

Dual-Bank/ Dual-Work -- Memory Technology--Flash Memory

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Abstract—Dual bank flash memory technology (often referred to as dual - work or simultaneous operation flash is a memory architecture that split the storage in to two independent section or BANK. it is primary purpose is to allow system to perform read-while-write (RWW)operation reading from one bank while concurrently programming or rising other .the physical flash array is dived e in to two distinct logical entities (eg BANK1 and BANK 2) each with its own base address standard single- bank flash memory usually stalls the CPU during a write or erase operation because it is cannot read code instruction from the same array it is modifying dual-bank technology eliminates this stall by isolating the operation the simultaneously operation high-end micro controller like certain STM 32 series(software transactional memory) can execute program code in one bank while receiving and writing a firmware update in to the second bank. The firmware update OTA you can perform “IN_ APPLICATION PROGRAMMING” (IAP). without stopping system. The new firmware is written to the active bank and are verified system “SWAP” the bank (often via configuration register) to boot from the new code system can continuously read application code from one bank to while logging high - frequency sensor data to the other ensuring the time critical operation are not integrated but long-flash -erase cycle by keep in the older version of firmware in the first bank while writing new version to the second. the system can easily revert to the utilize bank if update fails. in many implementations. the physical address of the logical bank can be swapped in hardware so that the new code always appear at the system primary boot address. dual bank mode is often optional and must be enabled through specific hardware “optional bytes” or register developer must manage the linker script carefully to ensure the application fit with the half with the total flash. if bank swapping is included or distributed libraries across both bank it max capability is needed in mobile communication used in devices like blue-tooth enabled phone and PDA s to allow rapid flash update while running real-time task.

Index Terms—OTA, STM, RWW, IAP, BIOS, USB.

I. INTRODUCTION

The dual bank /dual -work memory technology is a memory architecture designed to enhanced system reliability and perform by dividing memory in to two independent equal-size partition (BANK A and BANK B) thus allow for simultaneously read-while-write (RWW) operation where one bank can be performed or erased while the other being read for execution this is primarily feature of dual bank memory it eliminated CPU stall during memory update because active code can continuous running from one bank while other is being reprogrammed dual-banking is crucial for software (over-the-air) (OTA) update in automotive and embedded application . the new software is down loaded to the inactive bank while the current application running in the active bank provided zero-down-time for update. if a firmware update fails or the active bank because corrupted the system can immediately switch to the other bank allowing for the seamless recovery. High dependability and easier maintenance memory micro controller support logical address remapping enabling the swap of active and inactive bank to change the execution seamlessly often a new software updated.

It is important to distinguish dual-bank technology from dual-channel memory. dual-bank refers to the internal organization of the single-flash / SRAM component allowing separate operation (RWW).dual-channel refers to the interface between the CPU and RAM ,where two 64 bit channel operate together to double memory bandwidth. it allows for continuous operation during update it provide robust rollback mechanism. increase memory bandwidth and

efficiency by allowing parallel operation. dual-bank (also known as dual-work) memory technology is a design used primarily in flash memory and micro controller that divided the memory space in to two independent sections or bank

The hardware typically support a “bank-swap” feature where the memory addresses are logically swapped so the system boot the newly update bank up on reset. this technology frequently fails in high reliability micro controller and flash devices.

INFINEON TRAVEO T 2G

(micro controller family) support dualbank model for both code and data flash to enable quick firmware activation.

STM 32 micro controller: device like the stm32 F7/ STM 32 U5 series allow the main flash to be configured in either single- bank or dual -bank modes.

NXP and TEXAS INSTRUMENTATION(TI) uses similarly dual-bank architecture in the DSC and MSPMo(mixed-single micro-controller) families to provide secure and robust boot reading. this is a distinct from “dual- channel” RAM technology which uses two physical memory channel to double the data bandwidth for faster over all PC performance..

MEMORY TECHNOLOGY In COMPUTER

The dual bank /dual work memory technology is a memory architecture designed to enhance system reliability and performance by dividing memory in to independent equal-size partition (bank A and bank B) this allows for simultaneously read-while-write (RWW) operation where one bank can be programmed or erased while the other is being read for execution this is primary feature of dual-bank memory it eliminate CPU stall during memory updates because active code can continuous running from one bank while the other is being reprogrammed dual-banking is crucial for (over-the-air) OTA updated in automotive and embedded application .the new software is down loaded to inactive bank while the

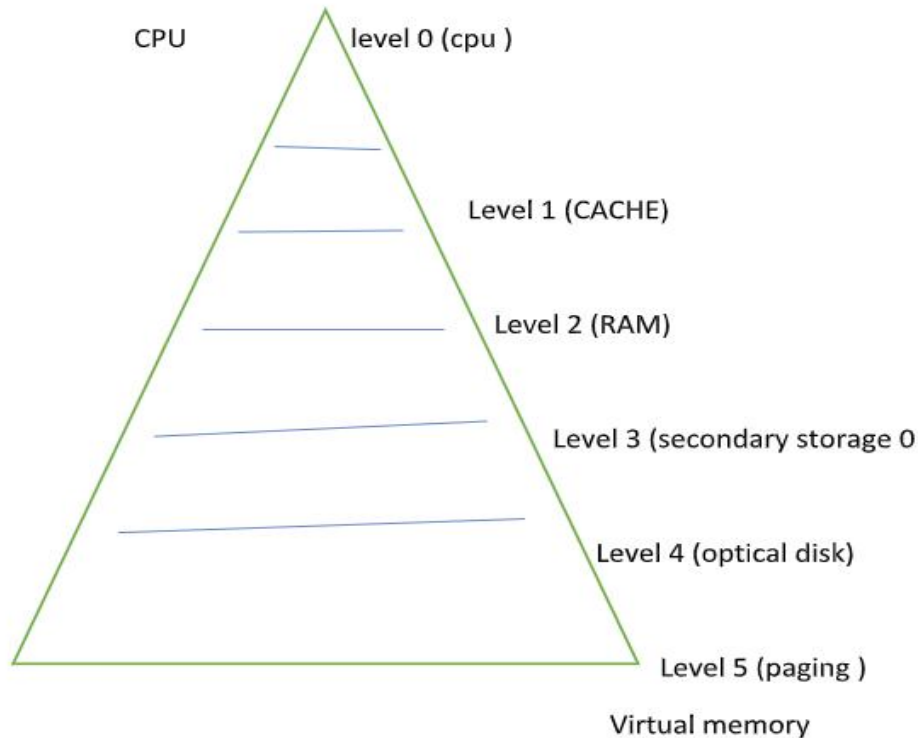
current application runs in the active bank providing zero-down-time for updates . if a firmware update fails or the active bank because corrupted the system can immediately switch to the other bank allowing for seamless recovery high – dependability and easier maintenance memory micro controller support logical address remapping enabling the swap of active and inactive bank to change the execution seamlessly after a new software updated .it is important to distinguish dual-bank technology from dual-channel memory. dual-bank refer I the internal organization of a sing-flash /SRAM component allowing separate operation (RWW) . dual-channel refer to the interface between the CPU and RAM where two 64-bit channel operate together to double memory bandwidth it allows for continuous operation during update it provide robust rollback mechanism. increasing memory band width and efficiency by allowing parallel operation. dual-bank also known as dual-work memory technology is a design used primarily in flash memory and micro controller that divided the memory space in to two independent sector or bank. The hardware typically supports a bank-swap feature where the memory address one logical swapped so the system boot from the newly updated bank upon the reset. This technology is frequently fail in high reliability micro controller ad flash device .

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II. MEMORY TECHNOLOGY IN COMPUTER



Memory technology in computer architecture involves a hierarchy structure designed to balance speed capacity and cost utilizing SRAM for fast volatile cache and DRAM for larger, slower main memory (DDR) double data rate .it uses non-volatile flash / magnetic disk for storage.

VOLATILE- NON _ VOLATILE

RAM requires power to maintain data while RPM/FLASH retain data without power locality of reference cache system rely on remote (recently used) and and separate (nearby) locality to improve the speed. micro controller distinct hardware that manage data flow between processor and memory optimized bandwidth and latency

VIRTUAL MEMORY

A technique that maps application memory to physical memory allowing the system to use disk space to simulate the additional RAM

NUMA (non- uniform memory access:

In multi-processor system this architecture allows processors to access their local memory faster than memory attached to other processor most computer system rely on four main semiconductor-based memory types

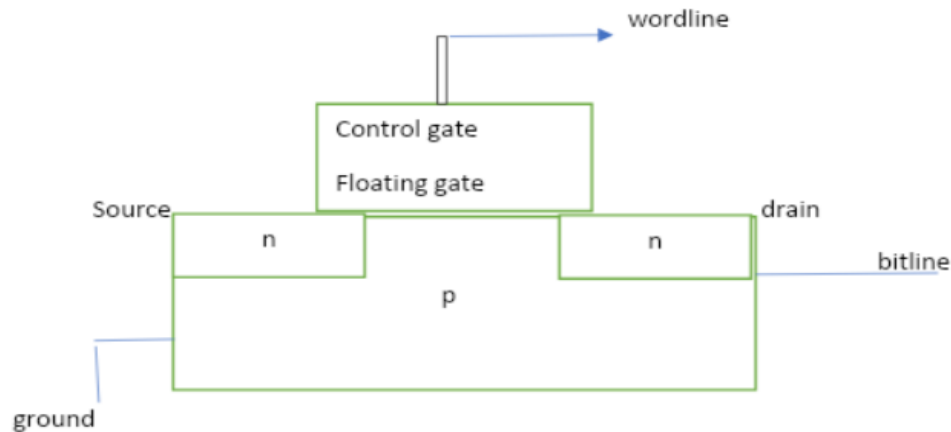
STATIC RAM(SRAM)

Uses a 6-bit transistor flip-flop circuit to store each bit. usage primarily for CPU (L1 L2L3) because it is extremely fast and does not require periodic refreshing.

TRADE OFF:it is physically large power -high at high frequency and expressive power bit.

DYNAMIC RAM(DRAM) stores bit as a charge on a single capacitor and transistor. Usage the standard memory (system RAM) due to the high density and lower cost.mechanism .the charge leaks over time requiring "refresh" cycle every few milli second to prevent data loss

III. FLASH MEMORY



FLASH MEMORY

Transistor flash memory are like MOSFET only one they have two gate on the top instead of one this is what a flash transistor look like inside you can see it 0m n-p-n sandwich with two gate on the top are called control gate and floating gate the two gate are separated by oxide layer through which current cannot normally pass both source and drain region are rich and electrons (because it made up od n-type silicon but electron cannot flow from source to drain because of electron deficit p-type material between them. If we apply positive voltage to the transistor two contact called therapidly over take bitline and the wordline electron get pulled in a rush from source to drain a few also manage to wriggle through the oxide layer by a processor called tunneling and get stuck on the floating gate even when the positive voltage are removed and whether there power supplied to the circuit or not if disconnected the positive voltage from the bitline and wordline and try to pass current through transistor from source to drain ,non will flow the electron on floating state so in this state we say the transistor is storing zero . the electron on the floating gate can be flushed act as putting a negative voltage on the word line .this the electron back the memory they came cleaning the floating gate ans allowing current to flow through the transistor once again in the state we say the transistor is storing a once.

Future of flash me chargememory

Flash has over taken magnetic storage over the last decade or so in every super computer and laptop to smart phone and I Pods hard drive have increasingly

given way to fast compact SSDs (solid-state-drive) based on flash chip that trend has been driven by – and laptop to drive -another one the shift from desk top computer and landline to mobile devices(smart phone and tablet) and cell phone which had to ultra compact high density extremely reliable memories that can with stand the stress and train to in one now

3D flash (stacked) technology. In which serve of different layer of memory cells can be grown on the same silicon wafer to increase storage capacity (just like the multiple flows of high offer test in pack more offer in to same area of land) instead of using floating gate 3D flash uses an alternative (through some time less reliable techniques called charge-trap which allow as to much higher to capacity memory on the same around of space well in to the tera bit (Tbit).

A non-volatile memory semiconductor technology based on floating gates transistor. Usage found in solid-state- drive (SSDs and USB .it is faster than traditional hard disk . but has limited write cycle before wearing out .

READ ONLY MEMORY

Non-volatile storage used to hold essential “boot-up” instruction (firmware / bios) TYPES; included MRAM (magneto resistance RAM) (hard wired) PRAM on-tone programmable andEEPROM (electrically erasable)

COMPUTER-IN-MEMORY(CIM)an emerging architecture that performs data operation directly with in the memory cell to reducethe energy and cast of moving data to the CPU.

NAND FLASH MEMORY

Nand flash memory is widely used non-volatile storage technology that retain data without power found in SSDs USB drive smart phone and memory cards if faster high storage density high write speed and low latency by arranging memory cell vertically making it ideal for mass storage in compact devices.

NOR FLASH MEMORY

Nor flash memory is non-volatile technology known for fast random read access high reliability and the ability to execute code directly and eXecute in place (XiP) ideal for firmware and boot code it is widely used in automotive industrial and consumer electronics offering better read performance than NAND but slower write/ erase speed.

DIFFERENCE NAND/NOR

Nand flash and nor flash are non-volatile storage technology differing mainly in architecture and use cases

NAND FLASH MEMORY

Offering high-density low cost fast write storage for data (SSDs and USBs). connect cell in SERIES while serve physical space and reduce the number of ground wire resulting in much higher storage density but requiring data to be accessed in “PAGES” or “BLOCKS” rather than individual bytes.

NOR FLASH MEMORY

Nor provide fast random read access allowing direct code execution (BIOS < firmware) each memory cell is connected directly to the bit line PARALLEL” allowing the processor to address every byte individually. much like RAM.

IV. CONCLUSION

Flash memory established as a foundation non-volatile storage technology that bridge the gap between high speed performance and persistent data retention operation comparable in both consumer and industrial capability it is dual role is defined by its versatile application as both portable user accessible storage and embedded system critical firmware’s storage .in consumer devices (USB drives , smart phone) it provide for reliable and compact storage for personal data in industrial /enterprises scenario (SSDs,

ROBOTICS) it is high – endurance offer using specialized SLC NAND for reliability (single-level-cell). NOR flash excel at code execution and fast read speed (ideal for BIOS/ FIRMWARE) while NAND flash in optimized for high-density data storage and fast write/ erase speed (ideal for file storage) . modern USB flash drive offer feature both USB type-A and type-C connector act as bridge to the transfer data seamlessly between mobile device (acting as HOST) and computer (acting as a DEVICE) flash memory act a indispensable non-volatile backbone of modern computing .it manage to be both fast-access temporary use storage modern for the consumer and robust high endurance repository for massive enterprises data fulfilling both immediate portability need and long-term, stable storage requirements.

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