

*TMS320 DSP
DESIGNER'S NOTEBOOK*

Bootloading a TMS320C4x Network - Part 1: Direct Connect System

APPLICATION BRIEF: SPRA247

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Bootloading a TMS320C4x Network - Part 1: Direct Connect System



Abstract

This document discusses how to perform an automatic system boot-up at hardware reset, when the TMS320C4x devices are directly connected to each other. A block diagram and several code examples are provided.



Design Problem

If the TMS320C4x devices are directly connected to each other, how can you perform an automatic system boot-up at hardware reset?

Solution

In this case the system is called a “Known, Direct Connect” network. In order to configure a network in this format, the network must have the following criteria:

- ❑ The system has one dedicated device known as the system “Parent.” The parent device is configured in hardware via the IIOFx pins to boot from external memory (see section 13.2 of the TMS320C4x User’s Guide) or from a PC platform. The RESETLOC(1,0) pins must be low in order for the on-chip ROM boot loader to load programs from external memory.
- ❑ All devices (except the system parent) are called system “Children.” The system child is dependent upon the parent for boot loading. The system children are configured in hardware via the IIOFx pins to boot from communication ports (see section 13-2 of the TMS320C4x User’s Guide).
- ❑ The system parent knows where (which communication ports) the children are connected.
- ❑ Each parent and child connection is direct. There are no intermediate devices involved in order for the parent to boot load the child.

Figure 1. Known, Direct Connect Network

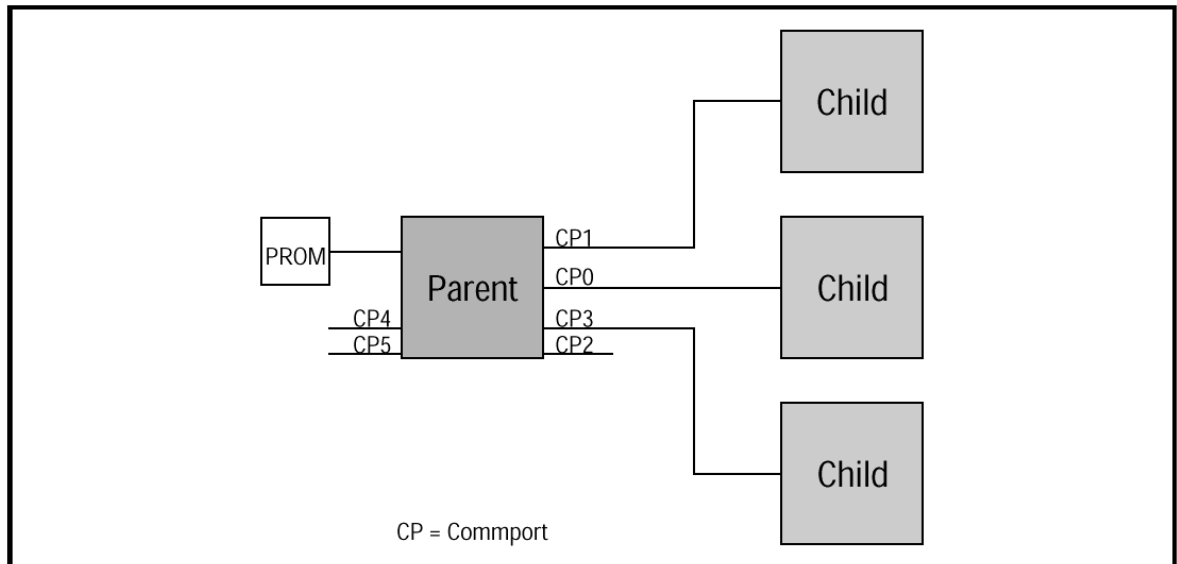


Figure 1 shows the system parent directly connected to the children. At a system reset the parent boot loads from external memory (PROM) and begins performing its tasks as the system parent. Each child polls its communication ports (function of the on-chip ROM boot loader) to see if the parent is attempting a boot. The parent knows where (which communication port) the child is connected. The example C code below demonstrates the process the parent follows in order to boot load the network. Pointers are initialized at the beginning and end of the boot table. The pointer at the beginning of the boot table is incremented after each word is transmitted to the child (out_word command) and continues until the end of the boot table is reached. At this point the child is booted and the parent repeats for all system children.



Example 1. System parent

```
int port_addr = 100040h;
                /* init port pointer to comm port 0 */
extern int beg_label, end_label;
                /* init external labels of the boot table */
int port [6] = {1, 2, -1, 3, -1, -1};
                /*init CP connection matrix. -1's indicate no connect*/
volatile int *table_ptr, *end_ptr;
                /* init the boot table pointer and end table pointer */
end_ptr = &end_label;
                /* set end pointer to the end of boot table */

main
{
for (CPX = 0; CPX < 6; CPX++)
    /* Continue for all six comm ports */
    {
        if (port [CPX] = 0)
            /* If child is connected then boot (!= -1) */

            table_ptr = &beg_label;
                /* Set table ptr to the beginning of boot table */
port_addr = port_addr +(10h*CPX);
                /* Point to next comm port address */

do
{
    *(port_addr + 2) = *table_ptr;
        /* Copy data at table_ptr to cp out mem. loc */
    table_ptr++; /* Increment ptr to next word of boot table */
}while(table_ptr < end_ptr);
        /* Continue until complete boot table is */
    } /* transmitted through CPX. */
CPX++; /* Next comm port */
}
}
```

When the first data word is sent from the parent, the child locks onto the communication port, stores the communication port address to register AR3, and continues to receive data until the termination word is received. If the child does not receive the complete boot table in the correct format, the child will never completely boot-up. Please refer to section 13-2 of the TMS320C4x User's Guide to learn more about the boot table requirements.

The parent code in Example 1 uses external labels to reference the boot table. The external labels are resolved when the boot table is linked to the parent's application code. The code that resides in the parent is shown in Example 3.

To create the boot table and link it to the parent's application, there are several steps that must be taken to convert the child's application code. The steps are listed below:



- ❑ The child application should remain self contained, assembled, and linked as an independent application (`child.out`).
- ❑ Use the Hex30 Conversion Utility to convert the `.out` file to a PROM programming file in boot table format. Please read the Hex30 Utility Addendum (Literature number SPRU081) to learn more about creating a boot table (`-boot` command) using Hex30. An example Hex30 command file is shown in Example 2:

Example 2. Hex30 Command File

```
child.out          /* Specify input COFF file */
-o child.hex       /* Specify output filename */
-a                /* Convert file to Hex30 ASCII format */
-memwidth 32      /* Word length of device (32 bits wide) */
-romwidth 32      /* Specify 32 to convert the complete word */
-boot             /* Hex30 to construct boot table header */
:                 :
:                 :
```

- ❑ • Now use the HEX2ASM conversion utility (executables and directions available on TMS320 BBS in archived file called `hex2asm.exe`) to convert the Hex30 programmer file (`child.hex`) to an assembly file (`child.asm`). The HEX2ASM utility extracts the valuable data and creates `.word xxxxxh` for each 32-bit word and saves it in a `.sect` table. The HEX2ASM converter can also include global labels. In Figure 2, the global labels that the parent references are `beg_label` and `end_label`.

NOTE:

Also please note that labels can be defined in the final linker `.cmd` file when linking the child boot table to the parent application code. This is accomplished by including the following in the linker `.cmd` file.

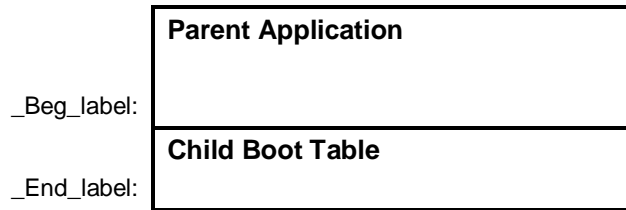
Example 3. Defining labels in the linker command file

```
SECTIONS
{
.child:          {_beg_label = .;
                 *(.child)
                 _end_label = . -1; } RAM 1
```

- ❑ • The output of the HEX2ASM converter is an assembly file. Link the `child.obj` file with the parent's `parent.obj` file.



Figure 2. Parent's Memory Map



At this point the parent application is linked to the child application (in boot table format) as illustrated in Figure 2. At reset, the parent device must boot load this information from external memory or a PC platform. If the parent boots from external memory the final (parent + child) code must be converted again by the Hex30 utility to create the PROM programmer file. If booting the parent via a PC platform, the data must be converted again in order for the PC to read and transmit the boot information properly.