TWL-SDK

DS Download Play User Guide

Version 1.0.8

The content of this document is highly confidential and should be handled accordingly.

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Revision History

Version	Revision Date	Description
1.0.8	2009/02/19	• Revised text in section 1.2 (text regarding mb_child for each debugger environment). • Deleted text (mb_child_simple.srl).
1.0.7	2009/01/13	• Added section 1.8 Support for Pseudo-Download Play Child Devices. • Added Chapter 6 Description of the fake_child Sample Program.
1.0.6	2008/09/16	• Changed descriptions for TWL-SDK. • Added section 1.7 Supported ROM.
1.0.5	2007/09/27	• To section 2.1.1.4, added supplementary information on icon image creation.
1.0.4	2006/05/16	Revised descriptions of sample code in section 4.1.
1.0.3	2005/03/06	• Corrected text in section 2.3.3 by deleting parts about the `NITRO_COMPRESS` switch specification. • Added section 2.3.4: described symptoms and fixes for DS Download Play bugs.
1.0.2	2005/08/08	• In section 4.1.1, updated changes to numbering for code reference. Moved number 4 to the following line and moved comment to the next line. • No change needed in 2.1.1.1; terminology was already correct.
1.0.1	2005/03/11	• Unified format for describing NITRO-SDK install destination (1). • Deleted text overlaps with following item (1.3). • Changed item names (because of use with `libsyscall.a`) (1.4). Corrected text (Supplement related to previous item). • Corrected text (clearly indicated that startup is same as from Card) (1.5). • Corrected terminology (AID) (2). • Corrected `MB_StartParentFromId` and `MB_EndToIdle` function names (2.1). • Corrected GGID and TGID terminology (2.1.1.2). • Revised description of the maximum number of connected children (2.1.1.3). • Corrected item format (2.1.1.4). Revised text (Supplemented with part about relationship between maximum number of connected children and number of players). Corrected text relating to names for libraries and sample modules. Deleted text (old restrictions relating to segment data). • Added text (Supplemented with part about distinguishing multiple communication modes) (2.3.1). • Added text (Supplemented with part relating to build switches) (2.3.3). • Corrected figure and supplemented text about parent-only region (3.1). • Corrected text (Supplemented with reason for data placement) (3.2.1). • Corrected text (Corrected `mb_parent.h` to be `mbp`) (4). Corrected text (To reflect the latest selection of sample code). • Added text (Supplemented with part about changes to procedure when using `MB_StartParentFromIdle` function (4.1). • Added the section for the `cloneboot` sample program (5).
1.0.0	2004/10/29	• Initial version.

1 Introduction

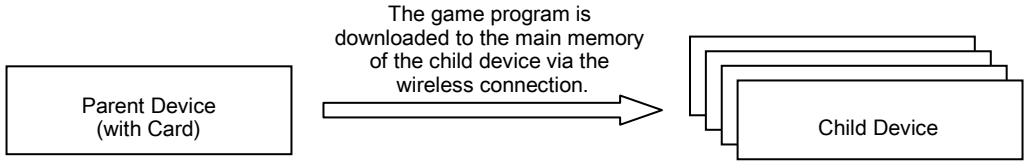
The TWL-SDK includes a series of APIs for use with the DS Download Play feature. This document describes how to use basic DS Download Play features. (In this document, `$TwlSDK` represents the directory in which TWL-SDK has been installed.)

1.1 Overview

Nintendo DS (DS) has DS Download Play capability that allows binary code to be transferred from a DS Download Play *parent* device to a DS Download Play *child* device and enables the child device to boot up without a Game Card.

In developer documentation and SDK source code files, DS Download Play is also referred to as "Wireless Multiboot." This feature can be used to download up to 2.5 MB of binary code from a parent device to the main memory of a child device, so that the child device can be booted up.

Figure 1-1 DS Download Play Schematic



1.2 DS Download Play Startup Procedure

To start a game using the DS Download Play feature, players should do the following.

1. Start the DS Download Play parent device.
2. Select DS Download Play from the Start menu on the child device and select the parent program to be downloaded.

To prevent the execution of illegal code by the IPL, binary code without an attached authentication code will not execute. For a child device to start from DS Download Play, an authentication code must be attached to the binary code being transmitted. For efficient development, the TWL-SDK includes `mb_child`; this allows the binary code to be run without an authentication code. Use `mb_child_***.srl`, included with the TWL-SDK, and follow the procedure below. Use `mb_child` in the same way even when executing under a debugging environment.

1. The following is a list of three pre-built programs stored in the TWL-SDK. Write any one of these programs into the NITRO Flash Card. (If using the debugger, load the binary code for `mb_child_***.srl` according to the type of debugger.)

```
$TwlSDK/bin/ARM9-TS/Rom/mb_child_NITRO.srl
$TwlSDK/bin/ARM9-TS/Rom/mb_child_TWL.srl
```

   For more information about `mb_child_NITRO.srl` and `mb_child_TWL.srl`, see the “Pre-Built Programs" section in the *TWL SDK Function Reference Manual*.

2. Start the DS Download Play parent device.
3. Start one of `mb_child` as the DS Download Play child device and select the parent program to be downloaded.

To start the game device, an authentication code must be attached to the binary sent to the child. For more information, see section 1.3 Attaching Authentication Code.

1.3 Attaching Authentication Code

With the DS, to prevent the execution of invalid binary code transmitted wirelessly, an authentication code must be attached to binary code that runs on the child.

Note: If an attempt is made to execute binary code that does not have an authentication code, the game device will stop midway through booting (approximately when the Nintendo logo fades from screen).

Use the following procedure to attach an authentication code to the binary code to be transmitted.

1. Create the binary code to be sent to the child.
2. Send this binary code to the Nintendo authentication server at Nintendo at https://www.warioworld.com/nitro/digitalsignatures/ to obtain an authentication code, which is also known as a digital signature.
3. Attach the authentication code to the original binary code using `$TwlSDK/tools/bin/attachsign.exe`.
4. Use the DS Download Play parent device to link the binary code obtained in step 3 and transmit it to the child device.

You can use this procedure to send code that runs on the parent game device to children. For more information on obtaining an authentication code, please contact support@noa.com.

1.4 Using the System Call Library and ROM Header

When creating the production version of ROM, use the System Call library (`libsyscall.a`) and the ROM headers (`rom_header_****.template.sbin`) provided by Nintendo. However, the binary file for child devices differs from that for parent devices; in this case, it is necessary to use the System Call library and the ROM headers included in the TWL-SDK.

1.5 Transferable Binary Code Size

The same size restriction that applies to startup from a card applies to binary code for DS Download Play. The maximum transferable size for resident code is 2.5 MB for the ARM9 and 256 KB for the ARM7. As with startup from a card, if data has been compressed with the `compstatic` tool, the size restriction applies to the compressed, not uncompressed, data.

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To send binary code that exceeds this size restriction, start the child in DS Download Play mode, then download the necessary additional binary code from the parent. However, due to security considerations related to transferring executable code, be sure to follow the guidelines.

1.6 Accessing Backup Regions in Game Cards and Game Paks

Technically, the backup region of a Game Card or Game Pak plugged into the parent device can be accessed from a child device started with DS Download Play. However, restrictions exist; follow the *Nintendo DS Programming Guidelines*.

1.7 Supported ROM

Only NITRO ROM can start as a DS Download Play child. HYBRID ROM and LIMITED ROM cannot boot. For a DS Download Play parent, all ROM and all start modes can be used.

1.8 Support for Pseudo-Download Play Child Devices

When using DS Download Play for wireless multiplayer matches, it is convenient if players who started the game from a Card and players who started the game from DS Download Play can be handled identically by the parent device. To offer this capability, the SDK supports pseudo-Download Play child devices.

When a child device running from a Card uses this feature to connect to a parent device in essentially the same manner as a normal wireless play child device, it is processed on the parent side as if a DS Download Play child has entered. These characteristics of the feature make it easy to manage a mixed session filled with both types of players.

A sample program for pseudo-download play child devices is included in Chapter 6 Description of the fake_child Sample Program.

2 DS Download Play Operations

This section describes the procedures and connection sequence for creating a DS Download Play parent.

The DS Download Play processes can be implemented using the DS Download Play (MB) library stored in the TWL-SDK. The MB library functions by using the Wireless Manager (WM) library internally, but other WM features cannot be used at the same time under current conditions.

2.1 Process Flow on the Parent Side

This section describes the preparations made on the parent side before DS Download Play starts. The parent prepares to send binary code according to the following procedure.

1. Select a communication channel.
2. Set the parent's parameters.
3. Start the parent device communication process.
4. Register the child binary information.
5. Receive a request from the child.
6. Send the binary and boot the child.

Once the child's binary information is registered in step 4, the parent begins disseminating information automatically and enters a child-receptive state.

2.1.1 Preparations By the Parent

2.1.1.1 Selecting Wireless Communication Channel

The following method is recommended for choosing the type of wireless communications channel.

1. Use the `WM_GetAllowedChannel` function to get usable channels.
2. Use the `WM_MeasureChannel` function to check the signal traffic level on each channel.
3. Select the channel with the most available bandwidth.

At this time, however, you cannot use the `WM_MeasureChannel` function after starting the MB library. When the MB library is used, the `MB_StartParent` function automatically moves the MB library module from the READY state to PARENT state, but the `WM_MeasureChannel` function can only execute when the WM library is in the IDLE state. Thus, before checking the signal traffic level of channels, use the `WM_Initialize` function to put the WM library module into the IDLE state.

After the communication channel has been selected, there are two ways to start DS Download Play:

- Terminate the WM library with the `WM_End` function, then start DS Download Play.
- Enter the IDLE state using the `MB_StartParentFromIdle` function, then start DS Download Play.

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When the MB_StartParentFromIdle function is used, the work buffer size passed to the MB_Init function may be set as small as WM_SYSTEM_BUF_SIZE bytes, as long as the WM_Initialize function is called separately. Be sure to call the MB_StartParentFromIdle and MB_EndToIdle functions and the MB_StartParent and MB_End functions in pairs.

2.1.1.2 Setting Parent's Parameters

When starting the DS Download Play parent device, the GGID and TGID must be set up just as with a normal wireless communication. The following player information on the parent device, such as the nickname to be displayed on IPL child screen during DS Download Play, must also be set.

- Player Nickname

  Maximum of 10 characters of UTF16-LE. The same format is used as with nicknames obtained with the OS_GetOwnerInfo function.

- Favorite Color

  Color-set number representing the player's favorite colors. This makes use of the same color set as favoriteColor obtained with the OS_GetOwnerInfo function. For more information, see the OS_GetFavoriteColorTable function reference.

- Player Number

  The player number for the parent is always 0.

2.1.1.3 Configuring Maximum Number of Children

The MB library drives wireless communications using the WM library; the assumption is that the default maximum number of devices is 16 (1 parent and 15 children). As a result, if a distributed program is configured for play by less than 16 devices, it may not be possible to achieve the transfer efficiency usually available, and a situation may develop in which the number of connection requests from children exceeds the maximum number of players.

If you already know the number of programs distributed from the parent and the maximum number of players allowed by them, you can use the MB_SetParentCommParam function to set the number of child devices that will be allowed to make connections. The maximum AID value for the children to be connected is set using the maxChildren argument of this function. The sendSize argument can be used in conjunction with the maxChildren argument for freely setting the send buffer size to be used for wireless communication within a predetermined time. The size of this buffer ranges from MB_COMM_PARENT_SEND_MIN to MB_COMM_PARENT_SEND_MAX.

2.1.1.4 Registering Child Binary Information

When registering the binary that will be sent to the child, set the following information:

- Pointer to the Distribution Binary Code Data

  When a child starts, only the binary code allocated in the ROM specification file as an ARM9 or ARM7 resident module is transferred. The code for starting the child can be extracted from the binary code using the MB_ReadSegment function. For more information about configuring resident

modules (hereafter referred to as Static segments), see the separate reference document for `makerom`.

All other binary data must be transferred from the parent to children after booting using wireless communications. The WBT library is provided in the SDK as a data transfer protocol, and it can be used as needed by applications. A sample program that uses the WBT library through wireless communications to rebuild a child device's own file system has been prepared as a module in the `$TwlSDK/build/demos/wireless_shared/wfs` directory.

- Game Name

  A maximum of 48 characters of UTF16-LE. During the IPL display, the string must fit on one 185-dot long line.

- Game Description

  A maximum of 96 characters of UTF16-LE. During the IPL display, the string must fit on two 199-dot long lines.

- Palette and Image Data for Icons Used to Display Downloaded Games on the IPL.

  This is 16-color palette data and 32 dot x 32 dot image data. The format is identical to that of banner images in ordinary programs. You can use `$TwlSDK/tools/bin/ntexconv.exe` to create data. For applications of the `ntexconv.exe` tool, refer to `$TwlSDK/man/tools/ntexconv.html`.

- GGID

  The Game Group ID for notifying children after booting up. The GGID set here is reflected in the `ggid` member of the structure that the child can obtain from the `MB_GetMultiBootParentBssDesc` function after booting up. The GGID can be used for reconnecting after booting up.

- Maximum Number of Players

  Specifies the maximum number of players (including the parent) displayed on the child's IPL screen. The total number of players, including the parent, is not the same as the maximum number of children, so be careful not to confuse this with the `maxChildren` argument of the `MB_SetParentCommParam` function. (If both functions are called with the same setting for the number of players, the maximum number of players is equal to `maxChildren` + 1.) Also note that this value is only meant for display on the child's IPL screen. The actual number of children that connect may be less than the value set in the `maxChildren` argument of the `MB_SetParentCommParam` function.

With the MB library, it is necessary to register the child binary using the `MB_RegisterFile` function after starting the parent process with the `MB_StartParent` function. Up to 16 different child binaries can be registered by a single parent when the MB library is used. The DS Download Play menu screen of the child shows various games being delivered.

2.1.2 Sending Data and Starting Children

Once preparations for delivering binary code are complete, the parent waits for request from a child. For each child, it performs processes in the order Entry → Download → Boot.

In addition to notification of the child device state through the callback function set with the `MB_CommSetParentStateCallback` function, the child device state can also be obtained using the `MB_CommGetParentState` (child AID) function.

Figure 2-1 Data Reception State Transitions and Parent Requests Used with DS Download Play Children

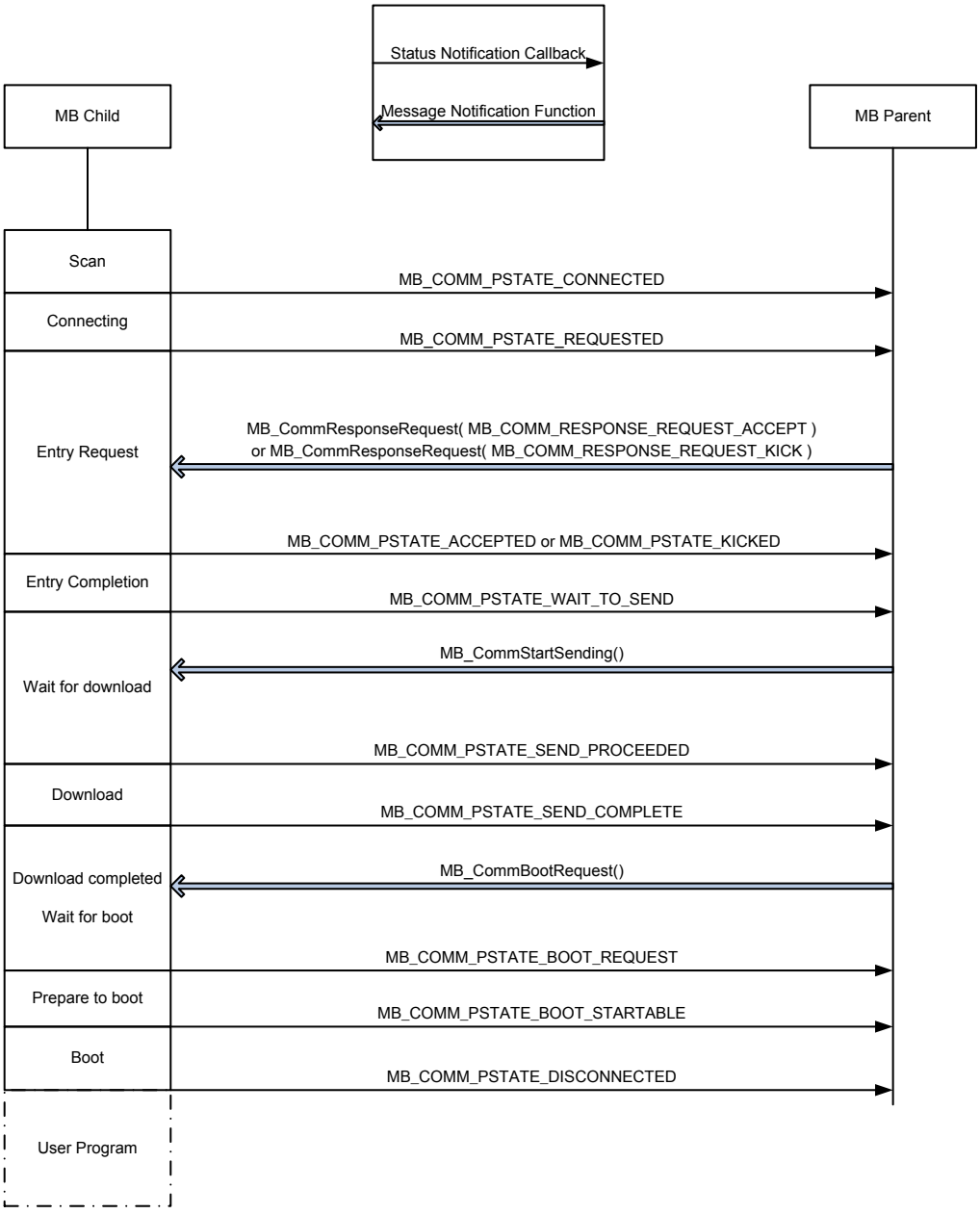


Figure 2-1 depicts the child states and the flow of requests from the parent. A callback is generated on the parent side every time the child changes states. Be sure to issue the appropriate command for each state from the parent side based on the state change notification made by this callback or the state obtained by the `MB_CommGetParentState` function.

The connection sequence flow between parent and child devices is shown below.

1. Connect

   When the IPL DS Download Play child program connects to the parent, the state changes to `MB_COMM_PSTATE_CONNECTED`. The child's MAC address can be obtained with this callback.

2. Entry

   When there is an entry request from a child to the parent device, notification of the `MB_COMM_PSTATE_REQUESTED` state is sent. The child device then waits for either the `MB_COMM_RESPONSE_REQUEST_ACCEPT` or `MB_COMM_RESPONSE_REQUEST_KICK` message to arrive from the parent device. If `MB_COMM_RESPONSE_REQUEST_ACCEPT` is sent, entry processing is performed and preparations for downloading data are made.

3. Download

   When the child completes preparations for downloading data, the parent is notified that the state has changed to `MB_COMM_PSTATE_WAIT_TO_SEND`. Once the child is in this state, the parent can begin sending data for the first time. Be careful not to start transmitting data when the state is `MB_COMM_PSTATE_ACCEPTED`. When data transmissions end, the child sends notification that the state is `MB_COMM_PSTATE_SEND_COMPLETE` and waits in this state until there is a boot request.

4. Boot

   If the child is in the `MB_COMM_PSTATE_SEND_COMPLETE` state, it enters the boot process when the parent issues the `MB_CommBootRequest` command. Once the parent is notified that the state is `MB_BOOT_STARTABLE`, the child-parent communications are completely severed.

2.2 Reconnecting with Parent

Because communications between the child and parent are severed once the child boots for DS Download Play, the connection must be reestablished from the beginning.

Note the following when reestablishing a connection.

- The child's boot timing

  Because MB communication cannot occur at the same time as other WM communication under the current MB library, the parent device must terminate communication using the `MB_End` function after the child device boots up. (If the `MB_StartParentFromIdle` function was used for starting, the `MB_EndToIdle` function is used to return to the IDLE state.) To reconnect and start communication between the parent device and child devices after booting for DS Download Play, measures such as adjusting the timing of boot requests sent from parent to child are necessary.

- Connection process using parent information

  The child can obtain parent information before booting by using the `ReadMultiBootParentBssDesc` function. Direct connection to the parent is possible based on the `WMBssDesc` obtained this way, but the connection cannot be made if the parent's GGID and TGID differ from the GGID and TGID expected by the child device. Furthermore, if the maximum size or the `KS` and `CS` flags differ, communications may not be stable after the connection is established; thus, be sure to prepare the application side ahead of time. You can prevent differences in communication settings between the parent and child by specifying the MAC address (`bssid`) found in `WMBssDesc` and rescanning for the parent.

- Handling TGIDs

  When the parent's wireless function is restarted, we recommend changing the parent device TGID to prevent a child device from the following.
  - Mistakenly attempting to re-connect to a parent device before that parent's wireless function has been restarted.
  - Connecting from an unrelated IPL child device after the parent's wireless function is restarted.

  However, the TGIDs between parent and child must be synchronized when connecting without rescanning by the child. Thus, be sure to set the TGID for parent and child using a method such as incrementing the shared TGID by a fixed value.

- Parent multiboot flag

  Multiboot flag information is included in the parent information passed as an argument of the `WM_SetParentParameter` function. However, do not set this flag under normal circumstances; the multiboot flag does not need to be set even when restarting the parent's wireless function and reconnecting after booting for DS Download Play.

2.3 Other Precautions

2.3.1 Applications with Multiple Communication Modes

If an application has multiple communication modes for both Multi-Card and DS Download Play (such as battle mode for Multi-Card Play and DS Download Play mode for one card), problems may arise because the parent can be viewed from different communication modes.

If a child detects multiple communication modes, include ID information in `userGameInfo` set by the parent and have the child reference this ID during scanning. However, `userGameInfo` cannot be used with the MB library; thus, to check if the MB library is being used, be sure to reference the `WM_ATTR_FLAG_MB` flag of `WMBssDesc.gameInfo.gameNameCount_attribute`.

This can also be handled by obtaining multiple GGIDs and distinguishing different communication modes based on the GGID.

2.3.2 About IRQ Stack

All callback functions operate in IRQ mode during wireless communication. When the processing internal to a callback consumes a large amount of stack, the safe thing to do is to set the IRQ stack to a slightly larger size in the `lcf` file.

Used particularly during debugging, the `OS_Printf` function consumes a large amount of stack. Thus, whenever possible, be sure to use the `OS_TPrintf` lite version of the function inside callbacks.

2.3.3 About Overlay of the DS Download Play Child Device Program

When a program running on a DS Download Play child device uses the overlay feature, the overlay table and overlay segments to be included in the child's binary must be received separately from the parent device. To ensure integrity of the received data, the following points must be observed at this time.

- Specifying the `NITRO_DIGEST` build switch

  The build switch `NITRO_DIGEST` must be specified in the build of the DS Download Play child program. This is required so that the TWL-SDK can accurately confirm that the overlay table and individual overlay segments correctly match those of the child. If the overlay feature is used without specifying these build switches, the program will be forced to halt on execution.

  Specifying this build switch is equivalent to calling the `compstatic.exe` tool with the `-a` option. Note that this build switch is only necessary for applications and is ignored in SDK builds.

- Using the FS library functions

  To guarantee that the TWL-SDK has correctly checked the integrity of data, in addition to the above build switch specifications, you must also use the FS library functions given below for overlay operations.

  Function always used
  - `FS_AttachOverlayTable`

  Function used only for synchronous loading
  - `FS_LoadOverlay`

  Functions used only for asynchronous loading
  - `FS_LoadOverlayInfo`
  - `FS_LoadOverlayImage` or `FS_LoadOverlayImageAsync`
  - `FS_StartOverlay`

2.3.4 About DS Download Play Bugs

There are a number of bugs with the DS Download Play features on the IPL. Below is a collection of symptoms and, where possible, workarounds.

2.3.4.1 DS Download Play Bug #1

Symptom

If DS Download Play child "B" begins downloading while DS Download Play child "A" is still booting after completing its download, child "B" may freeze. (Frequency of occurrence: low.)

Workaround

You can reduce the frequency of this occurrence by performing the following process in the game application. (This problem cannot be fixed completely.)

1. Install TWL-SDK2.0RC2 or a later version of the SDK.
2. When a child is kicked because it has sent a download request when download is not permitted, use the `MB_DisconnectChild` function to cancel the connection from the child side.

This workaround is implemented in the demo program `$TwlSDK/build/demos/mb/multiboot-Model`.

2.3.4.2 DS Download Play Bug #2

Symptom

If the DS Download Play child has completed downloading, but its connection is cancelled while the parent is sending the boot process, the child may freeze. (Frequency of occurrence: low.)

Workaround

There is no effective workaround to this problem for the game application.

2.3.4.3 DS Download Play Bug #3

Symptom

When the game banners for parents "A" and "B" are both displayed in the Download List of the DS Download Play child, the game from the unselected parent gets downloaded when the series of events shown below occurs. (Frequency of occurrence: every time.)

1. Child selects parent "A".
2. Child advances to the screen that prompts for confirmation to download the software.
3. Parent "A" gets turned off.
4. Download starts after more than a minute has passed.
5. Parent "B" game gets downloaded.

Workaround

There is no effective workaround to this problem for the game application.

Information on the child's screen is not updated once the state has advanced to the final confirmation state, but the Parent List is updated internally, so the selected parent displayed on the screen and the parent that has been actually selected are no longer the same. The parent information remains in the list for about a minute even after the parent's power has been turned off; hence, this bug does not occur if downloading commences during that time (of course, the download will fail because the parent no longer exists).

2.3.4.4 DS Download Play Bug #4

Symptom

If, after the game banners for parents "A" and "B" are both displayed in the Download List of the DS Download Play child, there is a timeout so that both banners are reset at the same time, the cursor may no longer appear when the list is refreshed. If a banner is selected at such time, the icon for the game title information will become garbled and the download will fail. (Frequency of occurrence: low.)

Workaround

There is no effective workaround to this problem for the game application.

2.3.4.5 DS Download Play Bug #5

Symptom

Between the time the final confirmation screen appears on the DS Download Play child to confirm software download and the time of actual download, the display for the number of communications members and their names is not updated. (Frequency of occurrence: every time.)

Workaround

There is no effective workaround to this problem for the game application. Consider the DS startup menu specifications.

2.3.4.6 DS Download Play Bug #6

Symptom

If the parent performs the following series of steps while the DS Download Play child is selecting a game, the unselected game will get downloaded. (Frequency of occurrence: every time.)

1. Child selects parent “A”.
2. Child advances to the screen that prompts to confirm software download.
3. Parent “A” quits DS Download Play and once again joins using the same GGID as before, but delivering a different game.
4. The child commences downloading about 3-4 seconds later.
5. The child ends up downloading the new game that Parent “A” is delivering, and not the game that had been selected.

Workaround

You can avoid this bug by setting a different GGID in the `MBGameRegistry` structure for each game that is registered by the `MB_RegisterFile` function in the game application.

The cause of this bug is very similar to that of bug #3. The game information list is automatically updated by an internal process up to the time the DS Download Play child has decided to download a game. The process uses the GGID and MAC addresses to determine if the reception beacon has the same game information as that on the list. If the game information is the same but the TGID has been updated, the child will retrieve the information again. Unfortunately, the information in the list will be changed if the identical parent is delivering a game with the same GGID.

This problem will not occur if the GGIDs are different, because each GGID will be treated as a separate game and added to the list.

3 Clone Boot Feature

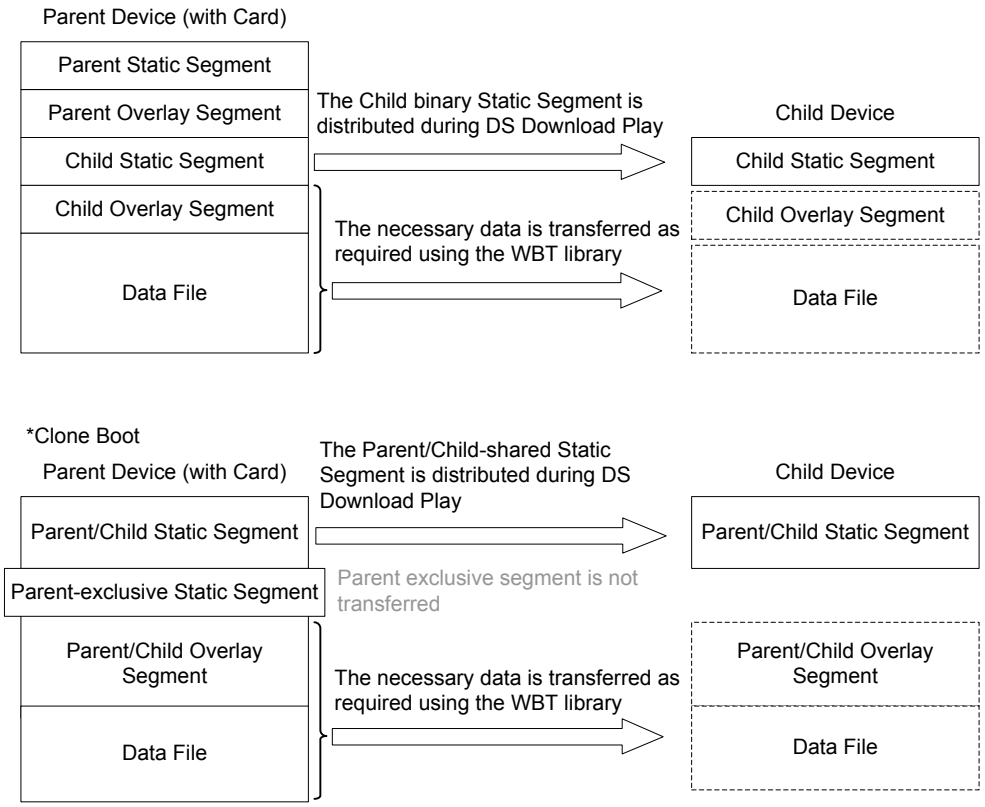
SDK provides a clone boot feature for sending the Static segment of the parent device to the child device without modification and then booting the child for DS Download Play. This section describes the clone boot procedure.

3.1 About Clone Boot

When clone boot is used, the Static segments that are the same as the parent's are distributed to children. The parent and booted children use the `MB_IsMultiBootChild` function to determine if they are a DS Download Play child device; after this, the process branches. Data that is not included in the Static segment must be obtained by reconnecting to the parent after booting and then using the WBT library.

As described in section 3.2 Clone Boot Procedure, part of the Static segment is for dedicated use of the parent.

Figure 3-1 Clone Boot



3.2 Clone Boot Procedure

The procedure for clone boot is described in the following sections.

3.2.1 Placing Data in ROM

Programs that support the clone boot feature can boot a DS Download Play child in the same way it is booted from a Game Card. The Multiboot library therefore provides security measures that are meant to avoid the complete reproduction of a game from the delivered data.

Programs that support the clone boot feature treat the data placed in the card's secure region (0x5000–0x6FFF) as data for the dedicated use of the parent and do not include it in the data delivered for DS Download Play. As a security measure to prevent the reproduction and duplication of commercial programs, please use this region to store data that will definitely be used by the parent but not by any children. For more information on configuring this parent-only region and storing data here, see the description of the *cloneboot* sample program in Chapter 5 The cloneboot Sample Program.

For more information about the secure region found on cards, see *Programming Manual*.

3.2.2 Authentication Code Attachment

Normal DS Download Play operations on a DS require that the binary for the child device has an authentication code attached. Clone boot also requires an attached authentication code.

To perform clone boot authentication, you must first obtain `libsyscall.a` used on the commercial version of the parent device and then the binary file (called `libsyscall_c.bin` below) corresponding to `libsyscall` for the clone child.

Execution of `$TwlSDK/tools/bin/emuchild.exe` on the `srl` file created in the build extracts only the static segment necessary for DS Download Play, and adds `libsyscall_c.bin` for children to create a binary file for signatures. (This binary file is henceforth referred to as `srl`.) Perform the same signature procedure on this file as that used for normal DS Download Play authentication, and attach the authentication code obtained to the original `srl` file.

If padding is performed using `RomFootPadding` during ROM creation, the signature is inserted in the proper location with `attachsign`. Hence, the `srl` file size will not increase as long as there is enough space to insert the signature.

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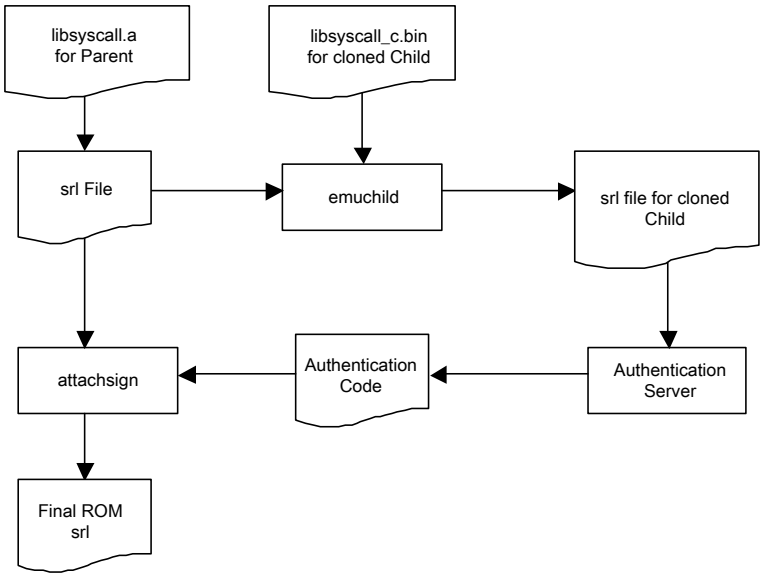
Figure 3-2 Clone Boot Binary Authentication Procedure



3.2.3 Clone Boot Binary Registration

Clone boot is activated by passing NULL as the child device binary file pointer when using the `MB_GetSegmentLength` and `MB_ReadSegment` functions in the MB library. Other processing is exactly the same as normal DS Download Play.

Code 3-1 Clone Boot Binary Registration Example

```
// Obtain clone boot data segment size
bufferSize = MB_GetSegmentLength( NULL );
if ( bufferSize == 0 )
{
    return FALSE;
}
// Secure Memory
sFilebuf = OS_Alloc( bufferSize );
if ( sFilebuf == NULL )
{
    return FALSE;
}
// Extract segment information
if ( ! MB_ReadSegment( NULL, sFilebuf, bufferSize ) )
{
    OS_Free( sFilebuf );
    return FALSE;
}
// Register download program
if ( ! MB_RegisterFile( gameInfo, sFilebuf ) )
{
    OS_Free( sFilebuf );
    return FALSE;
}
```

4 Sample Program (Multiboot-Model)

`The multiboot-Model` is a sample program that uses the DS Download Play feature to distribute programs from parent to child to share data between the parent and the child in the distributed program.

This chapter describes the following topics related to the parent.

- Preparing for the DS Download Play Feature
- Initializing the Parent
- Starting Parent Operations
- Waiting for Connections from Children
- Sending the Program to Children
- Restarting Children
- Starting the Parent Application
- Parent States

This chapter describes the following topics related to the child:

- DS Download Play Child Determination
- Getting Connection Information During DS Download Play
- Starting the Child Application

In the sample program, the series of MB library-related processes necessary to the parent for DS Download Play are collected together in module format under `$TwlSDK/build/demos/wireless_shared/mbp`.

Use this module when you create programs that utilize the DS Download Play feature. Note that you will also need to use `wh.h` (the Wireless Manager's wrapper module) with this module. For more information about `wh.h`, see Wireless Communications Tutorial.

4.1 DS Download Play Parent

This section uses a sample program to describe the procedure required of a DS Download Play parent.

4.1.1 Preparing for the DS Download Play Feature

As noted in section 2.1.1.1, to use the DS Download Play feature, an open communication channel must be found before the MB library is initialized.

Code 4-1 searches for a communication channel. (Comments in the sample program that are unrelated to this description are omitted here.)

Code 4-1 Search for Communication Channel

```
static void GetChannelMain( void )
{
    (void)WH_Initialize();                                          1

    while ( TRUE )
    {
        switch ( WH_GetSystemState() )
        {

        //---------------------------------------
        // Initialization complete
        case WH_SYSSTATE_IDLE:                                      2
            (void)WH_StartMeasureChannel();
            break;

         //---------------------------------------
        // Channel search complete
        case WH_SYSSTATE_MEASURECHANNEL:                            3
            {
                sChannel = WH_GetMeasureChannel();
                (void)WH_End();
            }
            break;

        //---------------------------------------
        // End WM
        case WH_SYSSTATE_STOP:                                      4
        /* Go to Multiboot once WM_End is completed */
        return;
        //---------------------------------------
            // Busy
        case WH_SYSSTATE_BUSY:
            break;
            //---------------------------------------
            // Error generation
        case WH_SYSSTATE_ERROR:
            (void)WH_Reset();
```

```
            break;
            //----------------------------------------
        default:
            OS_Panic("Illegal State\n");
        }
        OS_WaitVBlankIntr();        // Wait for V-Blank interrupt
    }
}
```

The process begins at **1**, using the `WH_Initialize` function to initialize the wireless communication feature. When the send and receive buffers necessary for wireless communication are secured and initialized and the wireless communications hardware is initialized, the `WH_Initialize` function changes the WM library state to `IDLE`.

When the WM library state becomes `IDLE` (the state at **2**), the `WM_MeasureChannel` function can be used to check the signal traffic level on each channel. In the sample program, the `WH_StartMeasureChannel` function is called to search for the channel with the lowest traffic level.

When the search for a channel ends (the state at **3**), the search result is obtained using the `WH_GetMeasureChannel` function. Because the search is complete and the communication channel is secured, end-processing for the WM library is performed by calling the `WH_End function`. The WM library must be terminated at this point because the MB and WM libraries cannot be used simultaneously.

When the WM library is closed (the state at **4**), the code stops searching for a communication channel and moves on to DS Download Play processing.

For the rest of the procedure, you can simply move to the IDLE state if the `MB_StartParentFromIdle` function is being used. The program code is changed as shown below, exiting the process at the state at **3**.

```
        //----------------------------------------
        // Channel search complete
        case WH_SYSSTATE_MEASURECHANNEL:                                    3
            /* Move to MultiBoot process while maintaining IDLE state */
            return;
        //----------------------------------------
        // Quit WM
        ...
```

4.1.2 DS Download Play Feature

Using the obtained wireless channel, the DS Download Play feature is initialized and other processes are carried out to accept children, deliver the download, and restart the children.

4.1.2.1 Initializing the Parent

The information delivered in the download, icon information, DS Download Play game registration information registered for the GGID, the communication channel obtained in the search process, and the TGID are all used to initialize the parent.

To prevent connections from unexpected child devices, we recommend that a different TGID value be assigned each time the parent device is started.

The following program fragment (Code 4-2) initializes the parent. (Comments in the sample program unrelated to this description are omitted.)

Code 4-2 Initialize the Parent

```
static BOOL ConnectMain( u16 tgid )

{
    MBP_Init( mbGameList.ggid, tgid );                                    1

    while ( TRUE )
    {
        --- Omitted ---
    }
}
```

In Code 4-3, the `MBP_Init` function initializes the parent and sets the necessary information (step 1 in Code 4-2). The `MBP_Init` function sets the parent player information to be displayed on the screens of children and initializes the MB library.

Code 4-3 Set the Parent User Information and Initialize the MB Library

```
void MBP_Init( u32 ggid, u16 tgid )
{
    /* Set the parent information to appear on screens of children */
    MBUserInfo     myUser;

    OSOwnerInfo info;

    OS_GetOwnerInfo( &info );                                             2
    myUser.favoriteColor = info.favoriteColor;
    myUser.nameLength = (u8)info.nickNameLength;
    MI_CpuCopy8( &myUser.name, info.nickName, OS_OWNERINFO_NICKNAME_MAX * 2 );

    myUser.playerNo = 0;      // Parent is number 0                      3

    // Initialize the status information
    mbpState    = (const MBPState) { MBP_STATE_STOP, 0, 0, 0, 0, 0, 0 };
```

```
    /* Begin MB parent control. */
    // Secure MB work region.
    sCWork = OS_Alloc( MB_SYSTEM_BUF_SIZE );                          4

    if ( MB_Init( sCWork, &myUser, ggid, tgid, MBP_DMA_NO )
         != MB_SUCCESS )
    {
        OS_Panic( "ERROR in MB_Init\n" );
    }
    MB_CommSetParentStateCallback( ParentStateCallback );             5

    MBP_ChangeState( MBP_STATE_IDLE );
}
```

With the `MBP_Init` function, you can set the parent's player information related to the player's nickname and favorite colors as obtained from the IPL owner information. For more information, see section 2.1.1.2 Setting Parent's Parameters.

In step 4, a work region is allocated for use by the MB library and then the `MB_Init` function is used to initialize the MB library.

In step 5, a callback function is set for changing the parent state as notified by the MB library. Processing for the notified parent state is performed inside this callback function.

As for the rest of the procedure, because the IDLE state is maintained when using the `MB_StartParentFromIdle` function as described above in section 4.1.2.1 Initializing the Parent, the amount of allocated memory can be reduced by changing the previously described program as shown below. (However, a buffer that is too big should not pose a problem.)

```
    // Secure MB work region.
    sCWork = OS_Alloc( MB_SYSTEM_BUF_SIZE - WM_SYSTEM_BUF_SIZE );     4
    ...
```

4.1.2.2 Starting Parent Operations

After the MB library is initialized by the `MB_Init` function, the next step is to start a DS device as the DS Download Play parent and to register the file to use for wireless downloads.

Code 4-4 starts parent operations. (Comments in the sample program unrelated to this description have been omitted.)

Code 4-4 Start Parent Operations

```
static BOOL ConnectMain( u16 tgid )
{
    --- Omitted ---

   while ( TRUE )
   {
      switch ( MBP_GetState() )
      {
      //-----------------------------------------
      // IDLE state
      case MBP_STATE_IDLE :                                          1
         {
            MBP_Start( &mbGameList, sChannel );
         }
         break;

    --- Omitted ---

      }
   }
}
```

After processing by the `MBP_Init` is complete (the state in step 1), the `MBP_Start` function starts the DS Download Play feature and registers the information for the program that will be wirelessly downloaded after the parent has accepted connections from children.

Code 4-5 Start DS Download Play Parent and Register File

```
void MBP_Start( const MBGameRegistry *gameInfo, u16 channel )
{
   SDK_ASSERT( MBP_GetState() == MBP_STATE_IDLE );

   MBP_ChangeState( MBP_STATE_ENTRY );
   if ( MB_StartParent( channel ) != MB_SUCCESS )                    3
   {
      MBP_Printf("MB_StartParent fail\n");
      MBP_ChangeState( MBP_STATE_ERROR );
      return;
   }

   /* ------------------------------------------------------------------ *
    * Initialized when MB_StartParent() is called.
    * You must register MB_RegisterFile() after MB_StartParent().
    * ------------------------------------------------------------------ */
```

```
    /*  Register download-program file information. */                    4
    if ( ! MBP_RegistFile( gameInfo ) )
    {
        OS_Panic("Illegal  multiboot gameInfo\n");
    }
}
```

In step 3, the `MB_StartParent` function is called with the communication channel specified as an argument to start operations as the DS Download Play parent.

Because the download program information is initialized when the `MB_StartParent` function is called, you must call the `MB_RegisterFile` function to register the download program information after the `MB_StartParent` function has been called.

In step 4 of the sample program, the `MBP_RegistFile` function is called to load the binary code to be sent for DS Download Play into main memory and to register download program information. The download program information used in the sample program is configured as shown in Code 4-6.

Code 4-6 Load Program into Memory and Register Program Information

```
/* This is the program information the demo downloads */
const MBGameRegistry mbGameList =
{
    "/child.srl",              // Child binary code
    (u16*)L"DataShareDemo",    // Game name
    (u16*)L"DataSharing demo", // Description of game contents
    "/data/icon.char",         // Icon character data
    "/data/icon.plt",          // Icon palette data
    WH_GGID,                   // GGID
    MBP_CHILD_MAX + 1,         // Maximum number of players
};
```

If the `MB_StartParentFromIdle` function is being used, the code at step 3 is changed as shown below to handle those changes described in sections 4.1.1 Preparing for the DS Download Play Feature and 4.1.2 DS Download Play Feature.

```
    MBP_ChangeState( MBP_STATE_ENTRY );
    if ( MB_StartParentFromIdle( channel ) != MB_SUCCESS )                3
    {
    ...
```

Next, a description is given for registering download program information by tracing the process flow in the `MBP_RegistFile` function.

In step 5, File System is used to open the download file to register it for loading.

The `MBP_RegistFile` function also supports the clone boot feature (described in Chapter 3 Clone Boot Feature). If the received file path's name is `NULL`, software will behave as if a clone boot has been specified.

Code 4-7 How to Register File: Open the File

```
static BOOL MBP_RegistFile( const MBGameRegistry* gameInfo )
{
    FSFile file, *p_file;
    u32 bufferSize;
    BOOL ret = FALSE;

    /*
     * According to this function's specification, if
     * romFilePathp is NULL, it operates as a clone boot. Otherwise,
     * the specified file is treated as the child program.
     */
    if (!gameInfo->romFilePathp)
    {
        p_file = NULL;
    }
    else
    {
        /*
         * The program file must be read by FS_ReadFile().Normally, the program
         * is saved as a file in CARD-ROM, so this is not a problem. However,
         * if you anticipate a special MultiBoot file system,
         * use FSArchive to construct an independent archive.
         */
    FS_InitFile( &file );
    if ( ! FS_OpenFile( &file, gameInfo->romFilePathp ) )
    {
        /* File cannot be opened */
        OS_Warning("Cannot Register file\n");
        return FALSE;
    }
        p_file = &file;
    }
     --- Omitted ---
}
```

Next, the `MB_GetSegmentLength` function obtains the size of segment information in step 6, then memory is allocated for loading the segment information in step 7.

Because only one file is maintained for the segment information in the sample program, if you plan to register multiple download files you must switch to processing that maintains multiple sets of segment information.

Code 4-8 How to Register File: Get Segment Size and Memory

```
static BOOL MBP_RegistFile( const MBGameRegistry* gameInfo )
{
   FSFile file, *p_file;
   u32 bufferSize;
   BOOL ret = FALSE;

    --- Omitted ---

   /*
    * Get the size of the segment information.
    * If download program is not legal, 0 is
    * returned for the size.
    */
   bufferSize = MB_GetSegmentLength( &file );                                  6
   if ( bufferSize == 0 )
   {
      OS_Warning( "specified file may be invalid format.\"%s\"\n",
                  gameInfo->romFilePathp );
   }
   else
   {
      /*
       * Secure memory for loading the download program's segment
       * information.  If the file has been registered successfully,
       * this region will be used until MB_End() is called.
       * If the memory size is plenty large enough, it can be
       * prepared statically.
       */
      sFilebuf = (u8*)OS_Alloc( bufferSize );                                  7
      if ( sFilebuf == NULL )
      {

    /* Failure to secure buffer for storing segment information */
      OS_Warning("can't allocate Segment buffer size.\n");
else      }

    --- Omitted ---

}
```

Segment information is read from the file using the `MB_ReadSegment` function in step 8 and registered using the `MB_RegisterFile` function in step 9. Once the download file is registered, the open download file is closed in step 10 because it is no longer needed.

Code 4-9 How to Register File: Read and Register Segment Information, Close File

```
static BOOL MBP_RegistFile( const MBGameRegistry* gameInfo )
{

    --- Omitted ---

   /*
    * Extract segment information from file.
    * This extracted information must remain resident in
    * main memory while the download program is being delivered.
    */
        if ( ! MB_ReadSegment( p_file, sFilebuf, bufferSize ) )                8
          {
              /*
               * Segment extraction from illegal file will fail.
               * If size is obtained successfully but the extraction
               * process fails anyway, perhaps some change has
               * been made to the file handle.  (File closed,
               * location seek, and so on.)
               */
              OS Warning(" Can't Read Segment\n" );
          }
          else
          {
              /*
               * Register Download program with extracted segment
               * information and MBGameRegistry.
               */
              if ( ! MB RegisterFile( gameInfo, sFilebuf ) )                   9
              {
                  /* Registration fails due to illegal program information */
                  OS_Warning(" Illegal program info\n");
              }
              else
              {
                  /* Process has ended correctly */
                  ret = TRUE;
              }
          }
          if (!ret)
              OS Free(sFilebuf);
       }
   }
   /* Close file if not a clone boot */
   if (p file == &file)
   {
       (void)FS CloseFile( &file );
}
 return ret;
}
```

At this point, the game device begins operating as a DS Download Play parent and the registered download file is distributed to children through download.

4.1.2.3 Waiting for Connections from Children

Once the game device begins operating as a DS Download Play parent, it processes connection requests from children.

The callback function set with MB_CommSetParentStateCallback is notified of connection requests from children as given in the code described in section 4.1.2.1 Initializing Parent. Because a variety of notifications in addition to connection requests from children are posted to this callback function, processing appropriate for each type of notification is required.

In the sample program, the state in which the parent waits for and accepts connection requests from children is defined as "MBP_STATE_ENTRY (accepting connection requests)." Connection requests from children are denied if the value returned by the MBP_GetState function (used to get the parent state) is other than MBP_STATE_ENTRY.

There are two states in which children make connection requests.

- MB_COMM_PSTATE_CONNECTED: Indicates that the child is connected to the parent.
- MB_COMM_PSTATE_REQUESTED: Indicates an entry request as a DS Download Play child.

In the sample program, information for managing a child's connection (mbpState.connectChildBmp) is updated when the parent receives notification of MB_COMM_PSTATE_CONNECTED from the child in question.

Code 4-10 Parent Receives Child Notification: Update Connection Information

```
static void ParentStateCallback( u16 child_aid, u32 status, void* arg )
{
    switch ( status )
    {
    //---------------------------------------------------------------
    // Instant notification of child connection
    case MB_COMM_PSTATE_CONNECTED:
        {
            // Parent does not accept connection except in entry reception state
            if ( MBP_GetState() != MBP_STATE_ENTRY )
            {
                break;
            }

            MBP_AddBitmap( &mbpState.connectChildBmp, child_aid );
            // Store child's MacAddress
            WM_CopyBssid( ((WMStartParentCallback*)arg )->macAddress,
                        childInfo[ child_aid - 1 ].macAddress );
            childInfo[ child_aid - 1 ].playerNo = child_aid;
        }
        break;
    }
}
```

When notification of MB_COMM_PSTATE_REQUESTED is posted in a callback function, a decision is made to either accept 2 or deny 1 the entry request.

Except when the entry request is denied due to the state of the parent, all entry requests in the sample program are accepted using the MBP_AcceptChild function, and the information for managing child entry requests is updated (mbpState.requestChildBm). The player information of children is obtained using the MB_CommGetChildUser function.

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Code 4-11 Process Connection Request

```
static void ParentStateCallback( u16 child_aid, u32 status, void* arg )
{
    switch ( status )
    {
    //---------------------------------------------------------
    // Instant notification of entry request from child
    case MB_COMM_PSTATE_REQUESTED:
        {
            const MBUserInfo* userInfo;

            // If the parent is not in the entry-accepting state, the child
            // requesting entry is kicked out without being checked.
            if ( MBP_GetState() != MBP_STATE_ENTRY )
            {
                MBP_KickChild( child_aid );                                    1
                break;
            }

            // Accept child's entry
            mbpState.requestChildBmp |= 1 << child_aid;

            MBP_AcceptChild( child_aid );                                      2

            // The timing of MB_COMM_PSTATE_CONNECTED is such that UserInfo
            // is not set, so MB_CommGetChildUser has no meaning unless it
            // is called after the state is REQUESTED.
            userInfo = MB_CommGetChildUser( child_aid );
            if ( userInfo != NULL )
            {
                  MI_CpuCopy8(userInfo, &childInfo[ child_aid - 1 ].user,
                              sizeof(MBUserInfo));
            }
            MBP_Printf("playerNo = %d\n", userInfo->playerNo );
        }
        break;
    }
}
```

If the connection request from a child is accepted, the MB_CommResponseRequest function notifies the child by posting MB_COMM_RESPONSE_REQUEST_ACCEPT. If the connection request is denied, the function notifies the child by posting MB_COMM_RESPONSE_REQUEST_KICK.

In the sample program, the information for managing child connections is updated when the notification is posted to the child.

Code 4-12 Accept or Kick Child Connection

```
void MBP_AcceptChild( u16 child_aid )                                    1
{
    if ( ! MB_CommResponseRequest( child_aid, MB_COMM_RESPONSE_REQUEST_ACCEPT ) )
    {
        // If a request fails, disconnect that child.
        MBP_DisconnectChild( child_aid );
        return;
    }

    MBP_Printf("accept child %d\n", child_aid);
}

void MBP_KickChild( u16 child_aid )                                      2
{
    if ( ! MB_CommResponseRequest( child_aid, MB_COMM_RESPONSE_REQUEST_KICK ) )
    {
        // If a request fails, disconnect that child.
        MBP_DisconnectChild( child_aid );
        return;
    }

    {
        OSIntrMode enabled = OS_DisableInterrupts();

        mbpState.requestChildBmp &= ~( 1 << child_aid );
        mbpState.connectChildBmp &= ~( 1 << child_aid );

        (void)OS_RestoreInterrupts( enabled );
    }
}
```

Children that receive MB_COMM_RESPONSE_REQUEST_KICK from a parent are disconnected from that parent. A callback function posts MB_COMM_PSTATE_KICKED to notify the parent that the child received a response that the connection was denied.

When the parent posts MB_COMM_RESPONSE_REQUEST_ACCEPT to a child, the latter transits to a state where it can accept download delivery. First, a callback function posts MB_COMM_PSTATE_REQ_ACCEPTED to notify the parent that the child received the connection-accepted response. Then a callback function posts MB_COMM_PSTATE_WAIT_TO_SEND to notify the parent that the child entered a state that accepts download delivery. Data transfer to the child will not execute properly if it begins before the parent receives this notification.

Nothing happens in the sample program if MB_COMM_PSTATE_KICKED and MB_COMM_PSTATE_ACCEPTED are posted, but when MB_COMM_PSTATE_WAIT_TO_SEND is posted, the information for managing child connections is updated and depending on the state of the parent, download delivery to that child begins. (For more information on the MBP_StartDownload function, see section 4.1.2.4 Sending the Program to Children.)

Code 4-13 Determine Child State, Begin Program Download

```
static void ParentStateCallback( u16 child_aid, u32 status, void* arg )
{
    switch ( status )
    {
    //---------------------------------------------------------
    // Post ACK to child for ACCEPT
    case MB_COMM_PSTATE_REQ_ACCEPTED:
        // No special process at this point.
        break;
    //---------------------------------------------------------
    // Notification to child when kicked.
    case MB_COMM_PSTATE_KICKED:
        // No particular process is required.
        break;
    //---------------------------------------------------------
    // Notification when download request is received from child.
    case MB_COMM_PSTATE_WAIT_TO_SEND:
        {
            // Child's state changes from entry to download-wait.
            // An interrupted process, so changed without
            // prohibiting interrupts.
            mbpState.requestChildBmp  &= ~( 1 << child_aid );
            mbpState.entryChildBmp    |= 1 << child_aid;

            // Calling MBP_StartDownload() from main routine starts data
            // transmission.  If already in the data-transmission state,
            // data transfer also begins to that child.
            if ( MBP_GetState() == MBP_STATE_DATASENDING )
            {
                MBP_StartDownload( child_aid );
            }
        }
        break;
    }
}
```

In the wait portion of the connection process (1), download delivery to a child can begin (4) if there is a child in a state that can accept download delivery (3). Conversely, the DS Download Play feature can be cancelled (2).

Code 4-14 Begin Download Delivery or Cancel DS Download Play

```
static BOOL ConnectMain( u16 tgid )
{
while ( TRUE )
    {
        switch ( MBP_GetState() )
        {
        //---------------------------------------
        // Waiting for entry from child
        case MBP_STATE_ENTRY :                                                    1
            {
                BgSetMessage( PLTT_WHITE, " Now Accepting          ");

                if ( IS_PAD_TRIGGER( PAD_BUTTON_B ) )
                {
                // B Button cancels DS Download Play
                    MBP_Cancel();                                                 2
                    break;
                }

                // Can start if there is at least one child in entry
                if ( MBP_GetChildBmp( MBP_BMPTYPE_ENTRY ) ) ||
                    MBP_GetChildBmp(MBP_BMPTYPE_DOWNLOADING) ||
                    MBP_GetChildBmp(MBP_BMPTYPE_BOOTABLE))                        3
                {
                    BgSetMessage( PLTT_WHITE, " Push START Button to start   ");

                    if ( IS_PAD_TRIGGER( PAD_BUTTON_START ) )
                    {
                        // Start download
                        MBP_StartDownloadAll();                                   4
                    }
                }
            }
            break;
        }
    }
}
```

4.1.2.4 Sending the Program to Children

Once `MB_COMM_PSTATE_WAIT_TO_SEND` is posted, the parent can begin download delivery to the child that posted the notification. Download delivery is started using either the `MB_CommStartSending` or `MB_CommStartSendingAll` function. To use the `MB_CommStartSendingAll` function, first check that all connected children can accept download delivery. Calling the function once may not begin download delivery to all children. Because download delivery cannot begin for children that are not in the `MB_COMM_PSTATE_WAIT_TO_SEND` state, be sure to start download delivery separately for each child if a `MB_COMM_PSTATE_WAIT_TO_SEND` notification is received after the `MB_CommStartSendingAll` function has executed.

In the sample program, the `MB_CommStartSending` function is used inside the `MBP_StartDownload` function and the connection state is updated for all children for which download delivery has started.

Code 4-15 Disable Interrupts, Begin Download

```
void MBP_StartDownload( u16 child_aid )
{
    if ( ! MB_CommStartSending( child_aid ) )
    {
        // If a request fails, disconnect that child.
        MBP_DisconnectChild( child_aid );
        return;
    }

    {
        OSIntrMode enabled = OS_DisableInterrupts();

        mbpState.entryChildBmp &= ~(1 << child_aid);
        mbpState.downloadChildBmp |= 1 << child_aid;

        (void)OS_RestoreInterrupts( enabled );
    }
}
```

When using the MBP_StartDownloadAll function, after the connection request is accepted and the parent enters the download delivering state represented by MBP_STATE_DATASENDING (1), the connect state of children is checked and the MBP_StartDownload function begins download delivery to those children that can accept the download (4). If the parent accepts a connection request from a child, but the child is not in a state to accept delivery, the download begins later, when the child enters the receptive state (2). Children in other states are disconnected (3).

Code 4-16 Verify Child States, Begin Download

```
void MBP_StartDownloadAll( void )

{
   u16 i;

   // Entry acceptance completed
   MBP_ChangeState( MBP_STATE_DATASENDING );                                  1

   for ( i = 1; i < 16; i++ )
   {
      if ( ! ( mbpState.connectChildBmp & (1 << i) ) )
      {
         continue;
      }

      if ( mbpState.requestChildBmp & (1 << i) )                              2
      {
         // Perform this process when currently entered children are ready
         //  and the MB_COMM_PSTATE_WAIT_TO_SEND notification is received.
         continue;
      }

      // Disconnect children that are not entered
      if ( ! ( mbpState.entryChildBmp & (1 << i) ) )                          3
      {
         MBP_DisconnectChild( i );
         continue;
      }

      // Start download for entered children
      MBP_StartDownload( i );                                                 4
   }
}
```

Inside the MB_CommStartSending function, MB_COMM_RESPONSE_REQUEST_DOWNLOAD (start delivery response) is posted to children. The child receives this post and confirms that download delivery has started by posting MB_COMM_PSTATE_SEND_PROCEED in a callback function. When download delivery to the child is complete, MB_COMM_PSTATE_SEND_COMPLETE is posted in a callback function.

In the sample program, nothing happens when MB_COMM_PSTATE_SEND_PROCEED is posted, but information for managing child connections is updated when MB_COMM_PSTATE_SEND_COMPLETE is posted.

Code 4-17 Notify When Download Begins and Ends

```
static void ParentStateCallback( u16 child_aid, u32 status, void* arg )
{
    switch ( status )
    {
    //---------------------------------------------------------------
    // Notify when binary transmission to child begins
    case MB_COMM_PSTATE_SEND_PROCEED:
        // None.
        break;
    //---------------------------------------------------------------
    // Notify when binary transmission to child ends
    case MB_COMM_PSTATE_SEND_COMPLETE:
        {
            // An interrupted process, so changed without
            // prohibiting interrupts.
            mbpState.downloadChildBmp &= ~( 1 << child_aid );
            mbpState.bootableChildBmp |= 1 << child_aid;
        }
        break;
    }
}
```

4.1.2.5 Restarting Children

The child can be restarted once download delivery to the child is complete. The `MB_CommIsBootable` function checks whether the child can be rebooted. In the sample program, the `MBP_IsBootableAll` function checks whether all connected children are in a state that allows rebooting.

Code 4-18 Check That Children Are Bootable

```
BOOL MBP_IsBootableAll( void )
{
   u16 i;

   if ( mbpState.connectChildBmp == 0 )
   {
      return FALSE;
   }

   for ( i = 1; i < 16; i++ )
   {
      if ( ! ( mbpState.connectChildBmp & (1 << i) ) )
      {
         continue;
      }

      if ( ! MB_CommIsBootable( i ) )
      {
         return FALSE;
      }
   }
   return TRUE;
}
```

If download delivery is complete for all children, a reboot request is sent to the children.

Code 4-19 Reboot Children When Download Is Complete

```
static BOOL ConnectMain( u16 tgid )
{
    --- Omitted ---

   while ( TRUE )
   {
      //---------------------------------------
      // Process for sending program
      case MBP_STATE_DATASENDING :
         {

            // Can start if all parties have finished downloading.
            if ( MBP_IsBootableAll() )
            {
               // Start boot
               MBP_StartRebootAll();
            }
         }
```

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```
            break;

        --- Omitted ---
          }
        }
}
```

The reboot request sent to children is made using either the `MB_CommBootRequest` or `MB_CommBootRequestAll` function. If you use the `MB_CommBootRequestAll` function, first verify that downloading to all connected children is complete. Calling the function once may not result in a request for all children to reboot.

In the sample program, the child reboot request is made using the `MBP_StartRebootAll` function. The connection state of all children is checked inside the `MBP_StartRebootAll` function, and the reboot request is made using the `MB_CommBootRequest` function. The state of parent is then changed to `MBP_STATE_REBOOTING` (wait for child reboot).

Code 4-20 Change Parent State, Continue Booting Children

```
void MBP_StartRebootAll( void )
{
    u16 i;
    u16 sentChild = 0;

    for ( i = 1; i < 16; i++ )
    {
        if ( ! ( mbpState.bootableChildBmp & (1 << i) ) )
        {
            continue;
        }
        if ( ! MB_CommBootRequest( i ) )
        {
            // If a request fails, disconnect that child.
            MBP_DisconnectChild( i );
            continue;
        }
        sentChild |= ( 1 << i );
    }

    // Error: exit if connection child is 0
    if ( sentChild == 0)
    {
        MBP_ChangeState( MBP_STATE_ERROR );
        return;
    }

    // Change state to child device restart wait state.
    MBP_ChangeState( MBP_STATE_REBOOTING );
}
```

The `MB_COMM_RESPONSE_REQUEST_BOOT` (reboot request) notification is sent to children from inside the `MB_CommBootRequest` function. Each child receives the reboot request and posts `MB_COMM_PSTATE_BOOT_STARTABLE` from inside a callback function when finished rebooting.

Because wireless communications between the parent and child are disconnected when the child is done rebooting, `MB_COMM_PSTATE_DISCONNECTED` is posted in a callback function.

In the sample program, if `MB_COMM_PSTATE_BOOT_STARTABLE` has been posted, the information for managing the connections of children is updated and the DS Download Play feature is ended using the `MB_End` function after all children are done rebooting.

Code 4-21 Verify That Download Is Complete, Disconnect Children

```
static void ParentStateCallback( u16 child_aid, u32 status, void* arg )
{
    switch ( status )
    {
    //---------------------------------------------------------
    // Notification that child boot ended correctly
    case MB_COMM_PSTATE_BOOT_STARTABLE:
        {
            // An interrupted process, so changed without
            // prohibiting interrupts.
            mbpState.bootableChildBmp &= ~( 1 << child_aid );
            mbpState.rebootChildBmp |= 1 << child_aid;

            // If all children are done booting, the parent
            // also enters the reconnection process.
            if ( mbpState.connectChildBmp == mbpState.rebootChildBmp )
            {
                MBP_Printf("call MB_End()\n");
                MB_End();
            }
        }
        break;
    //---------------------------------------------------------
    // Notification when child is disconnected
    case MB_COMM_PSTATE_DISCONNECTED:
        {
            // Delete entry if child disconnects in situation
            // other than rebooting.
            if ( MBP_GetChildState( child_aid ) != MBP_CHILDSTATE_REBOOT )
            {
                MBP_DisconnectChildFromBmp( child_aid );
            }
        }
        break;
    }
}
```

If changes have been made to this code such that the MB_StartParentFromIdle function is used, make the following changes to call the MB_EndToIdle function instead of the MB_End function at the end.

```
          // If all children have finished booting, the
          // parent also enters the reconnection process.
          if ( mbpState.connectChildBmp == mbpState.rebootChildBmp )
          {
             MBP_Printf("call MB_EndToIdle()\n");
             MB_EndToIdle();
          }
          ...
```

When the DS Download Play feature is ended by the MB_End function, the notification MB_COMM_PSTATE_END is posted by a callback function. In the sample program, the parent is moved to the process-end state (MBP_STATE_COMPLETE), and the work area in memory allocated for download delivery is released.

Code 4-22 End DS Download Play, Change Parent State, Clear Buffer

```
static void ParentStateCallback( u16 child_aid, u32 status, void* arg )
{
    switch ( status )
    {
    //---------------------------------------------------------
    // Notification at end of DS Download Play
    case MB_COMM_PSTATE_END:
        {
          if ( MBP_GetState() == MBP_STATE_REBOOTING )
          // Reboot process completed; end MB and
          // reconnect with the child.
          {
             MBP_ChangeState( MBP_STATE_COMPLETE );
          }
          else
          // Complete shutdown, return to STOP state
          {
             MBP_ChangeState( MBP_STATE_STOP );
          }
          // Release the buffer used for game delivery.
          // The work region is released when MB_COMM_PSTATE_END
          // comes in a callback, so OK to free.
          if ( sFilebuf )
          {
             OS_Free( sFilebuf );
             sFilebuf = NULL;
          }
          if ( sCWork )
          {
             OS_Free( sCWork );
             sCWork = NULL;
          }
          // The registration info is cleared at the same time MB_End is
```

```
            // called and work is freed, so MB_UnregisterFile can be omitted
        }
        break;
    }
}
```

In the final step, the code fragment for quitting the DS Download Play feature 2 is referenced from the rebooting process 1.

Code 4-23 End Reboot, Reconnect Wireless Communications

```
static BOOL ConnectMain( u16 tgid )
{
     --- Omitted ---

    while ( TRUE )
    {
        //---------------------------------------
        // Reboot process
        case MBP_STATE_REBOOTING:                                          1
            {
                BgSetMessage( PLTT_WHITE, " Rebooting now             ");
            }
            break;

        //---------------------------------------
        // Reconnection process
        case MBP_STATE_COMPLETE:                                           2
            {
                // If all parties connect without trouble,
                // quit DS Download Play process and restart
                // wireless communications as a normal parent.
                BgSetMessage( PLTT_WHITE, " Reconnecting now           ");

                OS_WaitVBlankIntr();
                return TRUE;
            }
            break;

     --- Omitted ---
        }
    }
}
```

4.1.3 Starting the Parent Application

In the multiboot-Model sample program, game software is downloaded to children using the DS Download Play feature. After the child reboots, the wireless-communications parent shares data with the program downloaded to the child. Because the wireless communication connection with the child is cut when the DS Download Play feature ends, the wireless connection with the child must be reestablished.

In the sample program, the connection information used by the DS Download Play feature is used for data sharing. The first step is to perform the initialization processes required for data sharing. The `GInitDataShare` function makes the initial settings for the buffer to be used for data-sharing communications. The `WH_Initialize` function initializes the WM library and wireless communications.

If changes have been made in the code to use the `MB_StartParentFromIdle` function, it does not need to be called at this point because the IDLE state is being maintained and the `WH_Initialize` function has already been called.

Code 4-24 Initialize Data Sharing, WM Library, and Wireless Communications

```
// Configure the buffer for data-sharing communications
GInitDataShare();
// If MB_StartParent & MB_End have been used, then initialize
// wireless communications at this point
(void)WH_Initialize();
```

Once wireless communications start, the parent may receive connection requests from devices other than the children to which the program has been delivered using the DS Download Play feature. To handle this possibility, the `WH_SetJudgeAcceptFunc` function sets the function to be used in deciding whether or not to allow the connection.

Code 4-25 Process Connection Requests

```
// Configure the function for deciding connection to children
WH_SetJudgeAcceptFunc( JudgeConnectableChild );
```

The JudgeConnectableChild function is used to make this determination in Code 4-26. The connection is permitted if the player number (aid) used during DS Download Play can be obtained from the MAC address of the terminal connected in step 1.

Code 4-26 Process Connection Request: Details

```
static BOOL JudgeConnectableChild( WMStartParentCallback* cb )
{
   u16 playerNo;

   /*  Search for cb->aid child's multiboot-time aid from MAC address */
   playerNo = MBP_GetPlayerNo( cb->macAddress );                                    1

   OS_TPrintf( "MB child(%d) -> DS child(%d)\n", playerNo, cb->aid );

   if ( playerNo == 0 )
   {
      return FALSE;
   }
   sChildInfo[ playerNo ] = MBP_GetChildInfo( playerNo );
   return TRUE;
}
```

Finally, wireless communications with this unit as the parent are started and data sharing begins.

Because the state is WH_SYSSTATE_IDLE (1) when the WH_Initialize function ends, the WH_ParentConnect function is used to start wireless communications. Arguments for the function include WH_CONNECTMODE_DS_PARENT, used to indicate data-sharing, and TGID and communication channel, used by the DS Download Play feature.

Once wireless communications begin, the state changes to WH_SYSSTATE_DATASHARING (2) and data sharing begins.

Code 4-27 Change State and Share Data

```
   /* Main routine */
   for ( gFrame = 0 ; TRUE ; gFrame++ )
   {
      OS_WaitVBlankIntr();

      ReadKey();

      BgClear();

      switch ( WH_GetSystemState() )
      {
      case WH_SYSSTATE_IDLE :                                                       1
         /* ----------------
          * If you want the child to reconnect to the same parent
          * without rescanning, tgid and channel must match.
          * In this demo, both the parent and the child use the same
          * channel as used at the time of multiboot, and tgid+1, which
          * is tgid at the time of multiboot.  For this reason, the
```

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```
            * child can reconnect without scanning.
            *
            * If you are going to specify a MAC address and rescan,
            * tgid and channel values do not need to be the same.
            * ---------------- */
            (void)WH_ParentConnect( WH_CONNECTMODE_DS_PARENT, (u16) (tgid + 1),
                                    sChannel );
            break;

        case WH_SYSSTATE_CONNECTED:
        case WH_SYSSTATE_KEYSHARING:
        case WH_SYSSTATE_DATASHARING:                                    2
            {
                BgPutString( 8 , 1 , 0x2 , "Parent mode" );
                GStepDataShare( gFrame );
                GMain();
            }
            break;
        }
    }
```

4.1.4 Parent States

The `MBP_GetState` function can obtain the parent states described in Table 4-1.

Table 4-1 Parent States

Values Returned by the MBP_GetState Function	State of the Parent
`MBP_STATE_STOP`	`MB_End` function was called from the `MBP_Cancel` function and the DS Download Play feature was stopped.
`MBP_STATE_IDLE`	`MBP_Init` function finished, the `MBP_Start` function was called, and the device can begin operating as the parent.
`MBP_STATE_ENTRY`	`MBP_Start` function finished and the parent is waiting for a connection from a child. This is the only state in which the parent can accept a connection from a child.
`MBP_STATE_DATASENDING`	`MBP_StartDownloadAll` function was called and download-delivery to the connected children has begun.
`MBP_STATE_REBOOTING`	`MBP_StartRebootAll` function was called and connected children are rebooting.
`MBP_STATE_COMPLETE`	All connected children received reboot requests and the DS Download Play feature was ended by the `MB_End` function.
`MBP_STATE_CANCEL`	`MBP_Cancel` function was just called.
`MBP_STATE_ERROR`	Error has occurred.

4.2 DS Download Play Children

The user program for a DS Download Play child starts after DS Download Play data is transferred from the parent device and the child is rebooted. During reboot, connection with the parent device is completely terminated.

In this section, the sample program multiboot-Model is used to describe how DS Download Play children are determined and how to obtain connection information used during DS Download Play.

4.2.1 DS Download Play Child Determination

The child uses the `MB_IsMultiBootChild` function to determine whether it was started using the DS Download Play feature.

Code 4-28 Check Whether the Child Booted by DS Download Play

```
// Check to see if self is child that started from DS Download Play.
if ( ! MB_IsMultiBootChild() )
{
    OS_Panic("not found Multiboot child flag!\n");
}
```

4.2.2 Getting Connection Information During DS Download Play

The connection information used during DS Download Play can be obtained with the `MB_ReadMultiBootParentBssDesc` function. If direct connection to the parent is to be made using the obtained `WMBssDesc`, the key-sharing flag and other settings must be the same as those set for the parent when the information was obtained.

Code 4-29 Obtain Connection Information: Parent and Child Must Match

```
MB_ReadMultiBootParentBssDesc( &gMBParentBssDesc,
                               WH_PARENT_MAX_SIZE,      // Parent max transfer size
                               WH_CHILD_MAX_SIZE,       // Child max transfer size
                               0,               // Key sharing
                               0 );             // Continuous transfer mode flag
```

4.2.3 Starting the Child Application

Data is shared with the parent as a wireless-communication child.

First, perform the initialization processes required for data sharing; the same processes are carried out for the parent. Use the `GInitDataShare` function to configure the initial settings of the buffer to be used for data-sharing communications, and use the `WH_Initialize` function to initialize the WM library and wireless communications.

Code 4-30 Initialize Data Sharing, WM Library, and Wireless Communications

```
GInitDataShare();

//*******************************
// Initialize wireless communications
(void)WH_Initialize();
//*******************************
```

Next, try connecting to the parent with retries in the main loop (1). Once wireless communications begin, the state moves to `WH_SYSSTATE_DATASHARING` (2) and data sharing begins.

Code 4-31 Connect Child to Parent, Change State, and Share Data

```
// Main loop
for ( gFrame = 0 ; TRUE ; gFrame ++ )
{
    // Divide the process based on communication state
    switch( WH_GetSystemState() )
    {
    case WH_SYSSTATE_CONNECT_FAIL:
        {
            // If WM_StartConnect() has failed, the WM internal
            // state is illegal, so you need to use M_Reset to reset WM to the
            // IDLE state.
            WH_Reset();
        }
        break;
    case WH_SYSSTATE_IDLE:
        {
            static retry = 0;
            enum {
                MAX_RETRY = 5
            };

            if ( retry < MAX_RETRY )
            {
                ModeConnect();                                          1
                retry++;
                break;
            }
            // Display ERROR if cannot connect to parent in MAX_RETRY
        }
    case WH_SYSSTATE_ERROR:
```

```
            ModeError();
            break;
        case WH_SYSSTATE_BUSY:
        case WH_SYSSTATE_SCANNING:
            ModeWorking();
            break;
        case WH_SYSSTATE_CONNECTED:
        case WH_SYSSTATE_KEYSHARING:
        case WH_SYSSTATE_DATASHARING:                                    2
            {
                BgPutString( 8 , 1 , 0x2 , "Child mode" );
                GStepDataShare( gFrame );
                GMain();
            }
            break;
        }
    }
```

Connection to the parent is made using the `WH_ChildConnect` function inside the `ModeConnect` function. Arguments to this function include `WH_CONNECTMODE_DS_CHILD`, which is used to indicate data sharing, and `gMBParentBssDesc`, information about the wireless communication connection that is used by the DS Download Play feature.

When reconnecting after the download, if the application has some special information that needs to be received from the parent, the latter will notify the child about this through its game information beacon, and the child can rescan to get that information. If this is not necessary, you can perform the reconnection by simply using `gMBParentBssDesc`. The `ModeConnect` function stores codes for both parent and child, telling them apart by using the `USE_DIRECT_CONNECT` switch; thus, select the method that best suits the application at hand. (The default method is a simple reconnection.)

Code 4-32 Child Connection Details

```
static void ModeConnect( void )
{
#define USE DIRECT CONNECT

    // If connecting to parent directly, without scanning again.
#ifdef USE DIRECT CONNECT

    //*********************************
    (void)WH ChildConnect( WH CONNECTMODE DS CHILD, &gMBParentBssDesc, TRUE);
    // WH ChildConnect(WH CONNECTMODE MP CHILD, &gMBParentBssDesc, TRUE);
    // WH ChildConnect(WH CONNECTMODE KS CHILD, &gMBParentBssDesc, TRUE);
    //*********************************
#else
    WH SetGgid(gMBParentBssDesc.gameInfo.ggid);
    // If executing a rescan for the parent.
    //*********************************
    (void)WH ChildConnectAuto(WH CONNECTMODE DS CHILD, gMBParentBssDesc.bssid,
                              gMBParentBssDesc.channel);
    // WH ChildConnect(WH CONNECTMODE MP CHILD, &gMBParentBssDesc, TRUE);
    // WH ChildConnect(WH CONNECTMODE KS CHILD, &gMBParentBssDesc, TRUE);
    //*********************************
#endif
}
```

5 The cloneboot Sample Program

To act as a DS Download Play parent, the `cloneboot` sample program uses the features described in Chapter 3 Clone Boot Feature, delivering copies of its own programs to child devices and sharing data with download children.

This cloneboot sample program shows the procedure for how to the unify the existing programs for both the parent and child from the multiboot-Model sample program to create a program that supports the clone boot feature. For more information on the multiboot-Model sample, see Chapter 4 Sample Program (Multiboot-Model).

This chapter describes the following changes to the program structure.

- Unification of the program source directories
- Changes to the ROM specification file
- Changes to makefile
- Additions to the build procedure for attaching authentication codes

The chapter also describes the following changes made to the program source:

- Changes to main entry names
- Addition of new entries
- Specification of a parent-only region
- Revision of the binary registration process

5.1 Changes to Program Structure

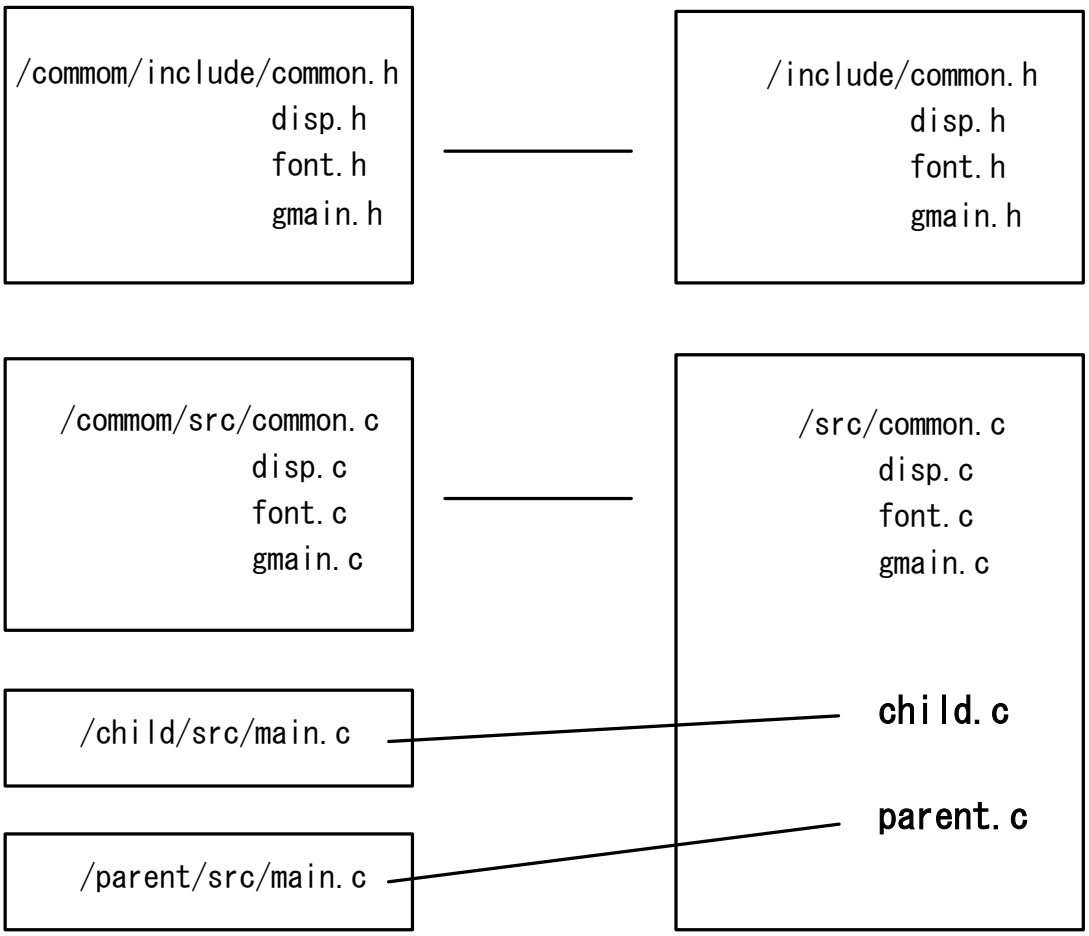
The following sections describe the changes that must be made to a program if it is to support the clone boot feature.

5.1.1 Unification of the Program Source Directories

In the multiboot-Model sample, the child program is first created and then the parent program is created with that child program included as a separate file, so the overall structure is composed of two separate build projects. Programs that support clone boot can be unified into a single project, because the parent is determined at the time of execution.

Here, the `src` and `include` directories, and all contents of the `parent`, `child`, and `common` directories are moved to the project's root directory. At this time, the `main.c` files that exist in both the parent and child programs get renamed to `parent.c` and `child.c`. (A new `main.c` is created in a later procedure.)

Figure 5-1 Unifying Source Directories



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5.1.2 Changes to the ROM Specification File

The child program included in the file system in the multiboot-Model sample is no longer present in the program that supports clone boot, so delete the following lines from the `main.rsf` file.

```
# Delete this specification
# HostRoot        $(MAKEROM_ROMROOT)
# Root            /
# File            $(MAKEROM_ROMFILES)
```

5.1.3 Changes to Makefile

To unify the parent and child programs and to change them into a program that supports the clone boot feature, a number of changes and additions must be made to the parent program's makefile. These are described in the sections below. The makefile used in the build for the child program is no longer necessary.

5.1.3.1 Correcting Directory and Source Specifications

Steps are taken such that the changes to directory structure that were made in section 5.1.1 Unification of the Program Source Directories are correctly reflected in the makefile. Also, the main source for both parent and child with changed filenames is added to the project.

Figure 5-2 Correcting Directory and Source Specifications

```
# The child program's build is no longer necessary, so delete the sub-build
# specifications.
# SUBDIRS         =       child
...

# Specify references to the new, unified directory.
SRCDIR            =       ./src
INCDIR            =       ./include
...

# Add the two main.c files with changed filenames (parent.c and child.c) to the
# build source.
SRCS              =       main.c     \
                          common.c    \
                          disp.c     \
                          font.c     \
                          gmain.c
SRCS      +=              parent.c   child.c
```

5.1.3.2 Specifying an LCF Template File for Clone Boot

To create a program that supports clone boot, you must secure a parent-only region as described in section 3.2.1 Placing Data in ROM. There is an LCF template file that has ROM placement configured for clone boot. You need to explicitly specify the following template.

```
$TwlSDK/include/nitro/specfiles/ARM9-TS-cloneboot-C.lcf.template
```

```
# Specify the link configuration template for clone boot.
LCFILE_TEMPLATE   = $(NITRO_SPECDIR)/ARM9-TS-cloneboot-C.lcf.template
```

5.1.3.3 Additions to the Build Procedure to Attach Authentication Code

For programs that support the clone boot feature, the procedure for getting authentication code is different from the usual procedure for DS Download Play programs, described in section 3.2.2 Authentication Code Attachment. For programs that support the clone boot feature, use the `emuchild` tool to create a binary for getting the signature code. The procedure for doing this is as follows:

Figure 5-3 Additions to the Build Procedure to Attach Authentication Code

```
# For retail-version applications, specify the distributed libsyscal.a and the
# corresponding libsyscall_child.bin
LIBSYSCALL               = ./ etc / libsyscall.a
LIBSYSCALL_CHILD         = ./ etc / libsyscall_child.bin

# Since already built, this is the procedure for creating the transfer-use
# binary with the emuchild tool.
# The created bin / sign.srl gets sent to the server that creates the
# authentication code.
presign:
   $(EMUCHILD)    \
      bin / $(NITRO_BUILDTYPE) / $(TARGET_BIN)    \
      $(LIBSYSCALL_CHILD)     \
      bin / sign.srl

# The procedure for including the obtained authentication code in the binary is
# the same as normal for clone boot.
# Here, the binary main_with_sign.srl is created with the authentication code as
bin / sign.sgn.
postsign:
   $(ATTACHSIGN)     \
      bin / $(NITRO_BUILDTYPE) / $(TARGET_BIN)     \
      bin / sign.sgn    \
      main_with_sign.srl
```

This notation is added for convenience. If you enter the notation directly on the command line, you do not need to add it to the makefile.

5.1.4 Changes to Program Source

A number of corrections must be made to the program source in line with the changes to the overall program structure made in the last section.

5.1.4.1 Change Main Entry Names

Because the original pair of `main.c` files (`parent.c` and `child.c`) both include the `NitroMain` function, which is a main entry, their names must be changed appropriately.

Figure 5-4 Changing Main Entry Names

```
child.c:

// Change name to be main entry for child.
// void NitroMain( void )
void ChildMain( void )
{
   ...
```

```
parent.c:

// Change name to be main entry for parent.
// void NitroMain( void )
void ParentMain( void )
{
   ...
```

Also, be sure to add the function prototype declarations to `common.h` using the changed names.

```
common.h

// Originally the parent's NitroMain function.
void ParentMain( void );

// Originally the child's NitroMain function.
void ChildMain( void );
```

5.1.4.2 Add New Main Entries

To call main entries for the parent and child whose names have been changed, add a new `NitroMain` function. In programs that support the clone boot feature, the `main.c` file is created as outlined in Code 5-1. This way, processes called for the parent can be separated from those called for the child, based on the value returned by the `MB_IsMultiBootChild` function.

Code 5-1 Adding New Main

```
main.c

#include <nitro.h>
#include "common.h"

void NitroMain( void )
{
   if( ! MB_IsMultiBootChild() )
   {
      ParentMain();
   }
   else
   {
      ChildMain();
   }
   /* The process does not reach this point */
}
```

In the example used here, the goal is to move from the multiboot-Model as easily as possible. Processes that are the same for parent and child can be shared. However, always make sure that a card has not been plugged into the child device.

5.1.4.3 Specify a Parent-Only Region

Part of the clone boot program code must be included in the parent-only ROM region, described in section 3.2.1 Placing Data in ROM.

Because the parent-only part of the card is a secure region, such as a ROM header, it cannot be read again from the parent after booting. For this reason, when performing a software reset using the `OS_ResetSystem` function, be careful not to reinitialize changeable (such as `.bss` and `.daya` section) data that has been placed in this region.

When using the `OS_ResetSystem` function, only the following C-language items can be used as data in the parent-only region.

- Constants
- Functions that do not have any internal static variables
- Global variables accompanied by an explicit dynamic initialization process. (In C++, an object accompanied by a constructor.)

In addition, content to be included in the parent-only region should not only be "essential to the parent," but must also "not be used at all by the child."

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At this time, no simple standard can be applied; the ability to judge these two criteria depends on the overall design of the application related to identifying the main version of the software as opposed to the versions distributed for DS Download Play. As a general rule, however, it is both easy and effective to include state transitions to the states where only the main part of the program can be played in this parent-only region.

In the `cloneboot` sample, all functions that are included in `parent.c` are specified for placement in the parent-only region. This region is specified as described in Code 5-2, using the TWL-SDK include files `parent_begin.h` and `parent_end.h`.

Code 5-2 Specifying for Placement in the Parent-Only Region

```
parent.c

...

//============================================================
//   Function definitions
//============================================================

// The parent-only region .parent section definitions start from here.
// Only functions that do not include static variables exist below this point.
#include <nitro/parent_begin.h>
void ParentMain( void )
{
...

}
// The parent-only region .parent section definitions end here.
#include <nitro/parent_end.h>
// End of file.
```

Here, `parent.c` includes all DS Download Play parent processes. The conditions for placement in the parent-only region are satisfied: the content is essential to the parent and is never used by the child.

Two representative examples of the many types of content that should not be specified for the parent-only region are given below for your reference.

Changing code so that these functions are not called invalidates them; thus, from a security standpoint, there is no reason to place functions that do not need to be called in the parent-only region.

Code 5-3 Content That Should Not Be Specified for Parent-Only Region (Example 1)

```
/* Function gets placed in the parent-only region (for debug output only) */
void  no_use( void )
{
  OS_Printf( "called!\n" );
}
...
void NitroMain( void )
{
  ...
```

```
  /* If parent, this gets called.  (No trouble if it is not called) */
  if( !MB_IsMultiBootChild( ) )  no_use( );
}
```

Next, you must completely avoid unintentionally placing a function used by both parent and child in the parent-only region. Here, the distinction between "main part of the program" and "delivered program" affects game quality.

Code 5-4 Content that Should Not Be Specified for Parent-Only Region (Example 2)

```
/* Function gets placed in the parent-only region. (A screen presentation process
that the child is not expected to use) */
void  draw_special_effect_1000( void )
{
   ... /* Screen presentation process */
}

/* Game process shared by parent and child */
void  UpdateGameFrame( void )
{
  /* Unexpectedly, function gets called by both parent and child under certain
conditions */
  if( score >= 1000 ) draw_special_effect_1000( );
}
```

5.1.4.4 Correct the Binary Registration Process

The process that registers binaries for the Multiboot library also needs to be changed to allow cloneboot. This procedure is described in section 3.2.3 Clone Boot Binary Registration.

Code 5-5 Correcting the Binary Registration Process

```
parent.c
...
const MBGameRegistry mbGameList =
{
   // If the MBP_Start function gives NULL for the path name, the process is
   // treated as a clone boot.
   // To read details about the function's internal processes, see
   // $TwlSDK/build/demos/wireless_shared/mbp/mbp.c.
   NULL,
   (u16*)L"DataShareDemo",    // Game name
   (u16*)L"DataSharing demo(cloneboot)",   // Description of game content
...
 }
```

6 Sample Program (fake_child)

The `fake_child` sample demonstrates the procedure to create a program that uses the pseudo-Download Play child device feature (described in section 1.8 Support for Pseudo-Download Play Child Devices) to connect to the parent device from the `multiboot-Model` sample and add entries to the session.

This chapter describes the communications sequence used in the `fake_child` sample. See Chapter 4 Sample Program (Multiboot-Model) for details on the `multiboot-Model` sample, which is the program running on the parent device targeted by this sample.

6.1 MB Library Initialization

To operate the MB library as a pseudo-Download Play child device, you must first prepare a work buffer, and then initialize the library by calling the `MB_FakeInit` function. Then, after any necessary event callbacks have been set, call the `MB_FakeStartScanParent` function to have the MB library automatically transition the wireless feature to the `SCAN` state and start searching for the parent device beacon.

main.c

```
static void ModeStartScan(void)
{
    ...
    mbfBuf = (u8 *)OS_Alloc(MB_FakeGetWorkSize());
    MB_FakeInit(mbfBuf, &userInfo);
    // Set the State Transition Notification Callback function
    MB_FakeSetCStateCallback(MBStateCallback);
    // Clear the parent device list
    MI_CpuClear8(parentInfo, sizeof(parentInfo));
    // Change the wireless state to scanning
    ChangeWirelessState(WSTATE_FAKE_SCAN);
    // Set the notification callback and the GGID of the parent device to scan for,
    // and start scanning
    MB_FakeStartScanParent(NotifyScanParent, WH_GGID);
```

6.2 Listing Parent Devices

Every time it discovers a beacon being broadcast by a DS Download Play parent device with one of the specified GGIDs, the MB library generates an event callback and notifies the program. The MB library manages a list of up to 16 beacons' worth of broadcast information at the same time, and the most recent information can always be referenced with the `MB_FakeGetParentGameInfo` function.

Because there may be multiple parent devices hosting the same game at the same time, the program must list player names or other information associated with each parent device on the screen so the user can intentionally select which parent to connect to.

main.c

```
static void NotifyScanParent(u16 type, void *arg)
{
    ....
    case MB_FAKESCAN_PARENT_BEACON:
        {
            // Notification sent each time the beacon of a known parent device is received
            MBFakeScanCallback *cb = (MBFakeScanCallback *)arg;
            WMBssDesc *bssdesc = cb->bssDesc;
            ....
        }
        break;
    case MB_FAKESCAN_PARENT_FOUND:
        {
            // Notification sent each time a new parent device is discovered
            MBFakeScanCallback *cb = (MBFakeScanCallback *)arg;
            WMBssDesc *bssdesc = cb->bssDesc;
            MBGameInfo *gameInfo = cb->gameInfo;
            ....
        }
        break;
    case MB_FAKESCAN_PARENT_LOST:
        {
            // Notification sent when a known parent device is lost for an extended time
            MBFakeScanCallback *cb = (MBFakeScanCallback *)arg;
            ....
        }
        break;
```

6.3 Connecting to a Parent Device

When the parent device to which to connect has been selected, call the `MB_FakeEndScan` function to terminate the search for beacons and wait for the process to complete. When the `MB_FakeEndScan` function has finished, call the `MB_FakeEntryToParent` function to connect to the parent device. The MB library automatically transitions the wireless feature to the `MP_CHILD` state and starts wireless MP communications with the parent device.

```
main.c

static void ModeEntry(void)
{
    ...
    switch (sWirelessState)
    {
    case WSTATE_FAKE_SCAN:
        // Terminate scanning
        MB_FakeEndScan();
        ChangeWirelessState(WSTATE_FAKE_END_SCAN);
        break;
    case WSTATE_IDLE:
        // Begin connection to the parent device selected by the user
        if (!MB_FakeEntryToParent(sConnectIndex))
        {
            // Error if the specified Index is not valid
            OS_TPrintf("ERR: Illegal Parent index\n");
            ChangeWirelessState(WSTATE_FAKE_ERROR);
            sMode = MODE_ERROR;
            return;
        }
        ChangeWirelessState(WSTATE_FAKE_ENTRY);
        break;
```

6.4 Waiting for Download to Complete

Because there is actually no communication processing required of pseudo-Download Play child devices, they simply maintain MP communications while waiting for a pseudo-“download complete” callback notification from the parent device.

```
main.c

static void MBStateCallback(u32 status, void *arg)
{
    ...
    case MB_COMM_CSTATE_BOOT_READY:
        // Notifies that both disconnection from the parent device and MB processing
        // has completed
        ChangeWirelessState(WSTATE_FAKE_BOOT_READY);
        break;
```

6.5 Preparations to Disconnect from or Reconnect to a Parent Device

Once the parent device issues the download complete notification, psuedo-Download Play children can terminate MP communications and disconnect from the parent. Once you have called the `MB_FakeEnd` function and the wireless disconnection process has completed, all MB library processing for the pseudo-Download Play child feature is ended. The work buffer allocated in the `MB_FakeInit` function can be released at this time.

After this, children can reconnect to the parent device as needed and perform DS wireless play. In this sample, data sharing communications start after scanning for parent devices and performing the reconnection sequence, the same as in `multiboot-Model`.

main.c

```
static void ModeEntry(void)
{
    ...
     switch (status)
    {
    case WSTATE_FAKE_BOOT_READY:
        // Terminate entry processing
        ChangeWirelessState(WSTATE_FAKE_BOOT_END_BUSY);
        MB_FakeEnd();
        break;

    case WSTATE_FAKE_BOOT_END:
        // Increment tgid to match the parent device
        sParentBssDesc.gameInfo.tgid++;
        // Start the reconnection process
        ChangeWirelessState(WSTATE_IDLE);
        sMode = MODE_RECONNECT;
        break;
```

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