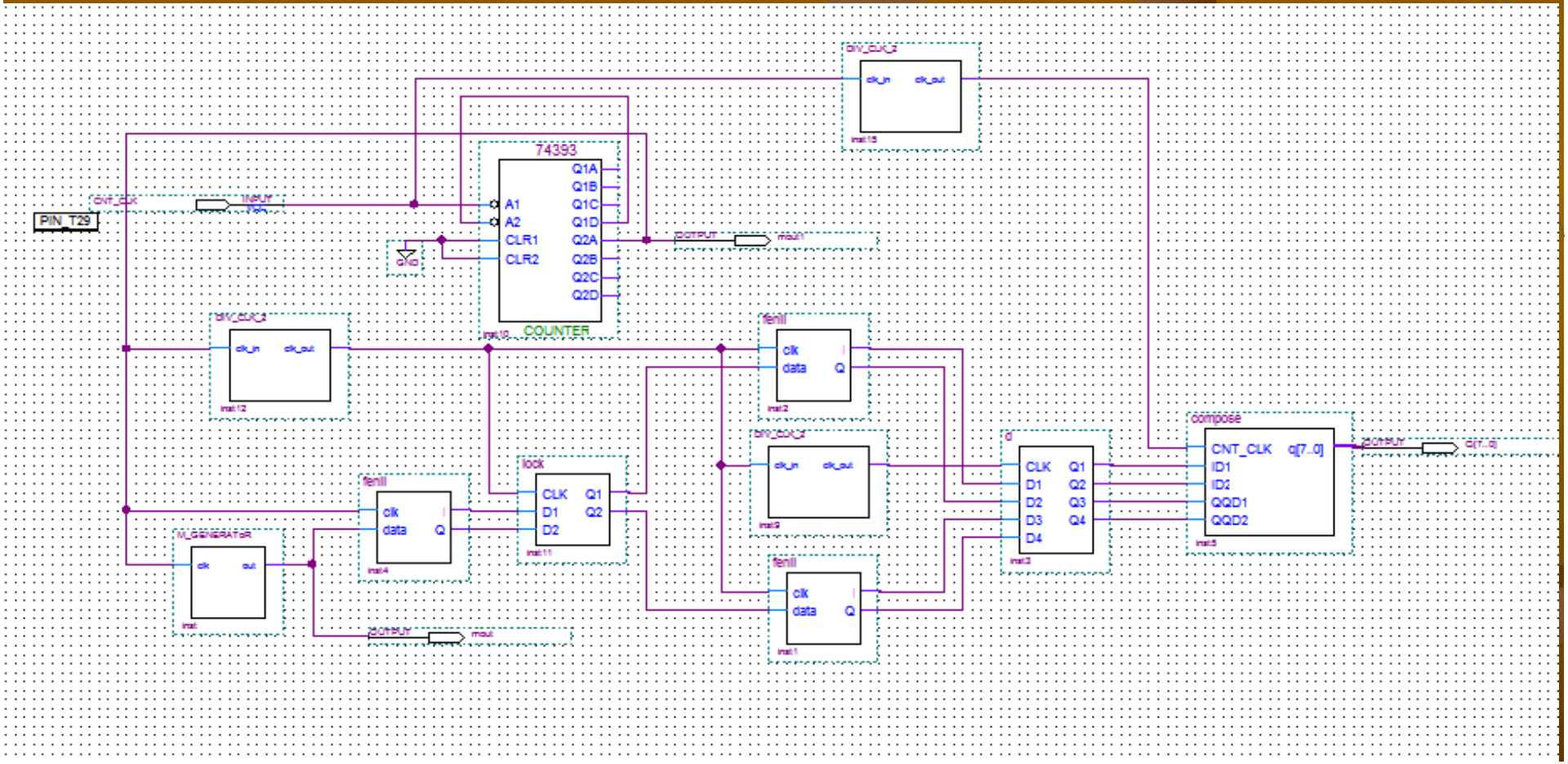
Specific implementation

- FPGA modeling schematic of 16QAM modulator



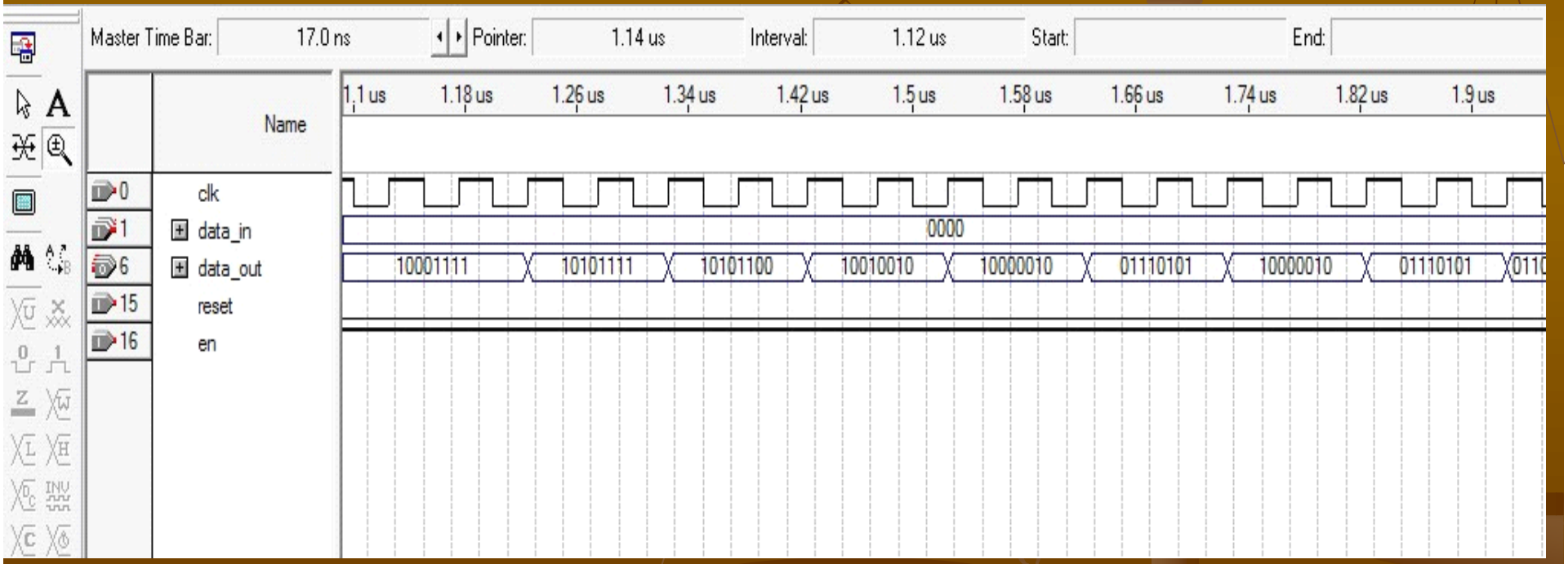
Specific implementation

- Top design of 16QAM modulator



Output analysis

- The simulation output (the outcome of modulation)



Reference

[1] http://en.wikipedia.org/wiki/Quadrature_amplitude_modulation

[2]http://baike.baidu.com/view/1137102.htm

[3] Yongbin Wu, Yousef R. Shayan, Implementation of High-Speed Multi-Level QAM Modems Based on Xilinx Virtex-ii FPGA [C]. IEEE Canadian Conference on Electrical and Computer Engineering, 4-7 May 2003, 1: 195 - 198.