BMLib Technical Reference Manual

Release 0.4.13

SOPHGO

Oct 27, 2025

Content

CHAPTER 1

Disclaimer

Legal Disclaimer

Notice

The purchased products, services and features are stipulated by the contract made between SOPHGO and the customer. All or part of the products, services and features described in this document may not be within the purchase scope or the usage scope. Unless otherwise specified in the contract, all statements, information, and recommendations in this document are provided “AS IS” without warranties, guarantees or representations of any kind, either express or implied. The information in this document is subject to change without notice. Every effort has been made in the preparation of this document to ensure accuracy of the contents, but all statements, information, and recommendations in this document do not constitute a warranty of any kind, express or implied.

Technical Support

Address

Floor 6, Building 1, Yard 9, FengHao East Road, Haidian District, Beijing,
100094, China

Website

https://www.sophgo.com/

Email

sales@sophgo.com

Phone

+86-10-57590723 +86-10-57590724

CHAPTER 2

Release note

version	release date	description
V0.1.0	2022.07.12	First release, including bmlib, bm-smi and tpu run-time.
V0.2.0	2022.07.30	Added bmvid and supplemented document.
V0.3.0	2022.08.30	Added soc mode support and bmcv support. Supported bm1684.
V0.4.0	2022.09.15	Improved bm1684 support, added cross-compilation guide of soc mode and supported SC7 accelerator card.
V0.4.1	2022.09.21	Improved soc mode support of bm1684 and fixed some opencv bug.

CHAPTER 3

Quick Start

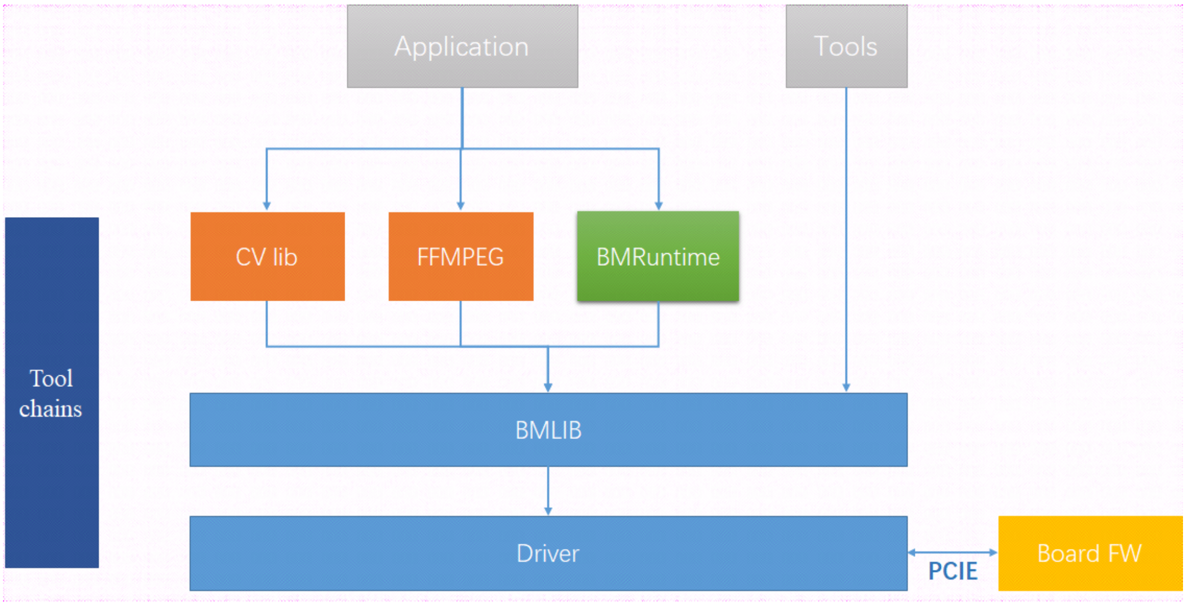
3.1 Term Interpretation

Term	Description
BM1684	The third-generation tensor processor unit for deep learning developed by SOPHGO
BM1684X	The fourth-generation tensor processor unit for deep learning developed by SOPHGO
TPU	Neural network processing unit in BM1684
SOC Mode	A product form, the SDK runs on A53 AARCH64 platform, and TPU is used as the platform bus device
PCIE Mode	A product form, SDK runs on the host platform (it can be X86 or AARCH64 server), BM1684 serves as deep learning computing accelerator card in PCIe interface
Driver	Driver is the channel for API to access the hardware
Gmem	DDR memory on card for NPU acceleration
Handle	A user process (thread) handle of the device, and all operations must be done through the handle

CHAPTER 4

Basic Concepts and Functions of Bmlib

The simple functional diagram of SDK based on SOPHGO neural network accelerator chip is as follows:



Bmlib is a underlying software library encapsulated on the kernel driver. Its main functions include:

- Creation and destruction of the device handle
- Memory help function interface
- Allocation and release of global memory
- Data handling between host and global memory

- Data handling in global memory
- API sending and synchronization
- Mapping and consistency management of global memory on the host side
- Profile interface
- Enabling and use of A53
- Miscellaneous management interface
- Power control interface

4.1 Concept of Handle

Our neural network acceleration device, whether in PCIe mode or SOC mode, will become a standard character device after the installation of the TPU driver. A handle needs to be created when the upper user process try to run on this device.

Handle is used in managing api, applying for memory and releasing memory. If a process creates two handles, which name is handle_A1 and handle_A2, then they are independent.

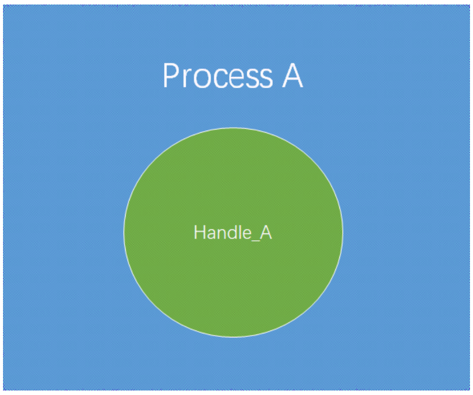
If there are two handles, Process_A and Thread_B,and Thread_B is a sub-thread of Process_A. Thread_A and Thread_B are created in Process_A and Thread_B respectively. Handle_A and Handle_B are also surely independent.

If an api is sent through handle_A, it must be passed through handle_A sync;

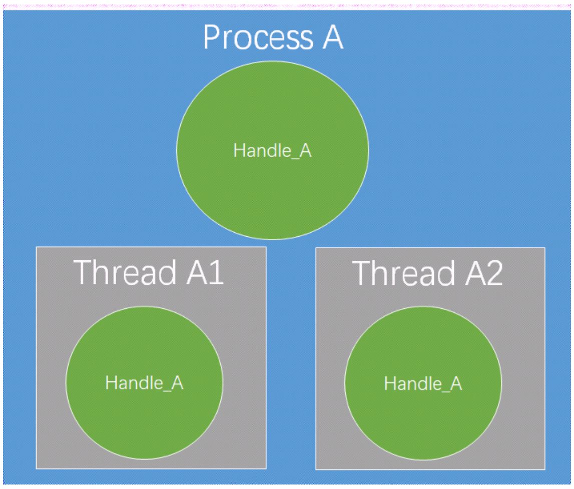
If a piece of memory is applied through handle_A, it must be released through handle_A;

It should be noted that the creator and user of the handle can be different. For example, process A creates handle_A, and the sub-thread A1 of A can also use handle_A, but the memory applied by A1 through the handle_A is statistically counted as that applied by A.

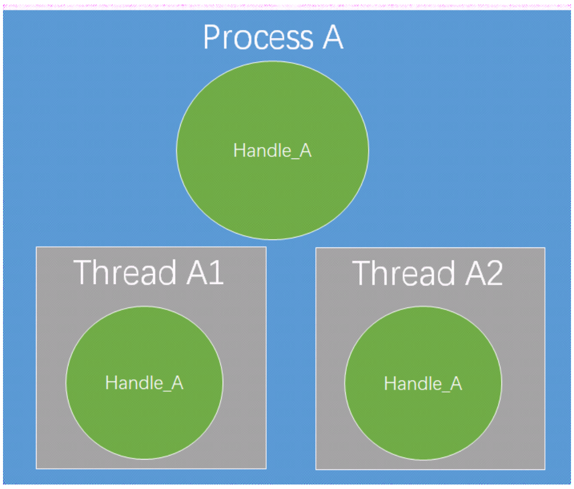
We recommend the following four ways to use handle:



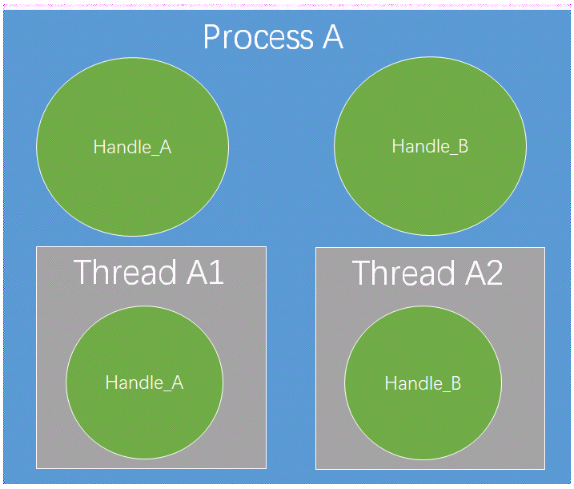
Create Handle_A in process A. Handle_A is only used in process A;



Create handle_A in process A. Handle_A is used in the two sub-threads of process A (it can be multiple, and the two in the figure are only illustrative);

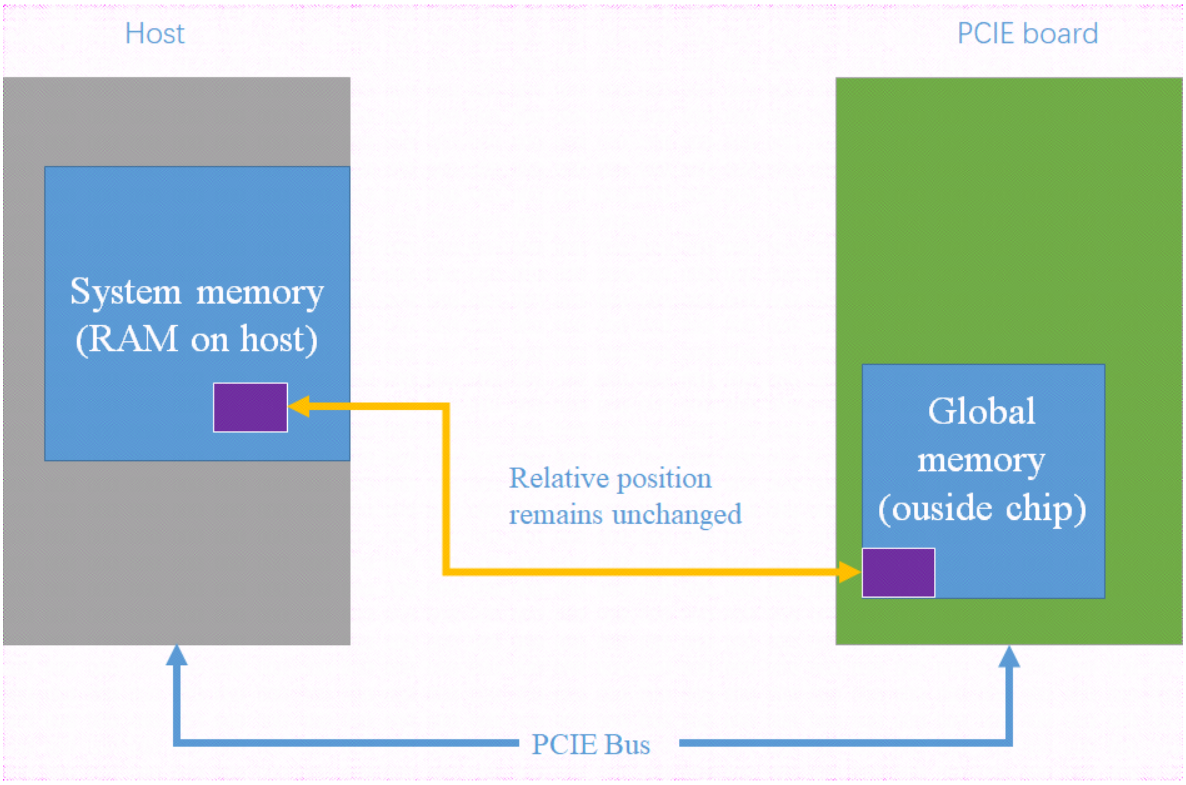


Process A and its sub-threads (can be multiple, and the two in the figure are just examples) create and use their own created handles;



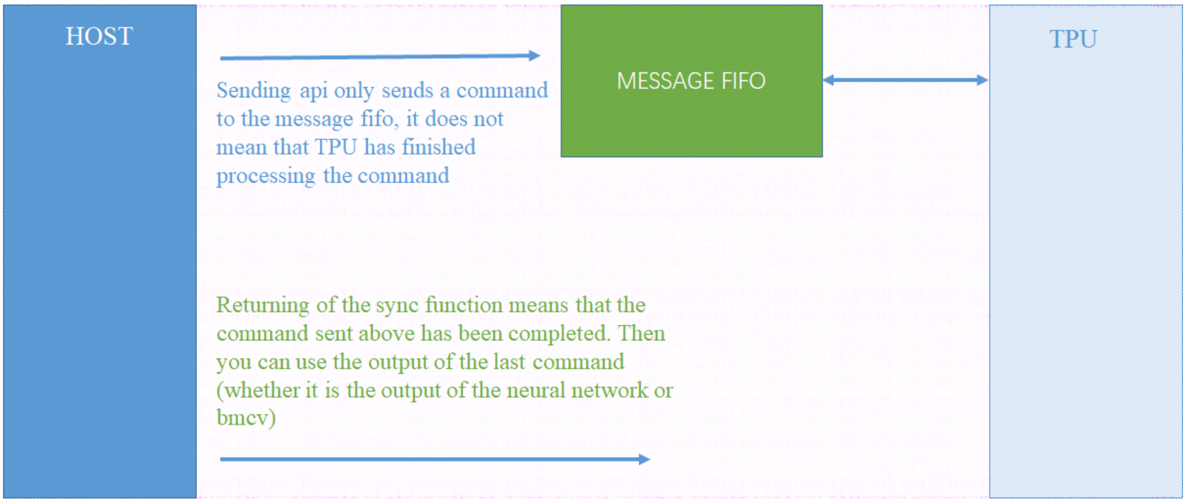
Process A creates multiple handles, which are used by each sub-thread.

4.2 Memory Type


Host
PCIE board
System memory (RAM on host)
Global memory (ouside chip)
Relative position remains unchanged
PCIE Bus

The above figure introduces the types of memory in PCIe mode, in which host can be PC/server, and PCIe board is SC5 series board. The memory on the host side is called system memory, and the memory on the PCIe board is called global memory or device memory. There is a DMA hardware in BM1684 chip special for carrying data between system memory and global memory.

4.3 Concept and Synchronization of Api


HOST
Sending api only sends a command to the message fifo, it does not mean that TPU has finished processing the command
MESSAGE FIFO
TPU
Returning of the sync function means that the command sent above has been completed. Then you can use the output of the last command (whether it is the output of the neural network or bmcv)

If the software on the host side wants the TPU to complete a task, it needs to send an "API" to the TPU, which is like a command. Please note that the sending API function and the execution completion of the API are asynchronous, so the software on the host side needs to call a sync function class until the API is really completed.

At present, the action of sending API has been encapsulated in bmcv / bmrt function library. Users cannot send API directly, but can send API by calling the interface of bmcv / bmrt.

After calling the interface of bmcv / bmrt to send the API, please refer to the bmcv / bmrt document to check whether you need to call the sync function to wait for the completion of the API. The interface of bmcv / bmrt may have encapsulated the sync function in the interface function of bmcv / bmrt. In this way, the API has been completed when the interface function of bmcv / bmrt returns.

4.4 Interface of Profile

Profile interface is used to obtain the time spent by the TPU processing API, which has been accumulated since TPU began to work (if there are continuous APIs to be processed). If only one process in the system uses TPU device, we can calculate the processing time of the API by calculating the difference between the profile data before and after calling the API.

4.5 Enable of A53

In PCIe mode, we provide some interfaces to start A53 core in BM1684 and let them complete some acceleration tasks.

4.6 Power Control

We provide interfaces to obtain and set the working frequency of TPU. Users can define their own power consumption control strategies.

4.7 Interface of Miscellaneous Information

It is used to obtain the information of the board and the statistical information during operation. At present, it includes the total amount and usage of memory and the utilization rate of TPU

CHAPTER 5

Detailed Interface Introductions to bmlib

5.1 Creation and Destruction of Device Handle

5.1.1 bm_dev_getcount

Function prototype: bm_status_t bm_dev_getcount(int *count)

Function: obtain the number of sophon devices in the current system. If the number of devices obtained is N, the legal value of devid is [0, N-1].

Parameter introduction:

Parameter	Input / output	Description
count	Output	Pointer for storing the number of sophon devices

Return value: BM_SUCCESS indicates getting the correct number; Other error codes indicate that the number cannot be obtained

5.1.2 bm_dev_query

Function prototype: bm_status_t bm_dev_query(int devid)

Function: query whether a device exists according to the device index value

Parameter introduction:

Parameter	Input / output	Description
devid	Input	Index value of the queried device

Return value: BM_SUCCESS indicates the existence of this device; Other error codes indicate that the device does not exist

5.1.3 bm_dev_request

Function prototype: bm_status_t bm_dev_request(bm_handle_t *handle, int devid)

Function: create a handle on a specific device

Parameter introduction:

Parameter	Input / output	Description
handle	Output	Save the pointer of the created handle
devid	Input	Specific device

Return value: BM_SUCCESS indicates the creation is successful; Other error codes represent creation error.

5.1.4 bm_get_devid

Prototype function: bm_get_devid(bm_handle_t *handle)

Function: get the device index according to the given handle

Parameter introduction:

Parameter	Input / output	Description
handle	input	device handle

Return value: int type device index pointed to by handle

5.1.5 bm_dev_free

Function prototype: void bm_dev_free(bm_handle_t handle)

Function: release the created handle

Parameter introduction:

Parameter	Input / output	Description
handle	input	Handle to be released

Return value: None

5.2 Interfaces of memory help functions

5.2.1 bm_mem_get_type

Function prototype: bm_mem_type_t bm_mem_get_type(struct bm_mem_desc mem);

Function: get the type of a piece of memory

Parameter introduction:

Parameter	Input / output	Description
mem	input	Queried memory

Return value: BM_MEM_TYPE_DEVICE represents global memory;

BM_MEM_TYPE_SYSTEM represents the user layer memory of Linux system.

5.2.2 bm_mem_get_device_addr

Function prototype: unsigned long long bm_mem_get_device_addr(struct bm_mem_desc mem);

Function: get the address of memory of device type

Parameter introduction:

Parameter	Input / output	Description
mem	input	Queried memory

Return value: returns the address of device memory, an unsigned number of 64 bits

5.2.3 bm_mem_set_device_addr

Function prototype: void bm_mem_set_device_addr(struct bm_mem_desc *pmem, unsigned long long addr);

Function: Set the address of a device type memory

Parameter introduction:

Parameter	Input / output	Description
pmem	Input / output	Pointer to the set memory
addr	input	Memory address set

Return value: None

5.2.4 bm_mem_get_device_size

Function prototype: unsigned int bm_mem_get_device_size(struct bm_mem_desc mem);

Function: get the size of a piece of memory of device type

Parameter introduction:

Parameter	Input / output	Description
mem	input	Queried memory

Return value: return the memory size, 32-bit unsigned number

5.2.5 bm_mem_set_device_size

Function prototype: void bm_mem_set_device_size(struct bm_mem_desc *pmem, unsigned int size);

Function: set the size of a piece of memory of device type

Parameter introduction:

Parameter	Input / output	Description
pmem	Input/output	Pointer to the set memory
size	input	The size of memory, in bytes

Return value: None

5.2.6 bm_set_device_mem

Function prototype: void bm_set_device_mem(bm_device_mem_t *pmem, unsigned int size, unsigned long long addr);

Function: fill in the size and address of a device type memory

Parameter introduction:

Parameter	Input / output	Description
pmem	Input / output	Pointer to the set memory
size	input	The size of memory, in bytes
addr	input	Address of memory

Return value: None

5.2.7 bm_mem_from_device

Function prototype: bm_device_mem_t bm_mem_from_device(unsigned long long device_addr, unsigned int len);

Function: build a bm_device_mem_t type structure according to the address and size

Parameter introduction:

Parameter	Input / output	Description
device_addr	input	Address of memory
len	input	The size of memory, in bytes

Return value: a bm_device_mem_t structure

5.2.8 bm_mem_get_system_addr

Function prototype: void *bm_mem_get_system_addr(struct bm_mem_desc mem);

Function: get the address of system type memory

Parameter Description: mem, the queried memory

Parameter	Input / output	Description
mem	input	Queried memory

Return value: return the address of the queried memory

5.2.9 bm_mem_set_system_addr

Function prototype: void bm_mem_set_system_addr(struct bm_mem_desc *pmem, void *addr);

Function: set the address of a system type memory

Parameter introduction:

Parameter	Input / output	Description
pmem	Input/output	Pointer to the set memory
addr	input	System address pointer

Return value: None

5.2.10 bm_mem_from_system

Function prototype: bm_system_mem_t bm_mem_from_system(void *system_addr);

Function: build a bm_system_mem_t according to the system pointer

Parameter introduction:

Parameter	Input / output	Description
system_addr	input	System address pointer

Return value: a bm_system_mem_t structure

5.3 Application and Release of Global Memory

5.3.1 bm_mem_null

Function prototype: bm_device_mem_t bm_mem_null(void);

Function: Return a bm memory structure which type is illegal

Parameter: None

Return value: a bm_device_mem_t structure

5.3.2 bm_malloc_neuron_device

Function prototype: bm_status_t bm_malloc_neuron_device(bm_handle_t handle, bm_device_mem_t *pmem, int n, int c, int h, int w);

Function: apply for a device type memory according to the shape information of batch, and the size of each neuron is an FP32 (4 bytes)

Parameter introduction:

Parameter	Input / output	Description
handle	input	Device handle
pmem	output	Allocate the pointer of device memory
n/c/h/w	input	Shape of batch

Return value: BM_SUCCESS means successful assignment; Other error codes represent allocation error

5.3.3 bm_malloc_device_dword

Function prototype: bm_status_t bm_malloc_device_dword(bm_handle_t handle, bm_device_mem_t *pmem, int count);

Function: allocate memory of device type with the size of count DWORD (4 bytes)

Parameter introduction:

Parameter	Input / output	Description
handle	input	Device handle
pmem	output	Allocate the pointer of device memory
count	input	Number of dword to be allocated

Return value: BM_SUCCESS indicates successful assignment; Other error codes represent allocation failure

5.3.4 bm_malloc_device_byte

Function prototype: bm_status_t bm_malloc_device_byte(bm_handle_t handle, bm_device_mem_t *pmem, unsigned int size);

Function: allocate memory of device type with specified number of bytes

Parameter introduction:

Parameter	Input / output	Description
handle	input	Device handle
pmem	output	Allocate the pointer of the device memory
size	input	Number of bytes to be allocated

Return value: BM_SUCCESS indicates successful assignment; Other error codes represent allocation failure

5.3.5 bm_malloc_device_byte_heap

Function prototype: bm_status_t bm_malloc_device_byte_heap(bm_handle_t handle, bm_device_mem_t *pmem, int heap_id, unsigned int size);

Function: allocate the memory of the device type with the specific number and size of bytes on the specific HEAP

Parameter introduction:

Parameter	Input / output	Description
handle	input	Device handle
pmem	output	Allocate the pointer of device memory
heap_id	input	HEAP assigned to GMEM (0/1/2)
size	input	Number of bytes to be allocated

Return value: BM_SUCCESS indicates successful assignment; Other error codes represent allocation failure

5.3.6 bm_malloc_device_byte_heap_mask

Function prototype: bm_status_t bm_malloc_device_byte_heap_mask(bm_handle_t handle, bm_device_mem_t *pmem, int heap_id_mask, unsigned int size);

Function: allocate device type memory with size of specified bytes on one or more specified HEAP

Parameter introduction:

Parameter	**Input/output**	**Description**
handle	input	Device handle
pmem	output	Allocate the pointer of the device memory
heap_id_mask	input	Specify the mask for allocating the HEAP ID of GMEM. Each bit represents a HEAP. If it is set to 1, it means it can be allocated from this HEAP. If it is 0, it means it cannot be allocated from this HEAP. The lowest bit bit0 represents heap0, increasing in sequence
size	input	Number of bytes to be allocated

Return value: BM_SUCCESS indicates successful assignment; Other error codes represent allocation failure

5.3.7 bm_free_device

Function prototype: void bm_free_device(bm_handle_t handle, bm_device_mem_t mem);

Function: release a piece of memory of device type

Parameter introduction:

Parameter	Input / output	Description
handle	input	Device handle
mem	input	Device memory to release

Return value: None

5.3.8 bm_gmem_arm_reserved_request

Function prototype: unsigned long long bm_gmem_arm_reserved_request(bm_handle_t handle);

Function: obtain the starting address of GMEM reserved for arm926

Parameter introduction:

Parameter	Input / output	Description
handle	input	Device handle

Return value: the starting address of GMEM reserved for arm926 (an absolute address)

5.3.9 bm_gmem_arm_reserved_release

Function prototype: void bm_gmem_arm_reserved_release(bm_handle_t handle);

Function: release GMEM reserved for arm926

Parameter introduction:

Parameter	Input / output	Description
handle	input	Device handle

Return value: None

5.4 Data Transportation between Host and Global Memory

5.4.1 bm_memcpy_s2d

Function prototype: bm_status_t bm_memcpy_s2d(bm_handle_t handle, bm_device_mem_t dst, void *src);

Function: copy system memory to device memory

Parameter introduction:

Parameter	Input / output	Description
handle	input	Device handle
dst	input	Structure of target device memory
src	input	Pointer to system memory

Return value: BM_SUCCESS indicates successful transmission; Other error codes represent transmission failure

5.4.2 bm_memcpy_s2d_partial_offset

Function prototype: bm_status_t bm_memcpy_s2d_partial_offset(bm_handle_t handle, bm_device_mem_t dst, void *src, unsigned int size, unsigned int offset);

Function: copy system memory to device type memory, specify the length and the starting address offset of device memory. The effect is to copy size length data from src to (dst starting address + offset).

Parameter introduction:

Parameter	Input/Output	Description
handle	input	Device handle
dst	input	Target device memory structure
src	input	Pointer to system memory
size	input	Length of copy
offset	input	This copy is made on the device memory side relative to the offset of the starting address of the device memory.

Return value: BM_SUCCESS indicates successful transmission; Other error codes represent transmission failure

5.4.3 bm_memcpy_s2d_partial

Function prototype: bm_status_t bm_memcpy_s2d_partial(bm_handle_t handle, bm_device_mem_t dst, void *src, unsigned int size);

Function: copy system memory to device type memory and specify the length; The effect is to copy the data of size length from src to the starting address of dst.

Parameter introduction:

Parameter	Input / output	Description
handle	input	Device handle
dst	input	Structure of target device memory
src	input	Pointer to system memory
size	input	Length of copy

Return value: BM_SUCCESS indicates successful transmission; Other error codes represent transmission failure

5.4.4 bm_memcpy_d2s

Function prototype: bm_status_t bm_memcpy_d2s(bm_handle_t handle, void *dst, bm_device_mem_t src);

Function: copy device type memory to system memory

Parameter introduction: handle, device handle; dst, pointer structure to system memory; src, device memory;

Parameter	Input / output	Description
handle	input	Device handle
dst	input	Pointer to system memory
src	input	Structure of source device memory

Return value: BM_SUCCESS indicates successful transmission; Other error codes represent transmission failure.

5.4.5 bm_memcpy_d2s_partial_offset

Function prototype: bm_status_t bm_memcpy_d2s_partial_offset(bm_handle_t handle, void *dst, bm_device_mem_t src, unsigned int size, unsigned int offset);

Function: copy device type memory to system memory, specifing the size, and offset of device memory. The effect is to copy size byte data from device memory start address + offset to dst.

Parameter introduction:

Parameter	Input / output	Description
handle	input	Device handle
dst	input	Pointer to system memory
src	input	Structure of source device memory
size	input	Length of copy (in bytes)
offset	input	The offset of this copy at the device memory end to the starting address of this device memory

Return value: BM_SUCCESS indicates successful transmission; Other error codes represent transmission failure.

5.4.6 bm_memcpy_d2s_partial

Function prototype: bm_status_t bm_memcpy_d2s_partial(bm_handle_t handle, void *dst, bm_device_mem_t src, unsigned int size);

Function: copy device type memory to system memory and specify the size; The effect is to copy size byte data from the starting address of device memory to dst.

Parameter introduction:

Parameter	Input / output	Description
handle	input	Device handle
dst	input	Pointer to system memory
src	input	Structure of source device memory
size	input	Length of copy (in bytes)

Return value: BM_SUCCESS indicates successful transmission; Other error codes represent transmission failure.

5.4.7 bm_mem_convert_system_to_device_neuron

Function prototype: bm_status_t bm_mem_convert_system_to_device_neuron(bm_handle_t handle, struct bm_mem_desc *dev_mem, struct bm_mem_desc sys_mem, bool need_copy, int n, int c, int h, int w);

Function: apply for a device type memory according to the batch shape (the size of a neuron is fp32 (4 bytes)), and copy a section of system memory to this device memory as needed.

Parameter introduction:

Parameter	Input / output	Description
handle	input	Device handle
dev_mem	output	Pointer to the allocated device memory
sys_mem	input	Memory structure of system type
need_copy	input	Whether to copy the system memory to the newly allocated device memory
n/c/h/w	input	Shape of batch

Return value: BM_SUCCESS indicates success; Other error codes represent failure

5.4.8 bm_mem_convert_system_to_device_neuron_byte

Function prototype: bm_status_t bm_mem_convert_system_to_device_neuron_byte(bm_handle_t handle, struct bm_mem_desc *dev_mem, struct bm_mem_desc sys_mem, bool need_copy, int n, int c, int h, int w);

Function: apply for a device type memory according to the batch shape (the size of a neuron is 1 byte), and copy a section of system memory to this device memory as needed.

Parameter introduction:

Parameter	Input / output	Description
handle	input	Device handle
dev_mem	output	Pointer to the allocated device memory
sys_mem	input	Memory structure of system type
need_copy	input	Whether to copy the system memory to the newly allocated device memory
n/c/h/w	input	Shape of batch

Return value: BM_SUCCESS indicates success; Other error codes represent failure

5.4.9 bm_mem_convert_system_to_device_coeff

Function prototype: bm_status_t bm_mem_convert_system_to_device_coeff(bm_handle_t handle, struct bm_mem_desc *dev_mem, struct bm_mem_desc sys_mem, bool need_copy, int coeff_count);

Function: apply for a device type memory according to the number of coefficient elements (the size of a coefficient element is 4 bytes), and copy a section of system memory to this device memory as needed.

Parameter introduction:

Parameter	Input / output	Description
handle	input	Device handle
dev_mem	output	Pointer to the allocated device memory
sys_mem	input	Memory structure of system type
need_copy	input	Whether to copy the system memory to the newly allocated device memory
coeff_count	input	Number of coefficient elements

Return value: BM_SUCCESS indicates success; Other error codes represent failure

5.4.10 bm_mem_convert_system_to_device_coeff_byte

Function prototype: bm_status_t bm_mem_convert_system_to_device_coeff_byte(bm_handle_t handle, struct bm_mem_desc *dev_mem, struct bm_mem_desc sys_mem, bool need_copy, int coeff_count);

Function: apply for a device type memory according to the number of coefficient elements (the size of a coefficient element is 1 byte), and copy a section of system memory to this device memory as needed.

Parameter introduction:

Parameter	Input / output	Description
handle	input	Device handle
dev_mem	output	Pointer to the allocated device memory
sys_mem	input	Memory structure of type system
need_copy	input	Whether to copy the system memory to the newly allocated device memory
coeff_count	input	Number of coefficient elements, in byte

Return value: BM_SUCCESS indicates success; Other error codes represent failure

5.5 Data Transportation in Global Memory

5.5.1 bm_memcpy_d2d

Function prototype: bm_status_t bm_memcpy_d2d(bm_handle_t handle, bm_device_mem_t dst, int dst_offset, bm_device_mem_t src, int src_offset, int len);

Function: copy a piece of device type memory to another piece of device type memory, and specify the size, purpose and offset of source data; The effect is to copy len DWORD (4 bytes) data from (src start address + src_offset) to (dst start address + dst_offset)

Parameter introduction:

Parameter	Input / output	Description
handle	input	Device handle
dst	input	Target device memory structure
dst_offset	input	Offset used to calculate the starting position of the data copy
src	input	Source device memory structure
src_offset	input	Offset used to calculate the starting position of the data copy
len	input	Data copy length, in DWORD (4 bytes)

Return value: BM_SUCCESS means successful transmission; Other error codes represent transmission failure.

5.5.2 bm_memcpy_d2d_byte

Function prototype: bm_status_t bm_memcpy_d2d_byte(bm_handle_t handle, bm_device_mem_t dst, size_t dst_offset, bm_device_mem_t src, size_t src_offset, size_t size);

Function: copy a piece of device type memory to another piece of device type memory, and specify the size, purpose and offset of source data; The effect is to copy len bytes of data from (src start address + src_offset) to (dst start address + dst_offset)

Parameter introduction:

Parameter	Input / output	Description
handle	input	Device handle
dst	input	Target device memory structure
dst_offset	input	Offset used to calculate the starting position of the data copy
src	input	Source device memory structure
src_offset	input	Offset used to calculate the starting position of the data copy
size	input	Data copy length, in bytes

Return value: BM_SUCCESS means successful transmission; Other error codes represent transmission failure.

5.5.3 bm_memcpy_d2d_stride

Function prototype: bm_status_t bm_memcpy_d2d_stride(bm_handle_t handle, bm_device_mem_t dst, int dst_stride, bm_device_mem_t src, int src_stride, int count, int format_size);

Function: copy a piece of device type memory to another piece of device type memory, specify the purpose and stride of source data, the number of data, and the type and byte size of data; The effect is to copy count data with element size of format_size bytes from the src start address to the dst start address with src_stride as the interval size, and store the data with dst_stride as the interval size.

Parameter introduction:

Parameter	**Input/Output**	**Description**
handle	input	Device handle
dst	input	Target device memory structure
dst_stride	input	Interval of each element of the target
src	input	Source device memory structure
src_stride	input	Interval for each element of the source data
count	input	Number of elements to be copied
format_size	input	The byte size of each element. For example, the byte size of float type is 4 and uint8_t type byte size is 1; The number of copies and stride are in format_size

Restrictions: dst_stride is usually 1; There is only one case that cannot be 1: dst_stride = 4 and src_stride = 1 and format_size = 1.

Return value: BM_SUCCESS means successful transmission; Other error codes represent transmission failure.

5.5.4 bm_memset_device

Function prototype: bm_status_t bm_memset_device(bm_handle_t handle, const int value, bm_device_mem_t mem);

Function: fill a piece of device memory with value

Parameter introduction:

Parameter	Input / output	Description
handle	input	Device handle
value	input	Values to be populated
mem	input	The target device memory structure. This function can only fill the global memory space with an integer multiple of 4 bytes

Return value: BM_SUCCESS: Successful filling; Other error codes represent filling failure

The role of this function and bm_memset_device_ext function has the same effect when mode is 4.

5.5.5 bm_memset_device_ext

Function prototype: bm_status_t bm_memset_device_ext(bm_handle_t handle, void* value, int mode, bm_device_mem_t mem);

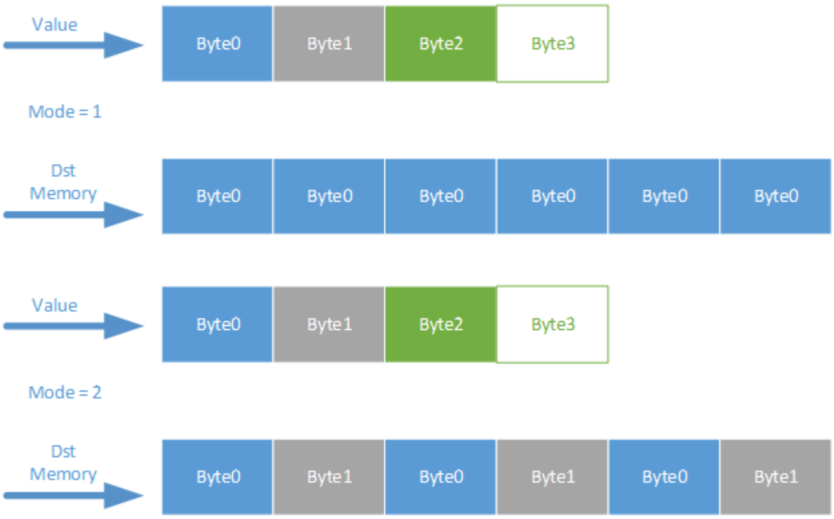
Function: fill a piece of device memory with the content pointed to by value and the specified mode

Parameter introduction:

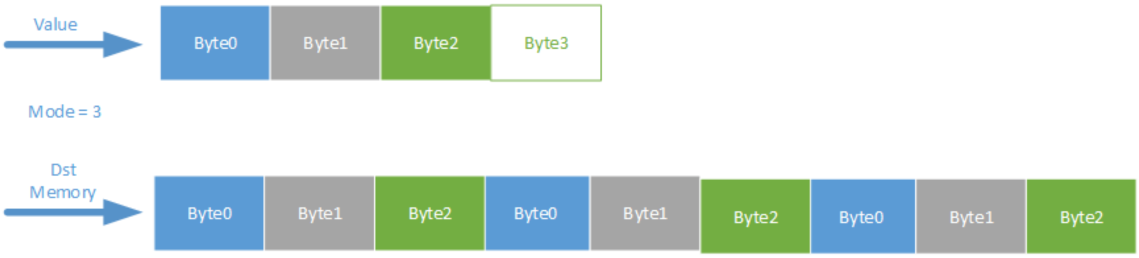
Parameter	Input / output	Description
handle	input	Device handle
value	input	Points to the value to be populated
mode	input	The filling mode is shown in the figure below
mem	input	Target device memory structure

Return value: BM_SUCCESS indicates Successful filling; Other error codes represent filling failure

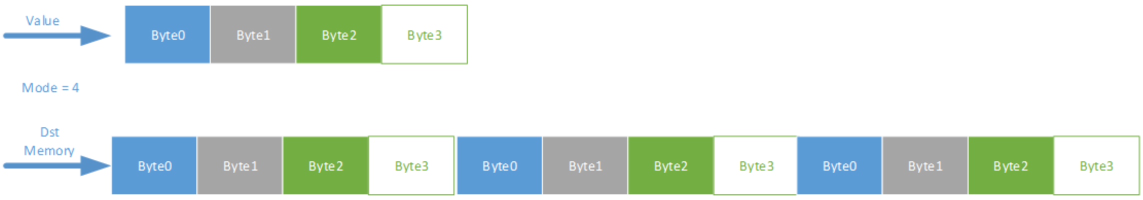
The function diagram of this function is as follows:



When mode is 2, the size of DST memory must be an integer multiple of 2 bytes



When mode is 3, the size of DST memory must be an integer multiple of 3 bytes



When the mode is 4, the size of dst memory must be an integer multiple of 4 bytes

5.6 Global memory transportation between different devices

5.6.1 bm_memcpy_c2c

Function prototype: bm_status_t bm_memcpy_c2c(bm_handle_t src_handle, bm_handle_t dst_handle, bm_device_mem_t src, bm_device_mem_t dst, bool force_dst_cdma);

Function: move global memory from one device to another (currently only devices on the same card are supported)

Parameter introduction:

Parameter	Input/output	Description
src_handle	input	Device handle to source address
dst_handle	input	Device handle to destination address
src	input	Source target device memory structure
dst	input	Target device memory structure
force_dst_cdma	input	The cdma of the destination device is forced to be used for transportation, and the cdma of the source device is used by default

Return value: BM_SUCCESS indicates success; Other error codes represent failure

5.7 Mapping and Consistency Management of Global Memory on the Host Side

5.7.1 bm_mem_mmap_device_mem

Function prototype: bm_status_t bm_mem_mmap_device_mem(bm_handle_t handle, bm_device_mem_t *dmem, unsigned long long *vmem);

Function: map a global memory to the user space of the host and enable cache (only valid in SoC mode, not in PCIe mode)

Parameter introduction:

Parameter	Input / output	Description
handle	input	Device handle
dmem	input	Execute the structure of the mapped global memory
vmem	output	A pointer that stores the mapped virtual address

Return value: BM_SUCCESS indicates success; Other error codes represent failure

5.7.2 bm_mem_mmap_device_mem_no_cache

Function prototype: bm_status_t bm_mem_mmap_device_mem_no_cache(bm_handle_t handle, bm_device_mem_t *dmem, unsigned long long *vmem);

Function: map a global memory to the user space of the host and disable cache (only valid in SoC mode, not in PCIe mode)

Parameter introduction:

Parameter	Input / output	Description
handle	input	Device handle
dmem	input	Execute the structure of the mapped global memory
vmem	output	A pointer that stores the mapped virtual address

Return value: BM_SUCCESS indicates success; Other error codes represent failure

5.7.3 bm_mem_invalidate_device_mem

Function prototype: bm_status_t bm_mem_invalidate_device_mem(bm_handle_t handle, bm_device_mem_t *dmem);

Function: invalidate a mapped device memory (valid only in SoC mode, not in PCIe mode)

Parameter introduction:

Parameter	Input / output	Description
handle	input	Device handle
dmem	input	Pointer to the structure of global memory that is invalidated

Return value: BM_SUCCESS indicates success; Other error codes represent failure

5.7.4 bm_mem_invalidate_partial_device_mem

Function prototype: bm_status_t bm_mem_invalidate_partial_device_mem(bm_handle_t handle, bm_device_mem_t *dmem, u32 offset, u32 len)

Function: invalidate a part of the mapped device memory (only valid in SoC mode, not in PCIe mode)

Parameter introduction:

Parameter	Input / output	Description
handle	input	Device handle
dmem	input	Pointer to the structure of global memory that is invalidated
offset	input	Address offset
len	input	Length of invalidate

Return value: BM_SUCCESS indicates success; Other error codes represent failure

5.7.5 bm_mem_flush_device_mem

Function prototype: bm_status_t bm_mem_flush_device_mem(bm_handle_t handle, bm_device_mem_t *dmem);

Function: flush a mapped device global memory (only valid in SoC mode, not supported in PCIe mode)

Parameter introduction:

Parameter	Input / output	Description
handle	input	Device handle
dmem	input	The structure of global memory that is flushed

Return value: BM_SUCCESS indicates success; Other error codes represent failure

5.7.6 bm_mem_flush_partial_device_mem

Function prototype: bm_status_t bm_mem_flush_partial_device_mem(bm_handle_t handle, bm_device_mem_t *dmem, u32 offset, u32 len)

Function: flush a part of the mapped device global memory (only valid in SoC mode, not in PCIe mode)

Parameter introduction:

Parameter	Input / output	Description
handle	input	Device handle
dmem	input	The structure of global memory that is flushed
offset	input	Address offset
len	input	Length of flush

Return value: BM_SUCCESS indicates success; Other error codes represent failure

5.7.7 bm_mem_unmap_device_mem

Function prototype: bm_status_t bm_mem_unmap_device_mem(bm_handle_t handle, void *vmem, int size);

Function: in SoC mode, unmap device memory. (valid only in SoC mode, not in PCIe mode)

Parameter	Input / output	Description
handle	input	Device handle
vmem	input	Virtual address of unmap
size	input	Size of unmap

Return value: BM_SUCCESS indicates success; Other error codes represent failure

5.7.8 bm_mem_vir_to_phy

Function prototype: bm_status_t bm_mem_vir_to_phy(bm_handle_t handle, unsigned long long vmem, unsigned long long *device_mem);

Function: in SoC mode, the virtual address obtained by bm_mem_mmap_device_mem function can be converted into the physical address of device memory. (Valid only in SoC mode, not in PCIe mode)

Parameter	Input / output	Description
handle	input	Device handle
vmem	input	Virtual address
device_mem	output	Physical address on the device

Return value: BM_SUCCESS indicates success; Other error codes represent failure

5.8 Synchronization of API

5.8.1 bm_flush

Function prototype: void bm_flush(bm_handle_t handle);

Function: this function is equivalent to bm_handle_sync. This function exists to maintain compatibility with old code. It is not recommended to continue to use it.

Parameter introduction:

Parameter	Input / output	Description
handle	input	Device handle

Return value: None

5.8.2 bm_device_sync

Function prototype: bm_status_t bm_device_sync(bm_handle_t handle);

Function: when the process of creating handle calls A to use this function, there are already N APIs processing on the device pointed to by handle. Function has not return util these N APIs are completed.

Parameter introduction:

Parameter	Input / output	Description
handle	input	Device handle

Return value: BM_SUCCESS indicates successful synchronization; Other error codes represent synchronization failure

5.8.3 bm_thread_sync

Function prototype: bm_status_t bm_thread_sync(bm_handle_t handle);

Function: wait for all APIs previously submitted by this caller thread on the handle to complete. If this caller thread has not submitted APIs on this handle, it will directly return success; The return of this function cannot guarantee that the APIs submitted by this caller thread on other handles has been completed.

Parameter introduction:

Parameter	Input / output	Description
handle	input	Device handle

Return value: BM_SUCCESS indicates successful synchronization; Other error codes represent synchronization failure

5.8.4 bm_handle_sync

Function prototype: bm_status_t bm_handle_sync(bm_handle_t handle);

Function: synchronize all API operations submitted to the current handle. When calling this function, there are N APIs sent through this handle. After the function returns, all N APIs are completed.

Parameter introduction:

Parameter	Input / output	Description
handle	input	Device handle

Return value: BM_SUCCESS indicates successful synchronization; Other error codes represent synchronization failure

5.9 Profile Interface

5.9.1 bm_get_profile

Function prototype: bm_status_t bm_get_profile(bm_handle_t handle, bm_profile_t *profile);

Function: get the profile data of the current time point

Parameter introduction:

Parameter	Input / output	Description
handle	input	Device handle
profile	output	Point to a structure that holds profling data

Return value: BM_SUCCESS indicates success; Other error codes represent failure

5.9.2 bm_get_last_api_process_time_us

Function prototype: bm_status_t bm_get_last_api_process_time_us(bm_handle_t handle, unsigned long *time_us);

Function: this function is deprecated.

Parameter introduction: None

Return value: BM_SUCCESS indicates success; Other error codes represent failure

5.10 Power Management Interface

5.10.1 bm_set_clk_tpu_freq

Function prototype: bm_status_t bm_set_clk_tpu_freq(bm_handle_t handle, int freq);

Function: set the working frequency of the current TPU, which is only valid in PCIe mode

Parameter introduction:

Parameter	Input / output	Description
handle	input	Device handle
freq	input	Pointer to save TPU current operating frequency

Return value: BM_SUCCESS indicates success; Other error codes represent failure

5.10.2 bm_get_clk_tpu_freq

Function prototype: bm_status_t bm_get_clk_tpu_freq(bm_handle_t handle, int *freq);

Function: obtain the working frequency of the current TPU

Parameter introduction:

Parameter	Input / output	Description
handle	input	Device handle
freq	output	Pointer to save current TPU operating frequency

Return value: BM_SUCCESS indicates success; Other error codes represent failure

5.11 Device Management Interface

5.11.1 bm_get_misc_info

Function prototype: bm_status_t bm_get_misc_info(bm_handle_t handle, struct bm_misc_info *pmisc_info);

Function: obtain misc information related to the device

Parameter introduction:

Parameter	Input / output	Description
handle	input	Device handle
pmisc_info	output	Pointer to save misc data

Return value: BM_SUCCESS indicates success; Other error codes represent failure

5.11.2 bm_get_chipid

Function prototype: bm_status_t bm_get_chipid(bm_handle_t handle, unsigned int *p_chipid);

Function: obtain the chip ID corresponding to the device

Parameter introduction:

Parameter	Input / output	Description
handle	input	Device handle
p_chipid	output	Pointer to save chip ID

Return value: BM_SUCCESS indicates success; Other error codes represent failure

5.11.3 bm_get_stat

Function prototype: bm_status_t bm_get_stat(bm_handle_t handle, bm_dev_stat_t *stat);

Function: obtain the runtime statistics of the device corresponding to the handle

Parameter introduction:

Parameter	Input / output	Description
handle	input	Device handle
Stat	output	Pointer for storing statistics

Return value: BM_SUCCESS indicates success; Other error codes represent failure

5.11.4 bm_get_gmem_heap_id

Function prototype: bm_get_gmem_heap_id(bm_handle_t handle, bm_device_mem_t *pmem, unsigned int *heapid);

Function: get the heap id of the device memory pointed to by pmem

Parameter introduction:

Parameter	Input / output	Description
handle	input	Device handle
Pmem	input	Device memory pointer
Heaped	output	Pointer to the heap ID where the device memory is stored

Return value: BM_SUCCESS indicates success; Other error codes represent failure

5.11.5 bmlib_log_get_level

Function prototype: int bmlib_log_get_level(void);

Function: get bmlib log level

Parameter introduction: void

Return value: bmlib log level

5.11.6 bmlib_log_set_level

Function prototype: void bmlib_log_set_level(int level);

Function: set bmlib log level

Parameter introduction:

Parameter	Input / output| Description
Level	input | The level of bmlib log to set

Return value: None

5.11.7 bmlib_log_set_callback

Function prototype: void bmlib_log_set_callback((callback)(const char* , int , const char, va_list));

Function: set callback to get bmlib log

Parameter introduction:

Parameter	Input/output	Description
Callback	input	Set the function pointer to get the callback function of bmlib log

Return value: None

5.11.8 bm_set_debug_mode

Function prototype: void bm_set_debug_mode(bm_handle_t handle, int mode);

Function: set debug mode for tpu fw log

Note: this function is used in SC3

Parameter introduction:

Parameter	Input / output	Description
handle	input	Device handle
Mode	input	fw log debug mode, 0/1 means disable/enable

Return value: None

5.11.9 bmlib_set_api_dbg_callback

Function prototype: void bmlib_set_api_dbg_callback(bmlib_api_dbg_callback callback);

Function: set debug callback to get fw log

Note: this function is used by SC3

Parameter introduction:

Parameter	Input / output	Description
handle	input	Device handle
Callback	input	Function pointer to get fw log callback function to set

Return value: None

5.11.10 bm_get_tpu_current

Function prototype: bm_status_t bm_get_tpu_current(bm_handle_t handle, int *tpuc);

Function: obtain the current value of the device corresponding to the handle. The default unit is milliampere (mA).

Parameter introduction:

Parameter	Input / output	Description
handle	input	Device handle
tpuc	output	Function pointer to get tpuc

Return value: BM_SUCCESS indicates success; Other error codes represent failure

5.11.11 bm_get_board_max_power

Function prototype: bm_status_t bm_get_board_max_power(bm_handle_t handle, int *maxp);

Function: obtain the maximum power consumption supported by the board where the device is located. The default unit is watt (W).

Parameter introduction:

Parameter	Input / output	Description
handle	input	Device handle
maxp	output	Function pointer to get maxp

Return value: BM_SUCCESS indicates success; Other error codes represent failure

5.11.12 bm_get_board_power

Function prototype: bm_status_t bm_get_board_power(bm_handle_t handle, int *boardp);

Function: obtain the current power consumption value of the board where the device is located. The default unit is watt (W).

Parameter introduction:

Parameter	Input / output	Description
handle	input	Device handle
boardp	output	Function pointer to get boardp

Return value: BM_SUCCESS indicates success; Other error codes represent failure

5.11.13 bm_get_fan_speed

Function prototype: bm_status_t bm_get_fan_speed(bm_handle_t handle, int *fan);

Function: obtain the fan duty ratio of the board where the device is located

Parameter introduction:

Parameter	Input / output	Description
handle	input	Device handle
fan	output	Function pointer to get fan

Return value: BM_SUCCESS indicates success; Other error codes represent failure

5.11.14 bm_get_ecc_correct_num

Function prototype: bm_status_t bm_get_ecc_correct_num(bm_handle_t handle, unsigned long *ecc_correct_num);

Function: get the number of times the device corrects errors when DDR is enabled.

Parameter introduction:

Parameter	Input/output	Description
handle	input	Device handle
ec c_correct_num	output	To get atx_12v function pointer

Return value: BM_SUCCESS indicates success; Other error codes represent failure

5.11.15 bm_get_12v_atx

Function prototype: bm_status_t bm_get_12v_atx(bm_handle_t handle, int *atx_12v);

Function: obtain the 12V power supply current of the device board. The default unit is milliampere (mA).

Parameter introduction:

Parameter	Input / output	Description
handle	input	Device handle
atx_12v	output	To get atx_12v function pointer

Return value: BM_SUCCESS indicates success; Other error codes represent failure

5.11.16 bm_get_sn

Function prototype: bm_status_t bm_get_sn(bm_handle_t handle, char *sn);

Function: obtain the serial number of the board (17 digits in total).

Parameter introduction:

Parameter	Input / output	Description
handle	input	Device handle
sn	output	Function pointer to get sn

Return value: BM_SUCCESS indicates success; Other error codes represent failure

5.11.17 bm_get_status

Function prototype: bm_status_t bm_get_status(bm_handle_t handle, int *status);

Function: obtain the device state corresponding to the handle. 0 is the active state and 1 is the fault state.

Parameter introduction:

Parameter	Input / output	Description
handle	input	Device handle
status	output	Function pointer to get status

Return value: BM_SUCCESS indicates success; Other error codes represent failure

5.11.18 bm_get_tpu_minclk

Function prototype: bm_status_t bm_get_tpu_minclk(bm_handle_t handle, unsigned int *tpu_minclk);

Function: get the minimum working frequency of the device corresponding to the handle. The default unit is megahertz (MHz).

Parameter introduction:

Parameter	Input / output	Description
handle	input	Device handle
tpu_minclk	output	To get function pointer of tpu_minclk

Return value: BM_SUCCESS indicates success; Other error codes represent failure

5.11.19 bm_get_tpu_maxclk

Function prototype: bm_status_t bm_get_tpu_maxclk(bm_handle_t handle, unsigned int *tpu_maxclk);

Function: get the maximum working frequency of the device corresponding to the handle. The default unit is megahertz (MHz).

Parameter introduction:

Parameter	Input / output	Description
handle	input	Device handle
tpu_maxclk	output	To get function pointer of tpu_maxclk

Return value: BM_SUCCESS indicates success; Other error codes represent failure

5.11.20 bm_get_driver_version

Function prototype: bm_status_t bm_get_driver_version(bm_handle_t handle, int *driver_version);

Function: get the driver version installed on the board.

Parameter introduction:

Parameter	Input / output	Description
handle	input	Device handle
dr iver_version	output	To get the function pointer of driver_version

Return value: BM_SUCCESS indicates success; Other error codes represent failure

5.11.21 bm_get_board_name

Function prototype: bm_status_t bm_get_board_name(bm_handle_t handle, char *name);

Function: obtain the name of the current board, format: chip id - board type (e.g., 1684-SC5+).

Parameter introduction:

Parameter	Input / output	Description
handle	input	Device handle
name	output	Function pointer to get name

Return value: BM_SUCCESS indicates success; Other error codes represent failure

5.11.22 bm_get_board_temp

Function prototype: bm_status_t bm_get_board_temp(bm_handle_t handle, unsigned int *board_temp);

Function: get the board temperature of the board of the device corresponds to the handle. The default unit is Celsius (℃).

Parameter introduction:

Parameter	Input / output	Description
handle	input	Device handle
board_temp	output	To get the function pointer of board_temp

Return value: BM_SUCCESS indicates success; Other error codes represent failure

5.11.23 bm_get_chip_temp

Function prototype: bm_status_t bm_get_chip_temp(bm_handle_t handle, unsigned int *chip_temp);

Function: get the temperature of the device corresponding to the handle. The default unit is Celsius (℃).

Parameter introduction:

Parameter	Input / output	Description
handle	input	Device handle
chip_temp	output	To get a function pointer of chip_temp

Return value: BM_SUCCESS indicates success; Other error codes represent failure

5.11.24 bm_get_tpu_power

Function prototype: bm_status_t bm_get_tpu_power(bm_handle_t handle, float *tpu_power);

Function: get the power consumption of the device corresponding to the handle. The default unit is watt (W).

Parameter introduction:

Parameter	Input / output	Description
handle	input	Device handle
tpu_power	output	To get the function pointer of tpu_power

Return value: BM_SUCCESS indicates success; Other error codes represent failure

5.11.25 bm_get_tpu_volt

Function prototype: bm_status_t bm_get_tpu_volt(bm_handle_t handle, float *tpu_volt);

Function: get the voltage of the device corresponding to the handle. The default unit is millivolt (mV).

Parameter introduction:

Parameter	Input / output	Description
handle	input	Device handle
tpu_volt	output	To get the function pointer of tpu_volt

Return value: BM_SUCCESS indicates success; Other error codes represent failure

5.12 Enable of A53

5.12.1 bmcpu_start_cpu

Function prototype: bm_status_t bmcpu_start_cpu(bm_handle_t handle, char *boot_file, char *core_file);

Function: Boot the ARM processor A53 on the device.

Parameter introduction:

Parameter	Input / output	Description
handle	input	Device handle
boot_file	input	Boot file for ARM processor boot
core_file	input	Kernel file for ARM processor boot

Return value: BM_SUCCESS indicates success; Other error codes represent failure

5.12.2 bmcpu_open_process

Function prototype: int bmcpu_open_process(bm_handle_t handle, unsigned int flags, int timeout);

Function: Create a process that runs on A53.

Parameter introduction:

Parameter	Input / output	Description
handle	input	Device handle
flags	input	Flag bit for creating a53 process
timeout	input	Timeout for creating a53 processes

Return value : Process handle on A53

5.12.3 bmcpu_load_library

Function prototype: bm_status_t bmcpu_load_library(bm_handle_t handle, int process_handle, char *library_file, int timeout);

Function: Load the dynamic libraries required by the process on A53.

Parameter introduction:

Parameter	Input/output	Description
handle	input	Device handle
process_handle	input	Process handle on A53
library_file	input	Dynamic library files to be loaded
timeout	input	Timeout for loading dynamic libraries

Return value: BM_SUCCESS indicates success; Other error codes represent failure

5.12.4 bmcpu_exec_function

Function prototype: int bmcpu_exec_function(bm_handle_t handle, int process_handle, char *function_name, void *function_param, unsigned int param_size, int timeout);

Function: Executes the specified function in the A53 process.

Parameter introduction:

Parameter	Input/output	Description
handle	input	Device handle
process_handle	input	Process handle on A53
function_name	input	Name of the function to be executed
function_param	input	Address of the function entry to be executed
param_size	input	Size of function inputs to be executed
timeout	input	A53 Timeout time for executing functions

Return value : 0 means success; greater than 0 means bmlib failed, less than 0 means function execution failed

5.12.5 bmcpu_exec_function_ext

Function prototype: int bmcpu_exec_function_ext(bm_handle_t handle, int process_handle, char *function_name, void *function_param, unsigned int param_size, unsigned int opt, int timeout);

Function: Execute the specified function in the A53 process to set whether to refresh the cache.

Parameter introduction:

Parameter	Input/output	Description
handle	input	Device handle
process_handle	input	Process handle on A53
function_name	input	Name of the function to be executed
function_param	input	Address of the function entry to be executed
param_size	input	Size of function inputs to be executed
opt	input	Whether to refresh the cache
timeout	input	A53 Timeout time for executing functions

Return value : 0 means success; greater than 0 means bmlib failed, less than 0 means function execution failed

5.12.6 bmcpu_map_phys_addr

Function prototype: void *bmcpu_map_phys_addr(bm_handle_t handle, int process_handle, void *phys_addr, unsigned int size, int timeout);

Function: Maps the physical address of the device to a virtual address that the A53 can access.

Parameter introduction:

Parameter	Input/output	Description
handle	input	Device handle
process_handle	input	Process handle on A53
phys_addr	input	The virtual address corresponding to the device memory requested on the host side
size	input	Memory size of the application
timeout	input	Timeout time for A53 mapped addresses

Return value: The virtual address the physical address of the device is mapped to, which A53 can access

5.12.7 bmcpu_unmap_phys_addr

Function prototype: bm_status_t bmcpu_unmap_phys_addr(bm_handle_t handle, int process_handle, void *phys_addr, int timeout);

Function: Release the physical address mapped by A53.

Parameter introduction:

Parameter	**Input/output**	**Description**
handle	input	Device handle
process_handle	input	Process handle on A53
phys_addr	input	The virtual address corresponding to the device memory requested on the host side
timeout	input	Timeout time for A53 mapped addresses

Return value: BM_SUCCESS indicates success; Other error codes represent failure

5.12.8 bmcpu_close_process

Function prototype: int bmcpu_close_process(bm_handle_t handle, int process_handle, int timeout);

Function: Close the process running on A53.

Parameter introduction:

Parameter	Input/output	Description
handle	input	Device handle
process_handle	input	Process handle on A53
timeout	input	Timeout time for A53 mapped addresses

Return value: BM_SUCCESS indicates success; Other error codes represent failure

5.12.9 bmcpu_reset_cpu

Function prototype: bm_status_t bmcpu_reset_cpu(bm_handle_t handle);

Function: Shutdown A53.

Parameter introduction:

Parameter	Input/output	Description
handle	input | Device handle	

Return value: BM_SUCCESS indicates success; Other error codes represent failure

CHAPTER 6

Definition of Relevant Data Structure

6.1 bm_status_t

```
typedef enum {
BM_SUCCESS = 0,
BM_ERR_DEVNOTREADY = 1, /* Device not ready yet */
BM_ERR_FAILURE = 2, /* General failure */
BM_ERR_TIMEOUT = 3, /* Timeout */
BM_ERR_PARAM = 4, /* Parameters invalid */
BM_ERR_NOMEM = 5, /* Not enough memory */
BM_ERR_DATA = 6, /* Data error */
BM_ERR_BUSY = 7, /* Busy */
BM_ERR_NOFEATURE = 8, /* Not supported yet */
BM_NOT_SUPPORTED = 9
} bm_status_t;
```

6.2 bm_mem_type_t

```
typedef enum {
BM_MEM_TYPE_DEVICE = 0,
BM_MEM_TYPE_HOST = 1,
BM_MEM_TYPE_SYSTEM = 2,
BM_MEM_TYPE_INT8_DEVICE = 3,
BM_MEM_TYPE_INVALID = 4
} bm_mem_type_t;
```

6.3 bm_mem_flags_t

```
typedef union {
struct {
bm_mem_type_t mem_type : 3;
unsigned int reserved : 29;
} u;
unsigned int rawflags;
} bm_mem_flags_t;
```

6.4 bm_mem_desc_t

```
typedef struct bm_mem_desc {
union {
struct {
unsigned long device_addr;
unsigned int reserved;
int dmabuf_fd;
} device;
struct {
void *system_addr;
unsigned int reserved0;
int reserved1;
} system;
} u;
bm_mem_flags_t flags;
unsigned int size;
} bm_mem_desc_t;
```

6.5 bm_misc_info

```
struct bm_misc_info {
int pcie_soc_mode; /0—pcie; 1—soc/
int ddr_ecc_enable; /0—disable; 1—enable/
unsigned int chipid;
#define BM1682_CHIPID_BIT_MASK (0X1 << 0)
#define BM1684_CHIPID_BIT_MASK (0X1 << 1)
unsigned long chipid_bit_mask;
unsigned int driver_version;
int domain_bdf;
};
```

6.6 bm_profile_t

```
typedef struct bm_profile {
unsigned long cdma_in_time;
unsigned long cdma_in_counter;
unsigned long cdma_out_time;
unsigned long cdma_out_counter;
unsigned long tpu_process_time;
unsigned long sent_api_counter;
unsigned long completed_api_counter;
} bm_profile_t;
```

6.7 bm_heap_stat

```
struct bm_heap_stat {
unsigned int mem_total;
unsigned int mem_avail;
unsigned int mem_used;
}
```

6.8 bm_dev_stat_t

```
typedef struct bm_dev_stat {
int mem_total;
int mem_used;
int tpu_util;
int heap_num;
struct bm_heap_stat heap_stat[4];
} bm_dev_stat_t;
```

6.9 bm_log_level

```
#define BMLIB_LOG_QUIET -8
#define BMLIB_LOG_PANIC 0
#define BMLIB_LOG_FATAL 8
#define BMLIB_LOG_ERROR 16
#define BMLIB_LOG_WARNING 24
#define BMLIB_LOG_INFO 32
#define BMLIB_LOG_VERBOSE 40
#define BMLIB_LOG_DEBUG 48
#define BMLIB_LOG_TRACE 56
```