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Log Management API

API that controls the device log.

- [BS2_GetLog](#): Gets certain amount of logs.
- [BS2_GetFilteredLog](#): Gets filtered logs.
- [BS2_ClearLog](#): Deletes all logs.
- [BS2_StartMonitoringLog](#): Starts Real-time log streaming.
- [BS2_StopMonitoringLog](#): Stops Real-time log streaming.
- [BS2_GetLogBlob](#): Gets certain amount of logs based on the event mask.
- [BS2_GetFilteredLogSinceEventId](#): Gets filtered logs.
- [BS2_GetImageLog](#) : Gets image logs using event ID.
- [BS2_GetLogSmallBlob](#): [+ 2.6.4] Gets certain amount of logs based on the event mask in an efficient way.

Callback Function

```
typedef void (*OnLogReceived)(uint32_t deviceId, BS2Event* log);
```

1. *OnLogReceived*

Callback function that is called when a new log is received.

Structure

BS2Event

```
typedef struct {
    uint32_t id;
    uint32_t dateTime;
    uint32_t deviceId;
    union {
        char userID[BS2_USER_ID_SIZE];
        uint32_t uid;
        uint32_t doorID;
        uint32_t liftID;
        uint32_t zoneID;
        struct {
            uint32_t ioDeviceID;
            uint16_t port;
            int8_t value;
            uint8_t reserved[25];
        };
    };
};
```

```
    struct {
        uint32_t zoneID;
        uint32_t doorID;
        uint32_t ioDeviceID;
        uint16_t port;
        uint8_t reserved[18];
    } alarm;
    struct {
        uint32_t zoneID;
        uint32_t doorID[4];
        uint8_t reserved[12];
    } interlock;
};
union {
    uint16_t code;
    struct {
        uint8_t subCode;
        uint8_t mainCode;
    };
};
uint8_t param;
#ifdef LESS_THAN_SDK_2_6_0
    BS2_BOOL image;           // Deprecated in V2.6.0
#else
    uint8_t image: 1;        // Support image and DST by bit division
    uint8_t isDST: 1;
    uint8_t half: 1;
    uint8_t hour: 4;
    uint8_t negative: 1;
#endif
} BS2Event;
```

1. **id**

Log record ID which automatically increases from 1 when the log is generated.

2. **dateTime**

The time when the log has been generated. It means the seconds past from UTC until the current time.

3. **deviceID**

ID of the device that generated the log.

4. **userID**

User ID related to log. When the value is 0, the log is not relevant to user.

5. **uid**

You can refer to doorID regarding door log, zoneID regarding zone log. If you do not know exactly then you can refer to uid.

Since uid, doorID, liftID, zoneID are declared as union, basically it means information such as

unordered list.

6. doorID

ID of the door that generated the log.

7. liftID

ID of the lift that generated the log.

8. zoneID

ID of the zone that generated the log.

9. ioDeviceID

Door or Input device ID. When the value is 0, the log is not relevant to Door or Input device.

10. port

Port for ioDeviceID.

11. value

Port value for ioDeviceID and means below.

BS2_PORT_VALUE_UNKNOWN : -1

BS2_PORT_VALUE_OPEN : 0

BS2_PORT_VALUE_CLOSED : 1

BS2_PORT_VALUE_SUPERVISED_SHORT : 2

BS2_PORT_VALUE_SUPERVISED_OPEN : 3

12. alarm.zoneID

Zone ID that makes intrusion alarm zone alarms.

13. alarm.doorID

Door ID that makes intrusion alarm zone alarms.

14. interlock.zoneID

Zone ID that makes interlock zone alarms.

15. interlock.doorID

Door ID that makes interlock zone alarms.

16. subCode

Sub code value of log types. Use if the additional information is necessary.

Category	Event code	Value	Description
Verify	BS2_SUB_EVENT_VERIFY_ID_PIN	0x01	ID and PIN verification success
	BS2_SUB_EVENT_VERIFY_ID_FINGER	0x02	ID and fingerprint verification success
	BS2_SUB_EVENT_VERIFY_ID_FINGER_PIN	0x03	ID, fingerprint, and PIN verification success
	BS2_SUB_EVENT_VERIFY_ID_FACE	0x04	ID and face verification success
	BS2_SUB_EVENT_VERIFY_ID_FACE_PIN	0x05	ID, face, and PIN verification success
	BS2_SUB_EVENT_VERIFY_CARD	0x06	Card verification success
	BS2_SUB_EVENT_VERIFY_CARD_PIN	0x07	Card and PIN verification success
	BS2_SUB_EVENT_VERIFY_CARD_FINGER	0x08	Card and fingerprint verification success
	BS2_SUB_EVENT_VERIFY_CARD_FINGER_PIN	0x09	Card, fingerprint, and PIN verification success
	BS2_SUB_EVENT_VERIFY_CARD_FACE	0x0A	Card and face verification success
	BS2_SUB_EVENT_VERIFY_CARD_FACE_PIN	0x0B	Card, PIN, and face verification success
	BS2_SUB_EVENT_VERIFY_AOC	0x0C	AOC card verification success
	BS2_SUB_EVENT_VERIFY_AOC_PIN	0x0D	AOC card and PIN verification success
	BS2_SUB_EVENT_VERIFY_AOC_FINGER	0x0E	AOC card and fingerprint verification success
	BS2_SUB_EVENT_VERIFY_AOC_FINGER_PIN	0x0F	AOC card, fingerprint, PIN verification success
Identify	BS2_SUB_EVENT_IDENTIFY_FINGER	0x01	Fingerprint identification success
	BS2_SUB_EVENT_IDENTIFY_FINGER_PIN	0x02	Fingerprint and PIN identification success
	BS2_SUB_EVENT_IDENTIFY_FACE	0x03	Face identification success
	BS2_SUB_EVENT_IDENTIFY_FACE_PIN	0x04	Face and PIN identification success
Auth	BS2_SUB_EVENT_DUAL_AUTH_FAIL_TIMEOUT	0x01	Dual authentication timeout
	BS2_SUB_EVENT_DUAL_AUTH_FAIL_ACCESS_GROUP	0x02	Attempted the dual authentication with invalid user
Credential	BS2_SUB_EVENT_CREDENTIAL_ID	0x01	Invalid user ID
	BS2_SUB_EVENT_CREDENTIAL_CARD	0x02	Invalid card
	BS2_SUB_EVENT_CREDENTIAL_PIN	0x03	Invalid PIN
	BS2_SUB_EVENT_CREDENTIAL_FINGER	0x04	Invalid fingerprint
	BS2_SUB_EVENT_CREDENTIAL_FACE	0x05	Invalid face
	BS2_SUB_EVENT_CREDENTIAL_AOC_PIN	0x06	Invalid AOC PIN
	BS2_SUB_EVENT_CREDENTIAL_AOC_FINGER	0x07	Invalid AOC fingerprint
Auth	BS2_SUB_EVENT_AUTH_FAIL_INVALID_AUTH_MODE	0x01	Invalid authentication mode
	BS2_SUB_EVENT_AUTH_FAIL_INVALID_CREDENTIAL	0x02	Non-registered authentication method
	BS2_SUB_EVENT_AUTH_FAIL_TIMEOUT	0x03	Authentication timeout

Category	Event code	Value	Description
Access	BS2_SUB_EVENT_ACCESS_DENIED_ACCESS_GROUP	0x01	Access was denied because the user has not been registered for the access group
	BS2_SUB_EVENT_ACCESS_DENIED_DISABLED	0x02	Access was denied because the user is inactive
	BS2_SUB_EVENT_ACCESS_DENIED_EXPIRED	0x03	Access was denied because the user entry period was expired
	BS2_SUB_EVENT_ACCESS_DENIED_ON_BLACKLIST	0x04	Access was denied because the card is on the blacklist
	BS2_SUB_EVENT_ACCESS_DENIED_APB	0x05	Access was denied because the user has violated the anti-passback rule
	BS2_SUB_EVENT_ACCESS_DENIED_TIMED_APB	0x06	Access was denied because the user tried to enter the timed anti-passback zone within the limited time frame
	BS2_SUB_EVENT_ACCESS_DENIED_FORCED_LOCK	0x07	Access was denied because the zone was forced to be locked
APB	BS2_SUB_EVENT_ZONE_HARD_APB	0x01	Hard APB zone
	BS2_SUB_EVENT_ZONE_SOFT_APB	0x02	Soft APB zone

17. mainCode

Main code value of log types.

Category	Event code	Value	Description
Auth	BS2_EVENT_VERIFY_SUCCESS	0x1000	1:1 authentication success
	BS2_EVENT_VERIFY_FAIL	0x1100	1:1 authentication fail
	BS2_EVENT_VERIFY_DURESS	0x1200	1:1 duress authentication success
	BS2_EVENT_IDENTIFY_SUCCESS	0x1300	1:N authentication success
	BS2_EVENT_IDENTIFY_FAIL	0x1400	1:N authentication fail
	BS2_EVENT_IDENTIFY_DURESS	0x1500	1:N duress authentication success
	BS2_EVENT_DUAL_AUTH_SUCCESS	0x1600	Dual authentication success
	BS2_EVENT_DUAL_AUTH_FAIL	0x1700	Dual authentication fail
	BS2_EVENT_AUTH_FAILED	0x1800	Attempted to authenticate with the non-registered credential
	BS2_EVENT_ACCESS_DENIED	0x1900	Invalid user attempted to authenticate or user violated the APB rule
	BS2_EVENT_FAKE_FINGER_DETECTED	0x1A00	Fake fingerprint detection

Category	Event code	Value	Description
User	BS2_EVENT_USER_ENROLL_SUCCESS	0x2000	User enroll success
	BS2_EVENT_USER_ENROLL_FAIL	0x2100	User enroll fail
	BS2_EVENT_USER_UPDATE_SUCCESS	0x2200	User update success
	BS2_EVENT_USER_UPDATE_FAIL	0x2300	User update fail
	BS2_EVENT_USER_DELETE_SUCCESS	0x2400	User delete success
	BS2_EVENT_USER_DELETE_FAIL	0x2500	User delete fail
	BS2_EVENT_USER_DELETE_ALL_SUCCESS	0x2600	Delete all user success
	BS2_EVENT_USER_ISSUE_AOC_SUCCESS	0x2700	Authentication success with access card
	BS2_EVENT_USER_DUPLICATE_CREDENTIAL	0x2800	Duplicated credential(Card/Fingerprint/Face) detection
Device	BS2_EVENT_DEVICE_SYSTEM_RESET	0x3000	System reset
	BS2_EVENT_DEVICE_SYSTEM_STARTED	0x3100	System started
	BS2_EVENT_DEVICE_TIME_SET	0x3200	System time set
	BS2_EVENT_DEVICE_TIMEZONE_SET	0x3201	Time zone chagned
	BS2_EVENT_DEVICE_DST_SET	0x3202	DST setting changed
	BS2_EVENT_DEVICE_LINK_CONNECTED	0x3300	LAN cable connected
	BS2_EVENT_DEVICE_LINK_DISCONNECTED	0x3400	LAN cable disconnected
	BS2_EVENT_DEVICE_DHCP_SUCCESS	0x3500	IP address allocated by DHCP
	BS2_EVENT_DEVICE_ADMIN_MENU	0x3600	Open administrator menu
	BS2_EVENT_DEVICE_UI_LOCKED	0x3700	Screen locked
	BS2_EVENT_DEVICE_UI_UNLOCKED	0x3800	Screen unlocked
	BS2_EVENT_DEVICE_COMM_LOCKED	0x3900	RS485 communication locked
	BS2_EVENT_DEVICE_COMM_UNLOCKED	0x3A00	RS485 communication unlocked
	BS2_EVENT_DEVICE_TCP_CONNECTED	0x3B00	TCP connected
	BS2_EVENT_DEVICE_TCP_DISCONNECTED	0x3C00	TCP disconnected
	BS2_EVENT_DEVICE_RS485_CONNECTED	0x3D00	RS485 connected
	BS2_EVENT_DEVICE_RS485_DISCONNECTED	0x3E00	RS485 disconnected
	BS2_EVENT_DEVICE_INPUT_DETECTED	0x3F00	Input device detected
	BS2_EVENT_DEVICE_TAMPER_ON	0x4000	Device or peripheral was removed
	BS2_EVENT_DEVICE_TAMPER_OFF	0x4100	Device or peripheral was reconnected
	BS2_EVENT_DEVICE_EVENT_LOG_CLEARED	0x4200	Log was deleted
	BS2_EVENT_DEVICE_FIRMWARE_UPGRADED	0x4300	Firmware was updated
	BS2_EVENT_DEVICE_RESOURCE_UPGRADED	0x4400	Resource was updated
BS2_EVENT_DEVICE_CONFIG_RESET	0x4500	System information was initialized(including network)	
BS2_EVENT_DEVICE_DATABASE_RESET	0x4501	Database was initialized	
BS2_EVENT_DEVICE_FACTORY_RESET	0x4502	Factory default	
BS2_EVENT_DEVICE_CONFIG_RESET_EX	0x4503	System information was initialized(without network)	
Supervised Input	BS2_EVENT_SUPERVISED_INPUT_SHORT	0x4600	Supervised Input (Short circuit detection)
	BS2_EVENT_SUPERVISED_INPUT_OPEN	0x4700	Supervised Input (Disconnection detection)
Device-Ex	BS2_EVENT_DEVICE_AC_FAIL	0x4800	AC Power failed
	BS2_EVENT_DEVICE_AC_SUCCESS	0x4900	AC Power succeeded

Category	Event code	Value	Description
Door	BS2_EVENT_DOOR_UNLOCKED	0x5000	Door unlocked
	BS2_EVENT_DOOR_LOCKED	0x5100	Door locked
	BS2_EVENT_DOOR_OPENED	0x5200	Door opened
	BS2_EVENT_DOOR_CLOSED	0x5300	Door closed
	BS2_EVENT_DOOR_FORCED_OPEN	0x5400	Door forced open
	BS2_EVENT_DOOR_HELD_OPEN	0x5500	Door held open
	BS2_EVENT_DOOR_FORCED_OPEN_ALARM	0x5600	Door-forced-to-open alarm has started
	BS2_EVENT_DOOR_FORCED_OPEN_ALARM_CLEAR	0x5700	Door-forced-to-open alarm was released
	BS2_EVENT_DOOR_HELD_OPEN_ALARM	0x5800	Door-held-open alarm has started
	BS2_EVENT_DOOR_HELD_OPEN_ALARM_CLEAR	0x5900	Door-held-open alarm was released
	BS2_EVENT_DOOR_APB_ALARM	0x5A00	Door-level anti-passback alarm has started
	BS2_EVENT_DOOR_APB_ALARM_CLEAR	0x5B00	Door-level anti-passback alarm was released
Zone	BS2_EVENT_ZONE_APB_VIOLATION	0x6000	Zone-level anti-passback rule has been violated
	BS2_EVENT_ZONE_APB_ALARM	0x6100	Zone-level anti-passback alarm has started
	BS2_EVENT_ZONE_APB_ALARM_CLEAR	0x6200	Zone-level anti-passback alarm was released
	BS2_EVENT_ZONE_TIMED_APB_VIOLATION	0x6300	Timed anti-passback rule has been violated
	BS2_EVENT_ZONE_TIMED_APB_ALARM	0x6400	Timed anti-passback alarm has started
	BS2_EVENT_ZONE_TIMED_APB_ALARM_CLEAR	0x6500	Timed anti-passback alarm was released
	BS2_EVENT_ZONE_FIRE_ALARM_INPUT	0x6600	Fire alarm input was detected
	BS2_EVENT_ZONE_FIRE_ALARM	0x6700	Fire alarm has started
	BS2_EVENT_ZONE_FIRE_ALARM_CLEAR	0x6800	Fire alarm was released
	BS2_EVENT_ZONE_FORCED_LOCK_START	0x6900	Door-forced-locked schedule has started
	BS2_EVENT_ZONE_FORCED_LOCK_END	0x6A00	Door-forced-locked schedule has ended
	BS2_EVENT_ZONE_FORCED_UNLOCK_START	0x6B00	Door-forced-unlocked schedule has started
	BS2_EVENT_ZONE_FORCED_UNLOCK_END	0x6C00	Door-forced-unlocked schedule has ended
	BS2_EVENT_ZONE_SCHEDULED_UNLOCK_END	0x6D00	Scheduled unlock ended
	BS2_EVENT_ZONE_SCHEDULED_LOCK_ALARM	0x6E00	Scheduled lock alarm zone start
BS2_EVENT_ZONE_SCHEDULED_LOCK_ALARM_CLEAR	0x6F00	Scheduled lock alarm zone clear	

18. param

It is used only when extra information on the device is needed. Usually, a time and attendance code, a port number of the door or input device is stored in the *param* argument. When a time and attendance code is stored, refer to the following values:

Device Type	T&A Code	Mapped Key	Value
BioStation 2	BS2_TNA_UNSPECIFIED	(N/A)	0
	BS2_TNA_KEY_1	F1	1
	BS2_TNA_KEY_2	F2	2
	BS2_TNA_KEY_3	F3	3
	BS2_TNA_KEY_4	F4	4
	BS2_TNA_KEY_5	1	5
	BS2_TNA_KEY_6	2	6
	BS2_TNA_KEY_7	3	7
	BS2_TNA_KEY_8	4	8
	BS2_TNA_KEY_9	5	9
	BS2_TNA_KEY_10	6	10
	BS2_TNA_KEY_11	7	11
	BS2_TNA_KEY_12	8	12
	BS2_TNA_KEY_13	9	13
	BS2_TNA_KEY_14	Call	14
	BS2_TNA_KEY_15	0	15
BS2_TNA_KEY_16	Esc	16	

[+ 2.6.3] Additional feature of param

Only if the event code is relevant to the user.

If you add, modify or delete users directly from the device, param is 1, 0 if done through BioStar.

For example, if param was 1 with the event BS2_EVENT_USER_ENROLL_SUCCESS, it means the user was added directly on the device.

This feature is supported from the firmware version below.

Device Type	Supported Ver.
BioStation 2	V1.7.0
BioStation A2	V1.6.0
CoreStation 40	V1.2.0
BioEntry P2	V1.2.0
BioStation L2	V1.4.0
BioLite N2	V1.1.0
BioEntry W2	V1.3.0
FaceStation 2	V1.2.0

19. image

Prior to SDK V2.6.0, it used the whole 1 byte and means below:

- Whether the image was included when the event occurred (true / false).

Since SDK V2.6.0, 1 byte has been changed to provide the following information by bit unit.

- Whether or not image is included. - Whether DST is applied

Category	Bit	Parameter	Description
Prior to SDK 2.6.0	8	image	Used in case image is included when an event occurs.

Category	Bit	Parameter	Description
Since SDK 2.6.0	1	image	Used in case image is included when an event occurs.
	1	isDST	Whether the current log has been applied to DST
	1	half	Whether DST is covered in 30-minute increments. 0 is 0 minutes, 1 is 30 minutes.
	4	hour	Time. 1 to 12 o'clock
	1	negative	0 is +, 1 is -

BS2EventBlob

```
typedef struct {
    uint16_t eventMask;
    uint32_t id;
    BS2EventExtInfo info;
    union
    {
        BS2_USER_ID userID; // valid if eventMask has
        BS2_EVENT_MASK_USER_ID
        uint8_t cardID[BS2_CARD_DATA_SIZE]; // valid if eventMask has
        BS2_EVENT_MASK_CARD_ID
        BS2_D00R_ID doorID; // valid if eventMask has
        BS2_EVENT_MASK_DOOR_ID
        BS2_ZONE_ID zoneID; // valid if eventMask has
        BS2_EVENT_MASK_ZONE_ID
        BS2EventExtIoDevice ioDevice; // valid if eventMask has
        BS2_EVENT_MASK_IODEVICE
    };
    uint8_t tnaKey;
    uint32_t jobCode;
    uint16_t imageSize;
    uint8_t image[BS2_EVENT_MAX_IMAGE_SIZE];
    uint8_t reserved;
} BS2EventBlob;
```

1. eventMask

Event mask value. Logs will be retrieved based on the mask value such as user, card, door, or zone.

Value	Description
0	None
1	BS2EventExtInfo structure
2	User ID
4	Card ID
8	Door ID
16	Zone ID
32	BS2EventExtIoDevice structure
64	Door ID

Value	Description
128	Zone ID
256	TNA Key
512	Job Code
1024	Image
65535	ALL

2. *id*

Log record ID which automatically increases from 1 when the log is generated.

3. *info*

BS2EventExtInfo structure information.

4. *userID*

User ID related to log. When the value is 0, the log is not relevant to user.

5. *cardID*

Card ID related to log. When the value is 0, the log is not relevant to card.

The device records card ID only for failure auth, it returns user ID when successful auth regardless of eventMask value.

6. *doorID*

Door ID related to log. When the value is 0, the log is not relevant to door.

7. *zoneID*

Zone ID related to log. When the value is 0, the log is not relevant to zone.

8. *ioDevice*

Door or input device ID related to log. When the value is 0, the log is not relevant to door or input. Refer to BS2EventExtIoDevice structure.

9. *tnaKey*

The T&A key that has been used for the authentication. When the value is 0, the log is not relevant to T&A key.

10. *jobCode*

The job code that has been used for the authentication. When the value is 0, the log is not relevant to job code.

11. *imageSize*

Size of the image when there is an image log.

12. *image*

Data of the image.

13. *reserved*

Reserved space.

BS2EventExtInfo

```
typedef struct {
    uint32_t dateTime;
    uint32_t deviceID;
    union {                                     ///< 2 bytes
        BS2_EVENT_CODE code;
        struct {
            uint8_t subCode;
            uint8_t mainCode;
        };
    };
    uint8_t reserved[2];
} BS2EventExtInfo;
```

1. *dateTime*

The time when the log has been generated. It means the seconds past from UTC until the current time.

2. *deviceID*

ID of the device that generated the log.

3. *subCode*

Sub code value of log types. Use if the additional information is necessary.

4. *mainCode*

Main code value of log types.

5. *reserved*

Reserved space.

BS2EventExtIoDevice

```
typedef struct {
    uint32_t ioDeviceID;
    uint16_t port;
    uint8_t value;
    uint8_t reserved[1];
} BS2EventExtInfo;
```

1. *ioDeviceID*

Door or input device ID related to log. When the value is 0, the log is not relevant to door or input.

2. *port*

Input port number.

3. *value*

Status of the input port.

Value	Description
-1	Unknown
0	Open
1	Closed
2	Supervised Short
3	Supervised Open

4. *reserved*

Reserved space.

BS2EventSmallBlob

```
typedef struct {
    uint16_t eventMask;
    uint32_t id;
    BS2EventExtInfo info;
    union
    {
        BS2_USER_ID userID; // valid if eventMask has
        BS2_EVENT_MASK_USER_ID
        uint8_t cardID[BS2_CARD_DATA_SIZE]; // valid if eventMask has
        BS2_EVENT_MASK_CARD_ID
        BS2_D00R_ID doorID; // valid if eventMask has
        BS2_EVENT_MASK_DOOR_ID
        BS2_ZONE_ID zoneID; // valid if eventMask has
        BS2_EVENT_MASK_ZONE_ID
        BS2EventExtIoDevice ioDevice; // valid if eventMask has
        BS2_EVENT_MASK_IODEVICE
    };
    uint8_t tnaKey;
    uint32_t jobCode;
    uint16_t imageSize;
    uint8_t* imageObj; // valid if eventMask has
    BS2_EVENT_MASK_IMAGE
    uint8_t reserved;
} BS2EventSmallBlob;
```

1. *eventMask*

Event mask value. Logs will be retrieved based on the mask value such as user, card, door, or zone.

Value	Description
0	None
1	BS2EventExtInfo structure
2	User ID
4	Card ID
8	Door ID
16	Zone ID
32	BS2EventExtIoDevice structure
64	Door ID
128	Zone ID
256	TNA Key
512	Job Code
1024	Image
65535	ALL

2. *id*

Log record ID which automatically increases from 1 when the log is generated.

3. *info*

BS2EventExtInfo structure information.

4. *userID*

User ID related to log. When the value is 0, the log is not relevant to user.

5. *cardID*

Card ID related to log. When the value is 0, the log is not relevant to card.

The device records card ID only for failure auth, it returns user ID when successful auth regardless of eventMask value.

6. *doorID*

Door ID related to log. When the value is 0, the log is not relevant to door.

7. *zoneID*

Zone ID related to log. When the value is 0, the log is not relevant to zone.

8. *ioDevice*

Door or input device ID related to log. When the value is 0, the log is not relevant to door or input. Refer to BS2EventExtIoDevice structure.

9. *tnaKey*

The T&A key that has been used for the authentication. When the value is 0, the log is not relevant to T&A key.

10. *jobCode*

The job code that has been used for the authentication. When the value is 0, the log is not relevant to job code.

11. *imageSize*

Size of the image when there is an image log.

12. *imageObj*

Data of the image.

13. *reserved*

Reserved space.

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