64 bit processor

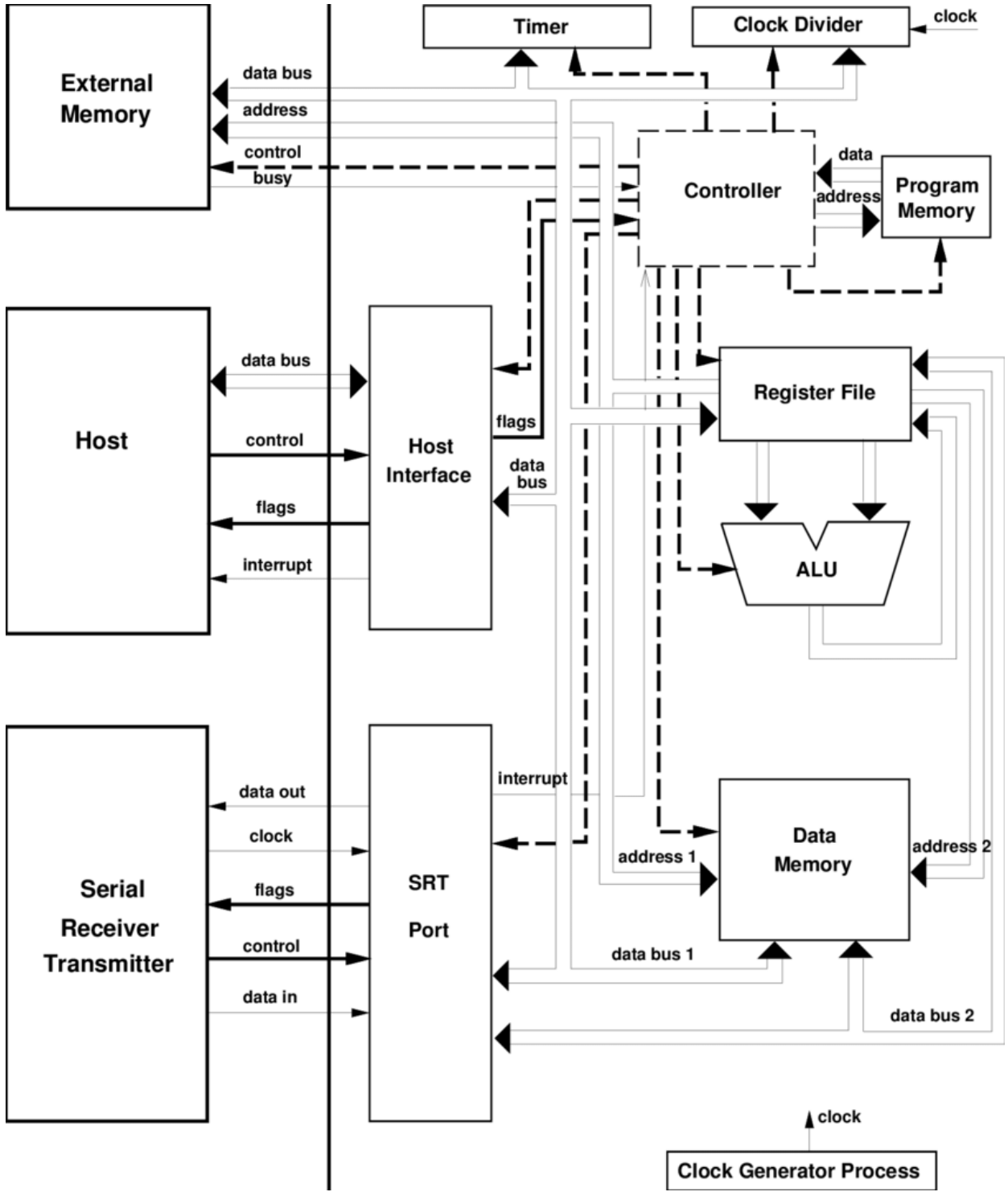
1. Introduction

A 64-bit processor is a microprocessor with a word size that is 64 bits wide, allowing it to process data and memory addresses represented by 64 bits. A 64-bit register can hold any of the 2^64 different values. Earlier processors were made with 16 bit or 32 bit data bus and registers. Thus, they couldn't address as much locations in the memory and had to do the same processes twice or more for data of 64 bits which made them slower. Overcoming these limitations, 64 bit processors gave us programmers the capacity to build extremely complex and data hungry programs and play our 4k video games. Moreover 64 bit processors can efficiently allow more virtual machines to run on a single processor. Hence, it is the most desired microprocessor in the market today.

2. Internal Architecture

The internal architecture of a 64-bit processor includes several key components:

- **Registers**: The processor features 64-bit wide registers, which allow for efficient processing of large integers and memory addresses.
- **Arithmetic Logic Unit (ALU)**: The ALU can perform 64-bit arithmetic and logical operations, enhancing computational capabilities.
- **Control Unit**: Manages the execution of instructions and controls data flow within the processor.
- **Cache**: Includes multiple levels of cache (L1, L2, and sometimes L3) to store frequently accessed data, reducing latency and improving performance.
- **Memory Management Unit (MMU)**: Supports 64-bit virtual and physical address spaces, allowing for more extensive and efficient memory usage.
- **Instruction Set**: 64-bit processors support 64-bit instruction sets (e.g., x86-64, ARM64), which include advanced instructions for improved performance and efficiency.



3. Compare between 32-bit & 64-bit processor

The comparison of 32 bit vs 64 bit processor can be summarized in the table below:

32-bit Processor	64-bit Processor
Can address up to 4 GB of RAM (2^32)	Can address up to 18 exabytes of RAM (2^64)
32-bit wide registers	64-bit wide registers
Limited to smaller data chunks, slower	Can handle larger data chunks, faster
Generally slower	Typically faster

32-bit Processor	64-bit Processor
Lower bus speeds	Higher bus speeds
Smaller internal cache	Larger internal cache
Limited instruction set	More advanced and optimized instruction sets
Limited to 32-bit software	Can run both 32-bit and 64-bit software
Less efficient	More efficient, supports more VMs
Basic computing, older applications	High-end gaming, professional applications, modern OS

4. Limitations

Even 64 bit processors have limitations which are listed below:

- Not all 64 bit address is always used. Thus, there is a waste of address space.
- Older programs written for 32 bit processors may not be compatible.
- They are economically more expensive.
- 64 bit processors consumer more power and produce more heat.

5.

1. Stallings, W. (2015). *Computer Organization and Architecture*. Pearson.
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4. https://chatgpt.com/