



Automotive Industry

AUTOSAR Memory Stack

Agenda

- **Need of memory stack**
- **Memory types**
- **Memory stack main functionalities**
- **Structure of memory stack**
- **Memory stack modules roles**
- **Memory stack main concepts**

Need of memory stack

- Memory stack provides access to Non-volatile memory
- Kinds of stored information
 - Seat Position
 - A/C Temperature
 - Radio Preferences
- Information are stored in Blocks
- A Block is an array of bytes
- Each application defines the blocks it needs
 - Length
 - Protection

Memory Types

- RAM
- ROM
- Non-Volatile Memory
 - EEPROM
 - FLASH
- Difference between EEPROM and FLASH
 - Erasing access
 - Speed
 - Cost
 - Lifetime

Memory stack main functionalities

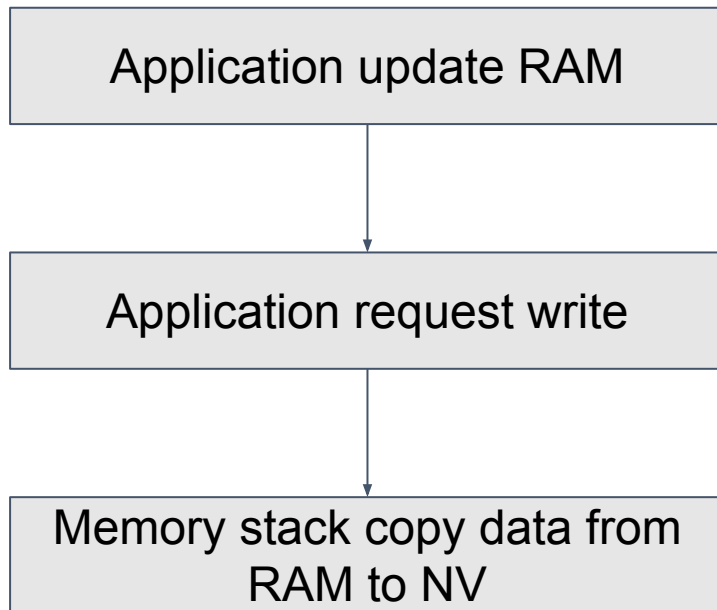
- Scheduling of accesses to any NV block for data saving/loading
- Access to blocks through BlockId , with optional queuing and priority management
- NV data safety through:
 - CRC checking
 - Redundancy management
 - Default data recovery
- Automatic multi-block loading/saving for ECU startup/shutdown modes

Memory stack main functionalities

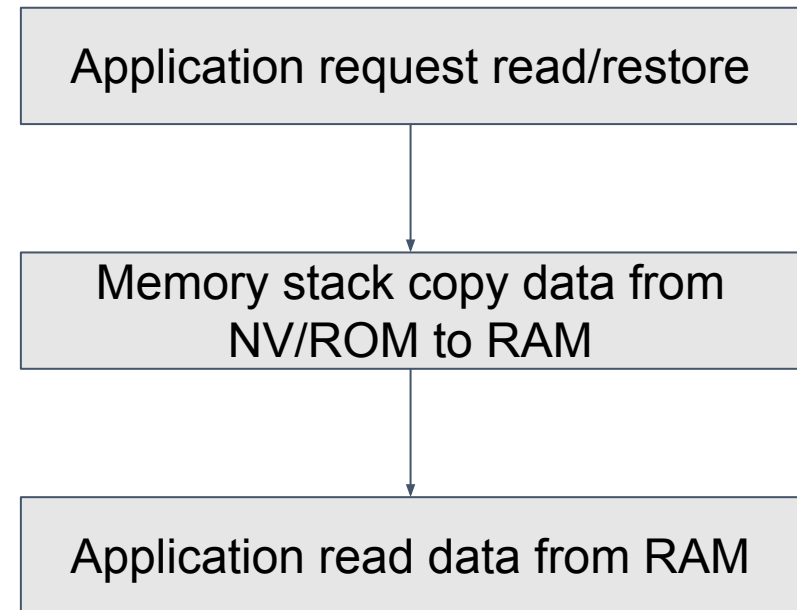
- NV Jobs priority management
- Explicit NV block invalidation services

Memory stack main functionalities

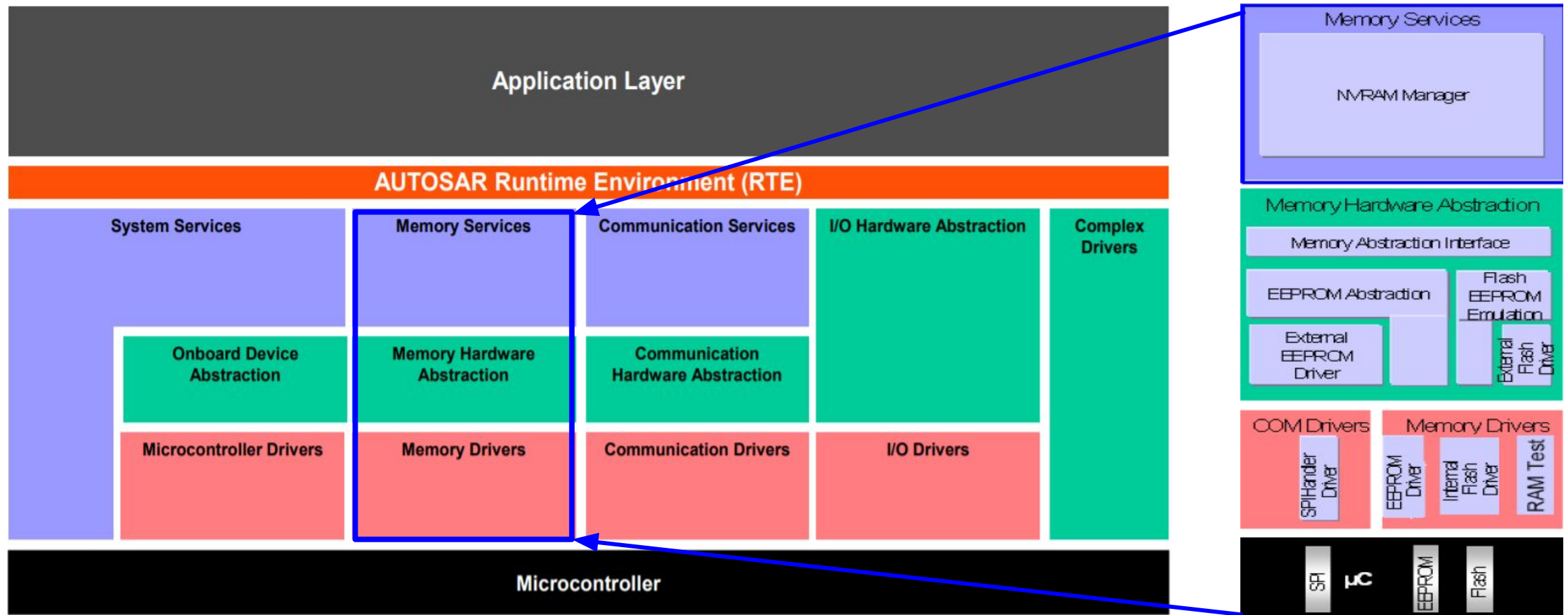
- Write operation



- Read/Restore operation



Structure of memory stack



Memory stack modules roles

- EEP module
 - It is responsible for abstraction of MC registers used to control on-chip EEPROM peripheral
 - It provides services for reading , writing, erasing to/from EEPROM
 - It also provides a service for comparing data
 - The EEPROM driver shall not buffer data

Memory stack modules roles

- FLS module
 - It is responsible for abstraction of MC registers used to control on-chip FLASH peripheral
 - It provides services for reading , writing, erasing to/from FLASH
 - It also provides a service for comparing data
 - The EEPROM driver shall not buffer data

Memory stack modules roles

- EA module
 - It is responsible of providing an abstraction of internal/external EEPROM devices
 - It provides the upper layers with a virtual addressing scheme
 - It provides “virtually” unlimited number of erase cycles

Memory stack modules roles

- FEE module
 - It is responsible of providing an abstraction of internal/external FLASH devices
 - It provides the upper layers with a virtual addressing scheme
 - It provides “virtually” unlimited number of erase cycles

Memory stack modules roles

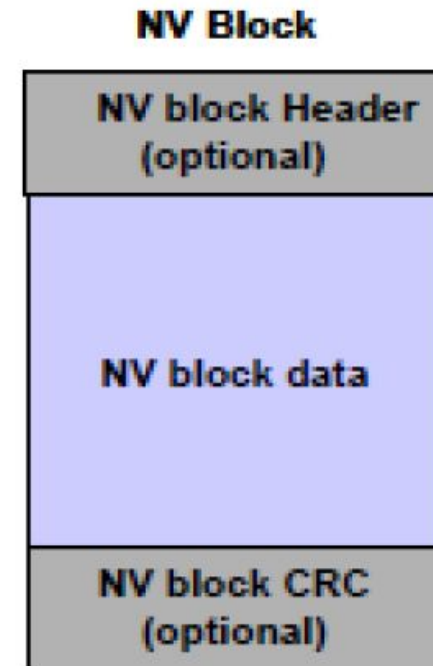
- MEMIF module
 - It allows the NVRAM manager to access several memory abstraction modules (FEE or EA modules)

Memory stack modules roles

- NVM module
 - Scheduling of accesses to any NV block for data saving/loading
 - Access to blocks through BlockId , with optional queuing and priority management
 - Nv data safety through
 - CRC checking
 - Redundancy management
 - Default data recovery
 - Automatic multi-block loading/saving for ECU startup/shutdown modes
 - Explicit NV block invalidation services

Memory stack main concepts

- NV blocks
 - The NV block is a basic storage object in NV memory
 - The NV block consist of
 - Optional NV block header (Static block ID)
 - Data
 - Optional CRC



Memory stack main concepts

- Different types of NV block management
 - Native NV block
 - Redundant NV block
 - Dataset NV block
- Related configuration parameters :
 - NVM_BLOCK_MANAGEMENT_TYPE
 - NVM_NV_BLOCK_NUM
 - NVM_DATASET_SELECTION_BITS

Memory stack main concepts

- ROM blocks
 - The ROM block is a basic storage object in ROM
 - It provides default data in case of an empty or damaged NV BLOCK
 - The ROM block consists of
 - Constant data
 - Related configuration parameters :
 - NVN_ROM_BLOCK_DATA_ADDRESS

Memory stack main concepts

- RAM blocks
 - The RAM block is a basic storage object in RAM
 - Used to allow applications to write and read freely
 - It consists of
 - Optional NV block header (Static block ID)
 - Data
 - Optional CRC

Memory stack main concepts

- CRC calculations
 - CRC shall be recalculated and updated in the RAM block upon each write request from application
 - During read operation
 - CRC bytes are read from NV
 - CRC is calculated over the data read from NV
 - The read value and the calculated value are compared
 - Related configuration parameters :
 - NVM_BLOCK_USE_CRC
 - NVM_BLOCK_CRC_TYPE
 - NVM_CRC_NUM_OF_BYTES

Memory stack main concepts

- Priority management
 - The memory stack supports a priority based job processing (in case of multiple write/read requests from application)
 - Two queues exists in memory stack
 - one for immediate write jobs
 - another for all other jobs
 - A write with immediate priority shall preempt the running job
 - The preempted job shall be resumed/restarted by the memory stack

Memory stack main concepts

- Polling and Callbacks
 - The memory stack can use either polling or callback to get the status of current write/read job requested from application
 - Mixed configuration can be used along the memory stack
 - The applications also can use polling or callback
 - Related configuration parameters
 - NVM_POLLING_MODE
 - EA/FEE_POLLING_MODE
 - EEP/FLS_USE_INTERRUPTS
 - NVM_SINGLE_BLOCK_CALLBACK

Memory stack main concepts

- Write verification
 - When a Ram block is written to NV memory the NV block shall be immediately read back and compared with the original content in RAM block
 - Write verification shall be performed in steps so that the number of bytes read specified by a configuration parameter
 - NVM_WRITE_VERIFICATION_DATA_SIZE
 - If write verification failed then write retries shall be performed by a configuration parameter
 - NVM_MAX_NUM_OF_WRITE_RETRIES

Memory stack main concepts

- Protection of NV block
 - Memory stack provides functionality of protecting the NV block from being overwritten
 - Related configuration parameters :
 - NVM_BLOCK_WRITE_PROT
 - NVM_WRITE_BLOCK_ONCE
 - Application could use “Nvm_SetBlockProtection” API to activate/deactivate block protection during runtime

Memory stack main concepts

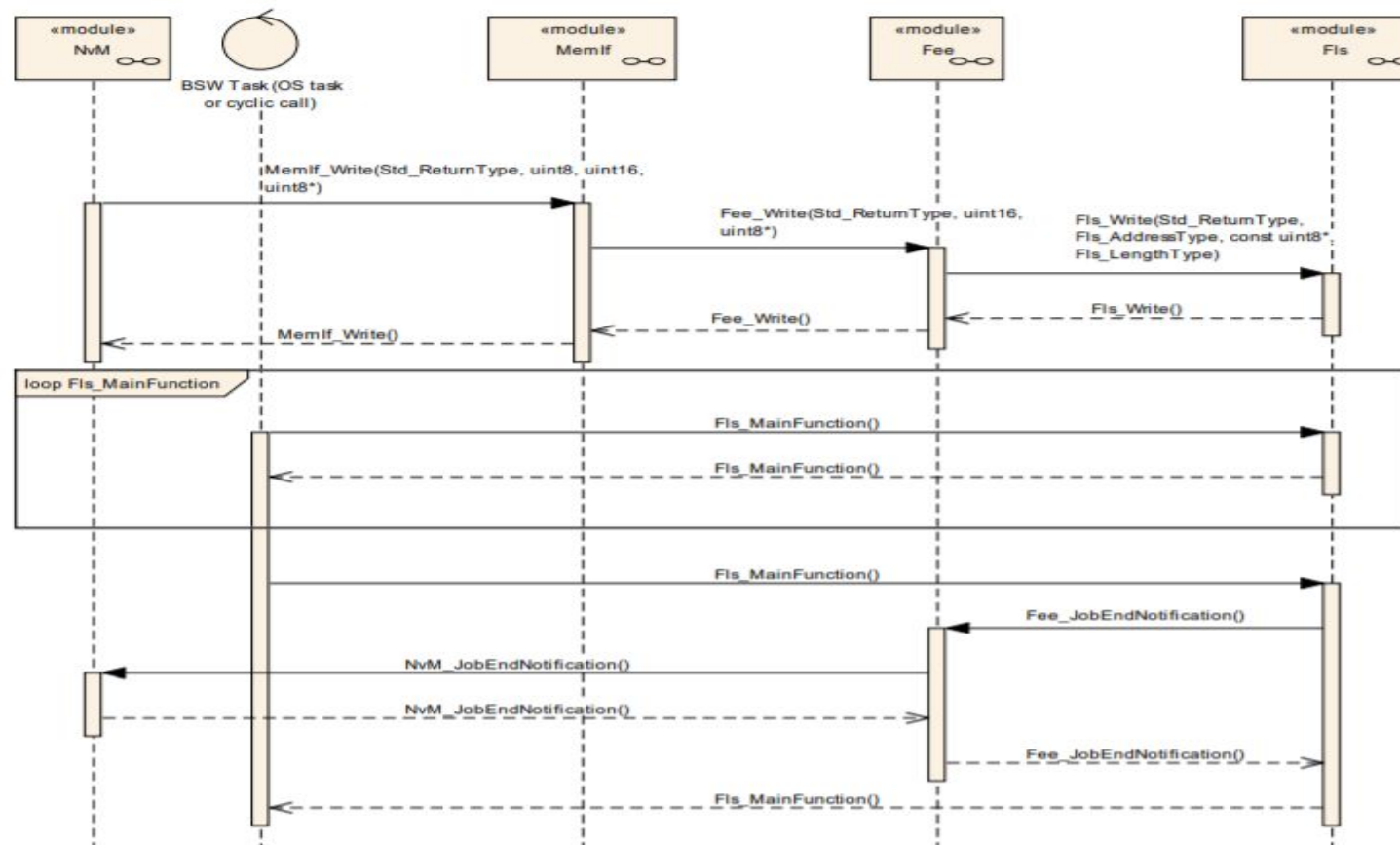
- Write all blocks / Read all blocks
 - Nvm_WriteAll() writes data to all NV blocks with attributes
 - Block is selected for WriteAll (by configuration)
 - Block has a permanent RAM block
 - Nvm_ReadAll() reads data from all NV Blocks with attributes
 - Block is selected for ReadAll (by configuration)
 - Block has a permanent RAM block
 - Nvm_WriteAll() and Nvm_ReadAll() are called in shutdown and startup respectively

Memory stack main concepts

- Write operation
 - Test block protection
 - Calculate CRC (if configured)
 - Copy data from RAM to NV

Memory stack main concepts

- Write sequence diagram - Callbacks

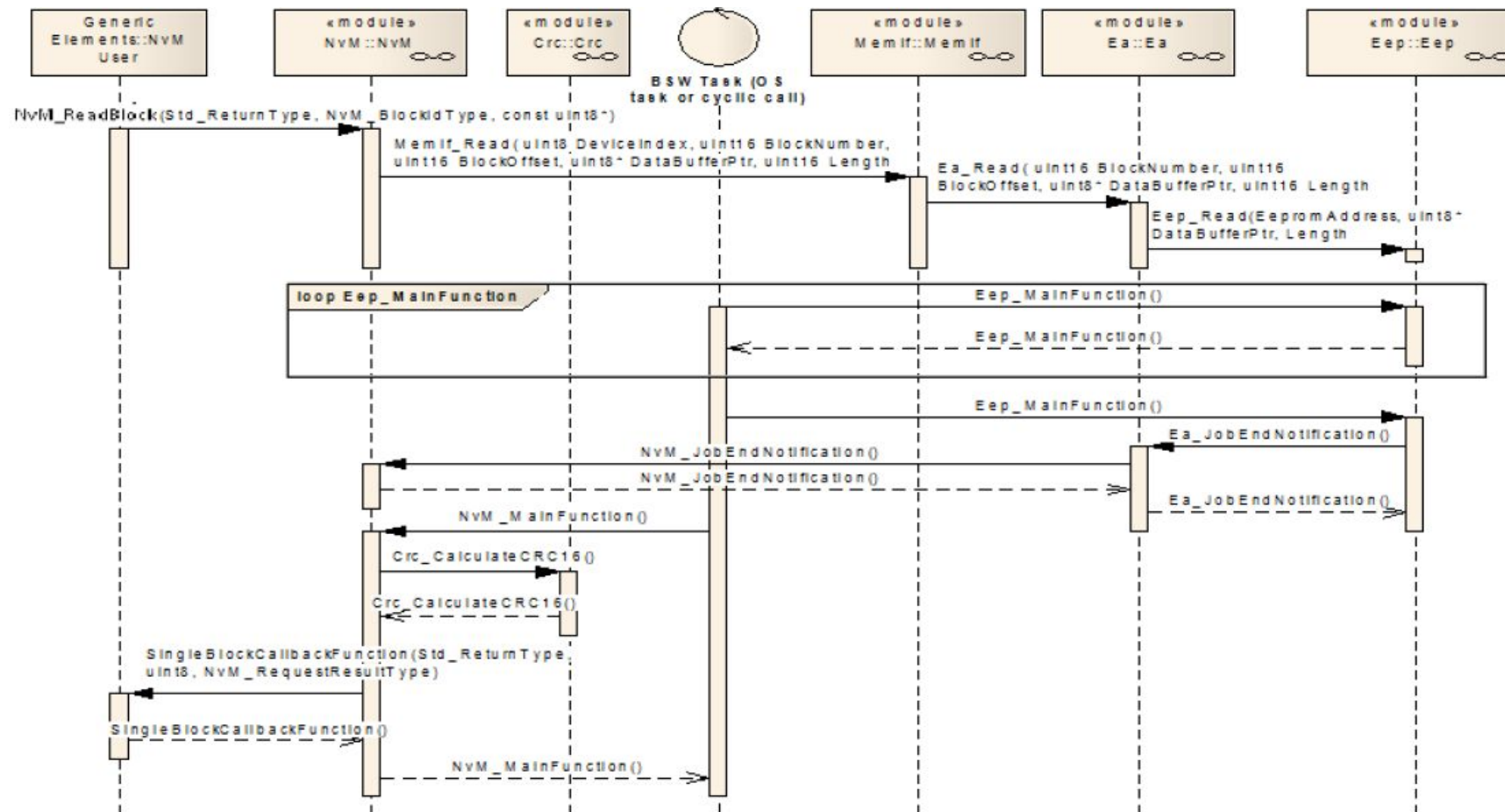


Memory stack main concepts

- Read operation
 - Copy from NV to RAM
 - CRC calculation and comparison
 - Match
 - Mismatch
 - Reading redundant blocks
 - Loading default values

Memory stack main concepts

- Read sequence diagram - Callbacks







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