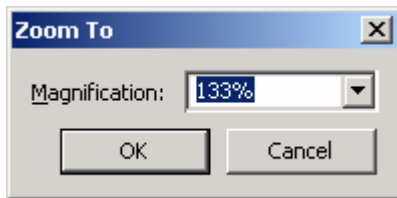


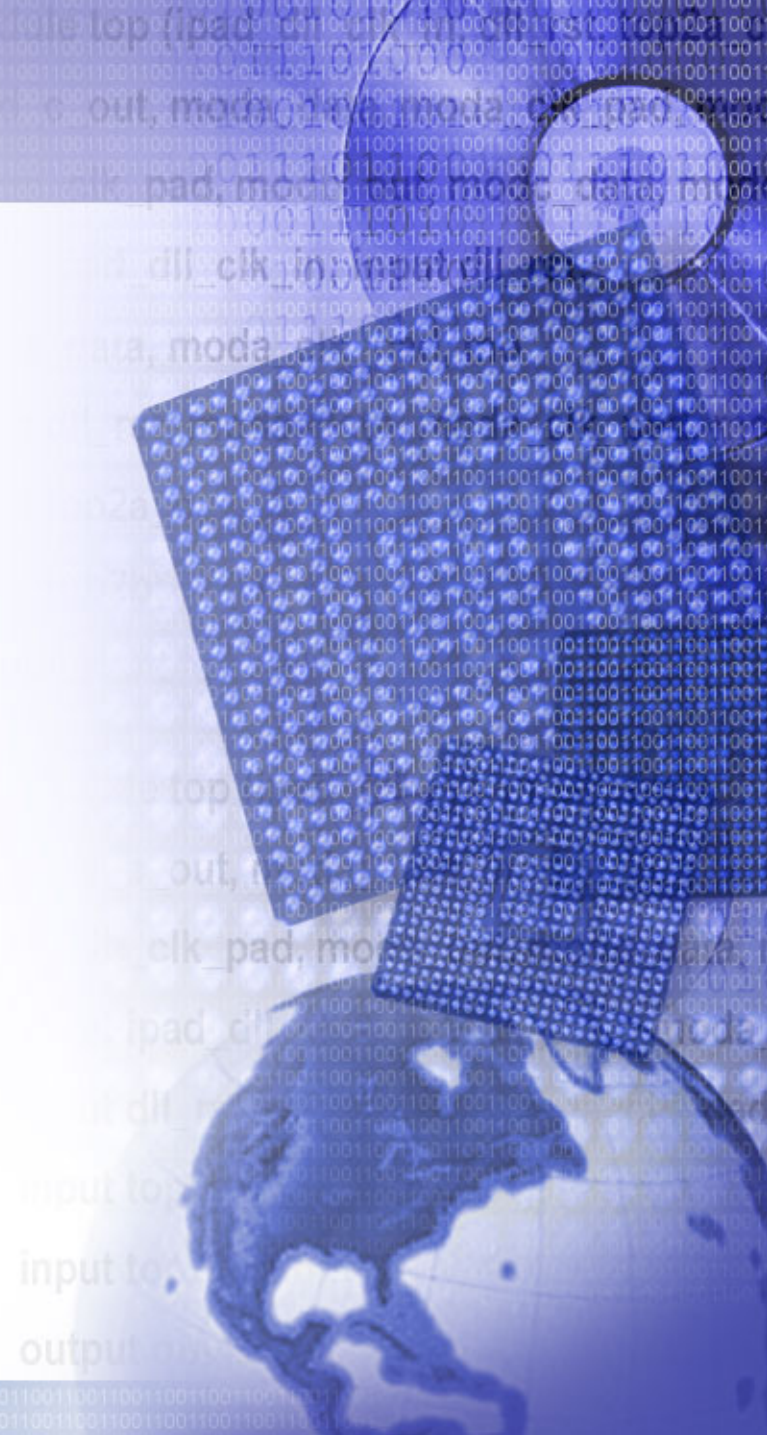


ML300 Virtex-II Pro and VxWorks System Upgrade with System ACE-CF

Xilinx System Engineering Group



Note: Screen shots in this acrobat file appear best when Acrobat Magnification is set to 133%



ML300 System Upgrade

Overview

- This demonstration includes:
 - Hardware and software system bring up
 - Initial System Bring up
 - PPC controlled upgrade
 - Dynamic upgrading of both hardware IP and software object modules while both the FPGA and OS remain active.

What will be covered

- System bring up from power on or system reset
 - Multiple switch selectable configurations
 - Hardware and SW bring-up
 - FPGA configuration
 - System ACE-CF bootrom
 - ACE via JTAG loads system image from CF and boot VxWorks
 - System ACE-CF bootloader
 - Retrieve system image from CF via ACE MPU port & boot VxWorks

What will be covered

- Virtex-II Pro self-upgrade using System ACE-CF
 - PPC selection via ACE-CF MPU Port
 - Hardware and SW bring-up
 - FPGA configuration
 - System ACE-CF bootrom
 - ACE via JTAG loads system image from CF and boot VxWorks
 - System ACE-CF bootloader
 - Retrieve system image from CF via ACE MPU port & boot VxWorks

What will be covered

- Virtex-II Pro self-upgrade using System ACE-CF
 - Load a new software module
 - Dynamically link a new software module with VxWorks
 - The OS stays up during this process
 - Reconfiguration of Virtex-II Pro
 - ACE file moved from CF via MPU port to RAM
 - .ACE file played over MPU to JTAG under PPC control
 - OS stays up during partial reconfiguration

Quick Start

1. Bootrom Process - Set config addr = 7 to configure FPGA and launch VxWorks OS.
Screen will be cleared and the Xilinx, WRS logo screen appears. LED Pattern A runs
2. LED Pattern B is generated by a SW module built into the VxWorks image; this pattern appears on the GPIO LEDs
3. HW upgrade #1 performed using the System ACE MPU port with the `partial_inv.ace` file. LED pattern changes to LED Pattern C
4. SW upgrade #1 is performed using the dynamic loading capability of VxWorks. Retrieves a new SW module to replace the built-in SW module from the Microdrive (`/VXWORKS/MODULES/ML300walk_one_inv.out`).
LED pattern changes to LED Pattern D
5. HW upgrade #2 performed using the System ACE MPU port and the `partial_buf.ace` file from the Microdrive. LED pattern changes to LED Pattern E
6. SW upgrade #2 using dynamic unloading capability of VxWorks. Reverts back to the original built-in SW module. LED pattern changes back to LED Pattern B

Quick Start (cont.)

7. System is now in the original state before the upgrade process began. The SW and HW components are now identical to that of the starting point.
8. LED Pattern A is displayed and the initial Xilinx & WRS logo screen appears.
9. Bootloader Process - Set config addr = 3 to configure the FPGA and launch the bootloader. The bootloader retrieves the VxWorks image from Microdrive (`/VXWORKS/IMAGES/vxWorks`). Repeat steps 2-8

Files

- Files under `xilinx.sys` control
 - Contents of `XILINX` listed below

| Addr | Sub-directory | ACE File | HW | SW | Comment |
|------|---------------|----------------|-------------|------------|----------------------|
| 0 | bootload | top.ace | Full_IP.bit | | |
| 1 | xrom | top.ace | Full_IP.bit | | |
| 2 | linux | top.ace | Full_IP.bit | | |
| 3 | vxboot | vxboot1_cf.ace | Full_IP.bit | bootloader | HW(bit) +SW(elf) ACE |
| 4 | quake | top.ace | Full_IP.bit | | |
| 5 | v2pdraw | top.ace | Full_IP.bit | | |
| 6 | tictac | top.ace | Full_IP.bit | | |
| 7 | vxworks | ML300lab5.ace | Full_IP.bit | bootrom | HW(bit) +SW(elf) ACE |

Note: HW + SW ACE files consist of a ELF file concatenated with a bitstream

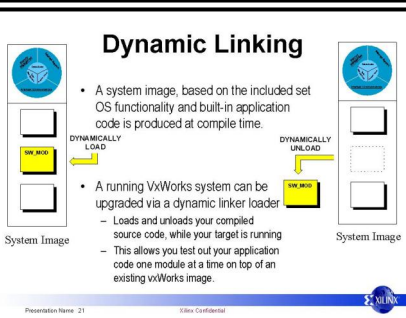
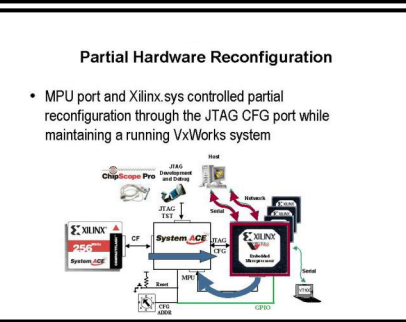


Files

- Files **not** under `xilinx.sys` control
 - All on Microdrive (local file system)

| File | Location | Comment |
|------------------------------|--------------------------|---|
| vxWorks | Local File System | VxWorks System Image Retrieved by bootloader from Local Disk Drive |
| partial_buf.ace | Local File System | Partial Bitstream Loaded from Local Disk Drive |
| partial_inv.ace | Local File System | Partial Bitstream Loaded from Local Disk Drive |
| assorted bmp files | Local File System | Bitmap Images retrieved from Local File System and Displayed on screen |
| ml300walk_one_inv.out | Local File System | VxWorks SW Module Dynamically Loaded and Unloaded |

ML300 Screen shots reference sheet



1. Logos (LED Pattern A)
2. Running initial OS SW (LED Pattern B)

3. HW Upgrade #1 (LED Pattern C)

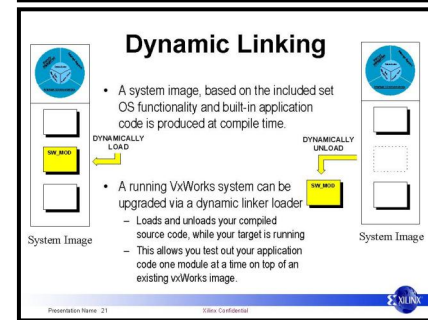
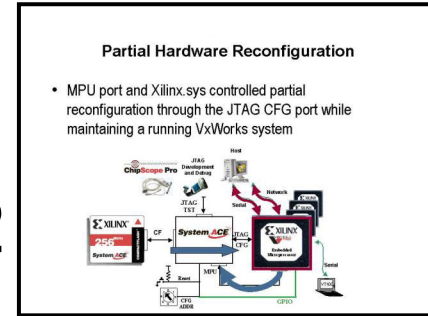
4. SW Upgrade #1 (LED Pattern D)

5. HW Upgrade #2 (LED Pattern E)

6. SW Upgrade #2 (LED Pattern B)

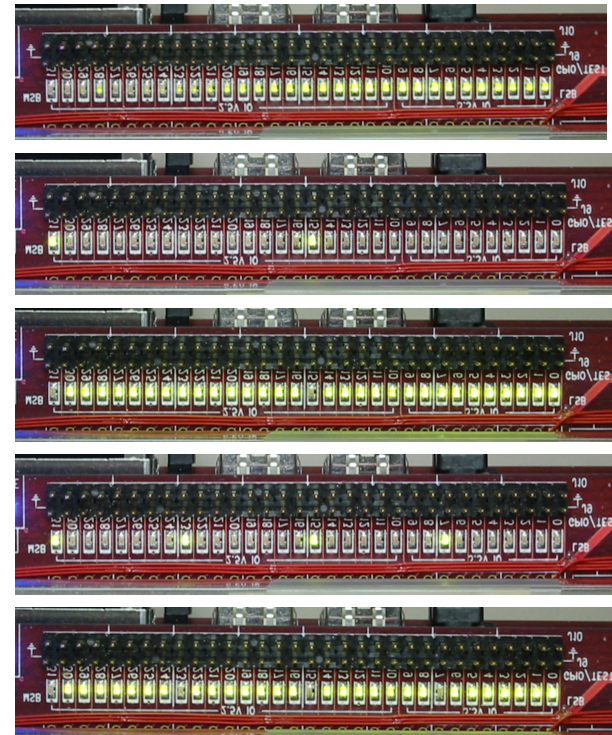
7. Back to initial OS image

8. Logos (LED Pattern A)




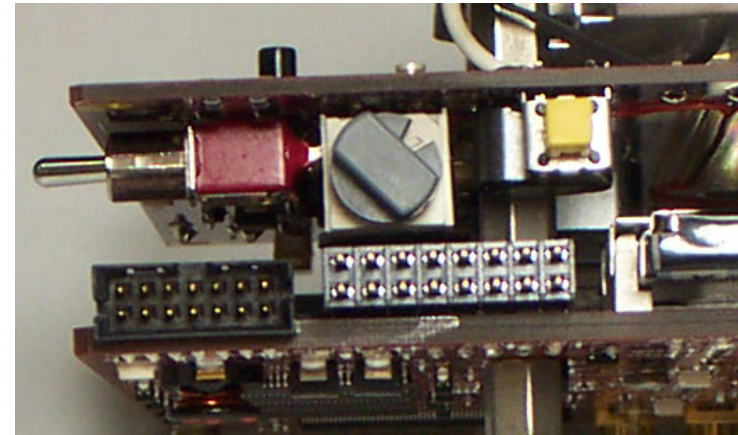
ML300 LED Patterns

- Pictures of Patterns A,B,C,D,E
 - Cylon = pattern A
 - 2 Walking ones = pattern B
 - 2 walking zeros = pattern C
 - 4 walking ones = pattern D
 - 4 walking zeros = pattern E



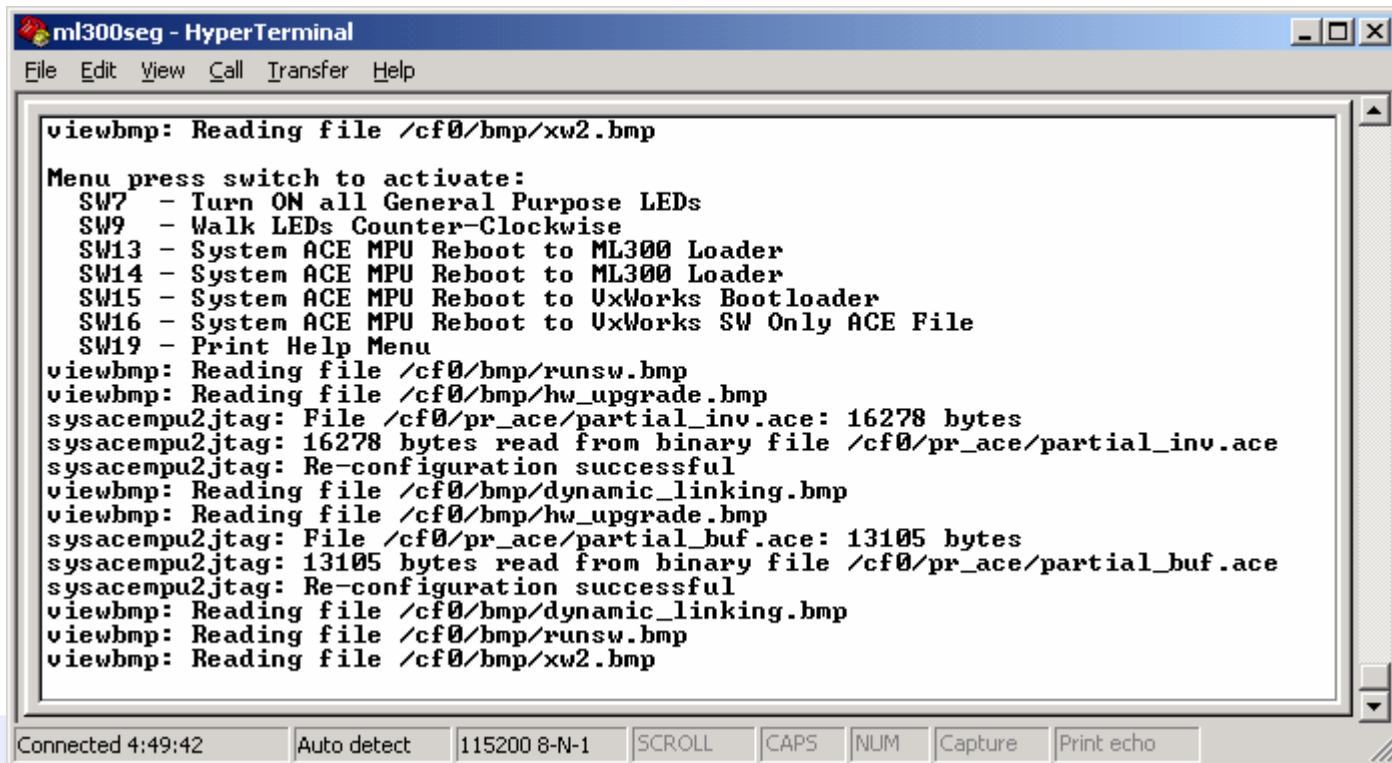
Step 1

- FPGA is configured & Memory loaded with VxWorks OS
 - SysACE configures FPGA & boots OS using JTAG CFG port
- **Set Mode Switch to 7** 
- **Turn Power ON**
 - FPGA Configures as expected
 - VxWorks boots from RAM
 - Once kernel initialization is completed, VxWorks enters multi-tasking mode



Step 1

- Each step is reflected on serial terminal
 - Full sequence (Steps 2-8) shown here



```
ml300seg - HyperTerminal
File Edit View Call Transfer Help

viewbmp: Reading file /cf0/bmp/xw2.bmp

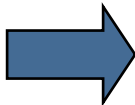
Menu press switch to activate:
SW7 - Turn ON all General Purpose LEDs
SW9 - Walk LEDs Counter-Clockwise
SW13 - System ACE MPU Reboot to ML300 Loader
SW14 - System ACE MPU Reboot to ML300 Loader
SW15 - System ACE MPU Reboot to UxWorks Bootloader
SW16 - System ACE MPU Reboot to UxWorks SW Only ACE File
SW19 - Print Help Menu
viewbmp: Reading file /cf0/bmp/runsw.bmp
viewbmp: Reading file /cf0/bmp/hw_upgrade.bmp
sysacempu2jtag: File /cf0/pr_ace/partial_inv.ace: 16278 bytes
sysacempu2jtag: 16278 bytes read from binary file /cf0/pr_ace/partial_inv.ace
sysacempu2jtag: Re-configuration successful
viewbmp: Reading file /cf0/bmp/dynamic_linking.bmp
viewbmp: Reading file /cf0/bmp/hw_upgrade.bmp
sysacempu2jtag: File /cf0/pr_ace/partial_buf.ace: 13105 bytes
sysacempu2jtag: 13105 bytes read from binary file /cf0/pr_ace/partial_buf.ace
sysacempu2jtag: Re-configuration successful
viewbmp: Reading file /cf0/bmp/dynamic_linking.bmp
viewbmp: Reading file /cf0/bmp/runsw.bmp
viewbmp: Reading file /cf0/bmp/xw2.bmp

Connected 4:49:42 Auto detect 115200 8-N-1 SCROLL CAPS NUM Capture Print echo
```

Step 1

- Logo Screen appears
- LED Pattern A runs

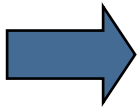
ML300
Screen



Step 2

- This screen shot appears
- LED Pattern B runs from originally loaded software

ML300
Screen

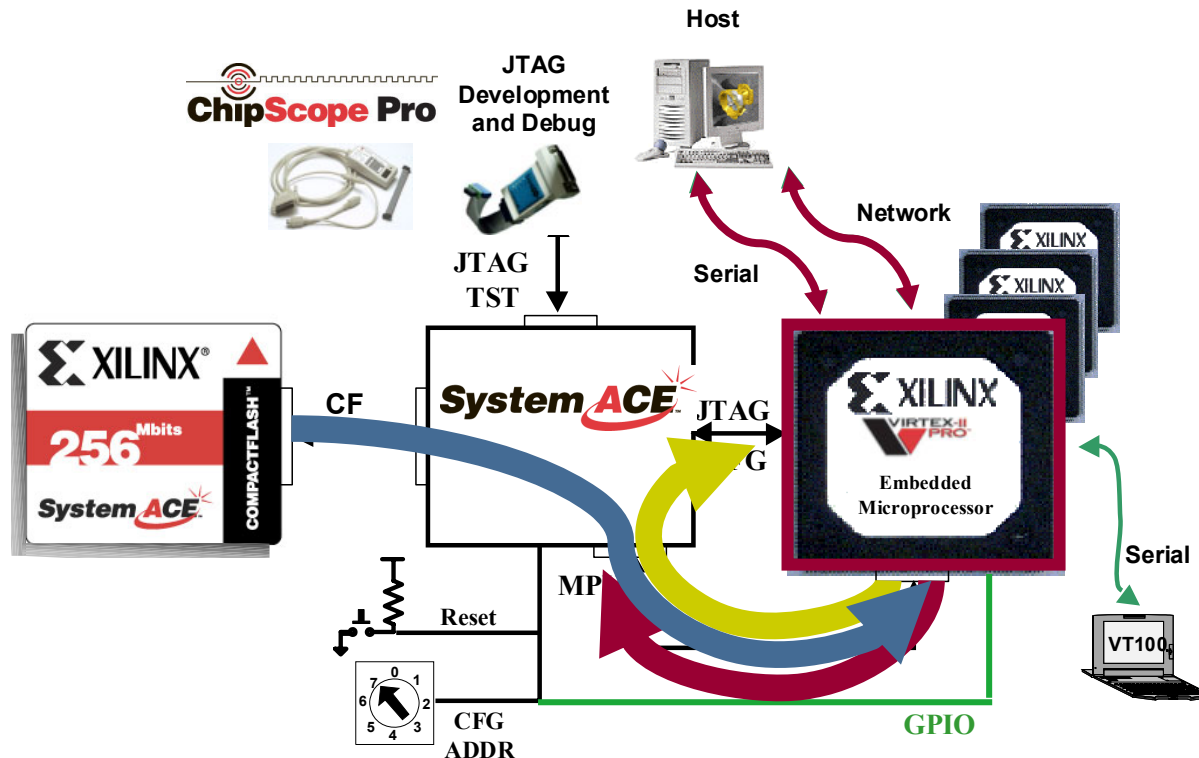


**RUNNING SOFTWARE
FROM
BOOTED VXWORKS IMAGE**

Step 3

Partial Reconfig Local File System

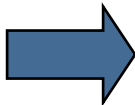
1. Request an ACE file from System ACE-CF / Local file system
2. Receive the ACE file via the MPU port, loading it into RAM
3. Send the ACE file back to the MPU port; System ACE plays the ACE file over JTAG CFG Port, performing a Partial reconfiguration of the FPGA



Step 3

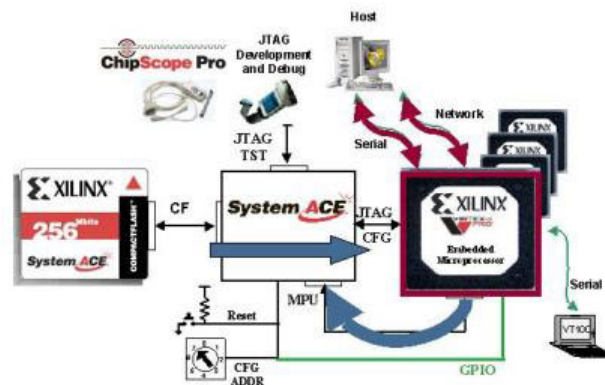
- HW Upgrade #1
 - Partial Reconfiguration of IOBs
 - Activates inverters on LED outputs
 - LED Pattern C runs

ML300
Screen



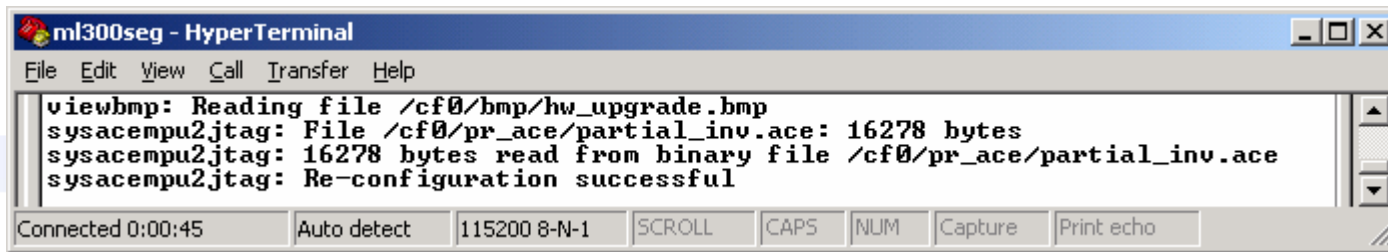
Partial Hardware Reconfiguration

- MPU port and Xilinx.sys controlled partial reconfiguration through the JTAG CFG port while maintaining a running VxWorks system



Step 3

- Retrieves an ACE file through the MPU port from the Compact Flash (`/cf0/pr_ace/partial_inv.ace`)
 - Reads it into RAM
- Plays this ACE file back out to the MPU port
- System ACE plays it to the JTAG CFG port
 - Partial reconfiguration of FPGA
 - Changes the LED buffers to Inverters, from LED Pattern B to LED Pattern C



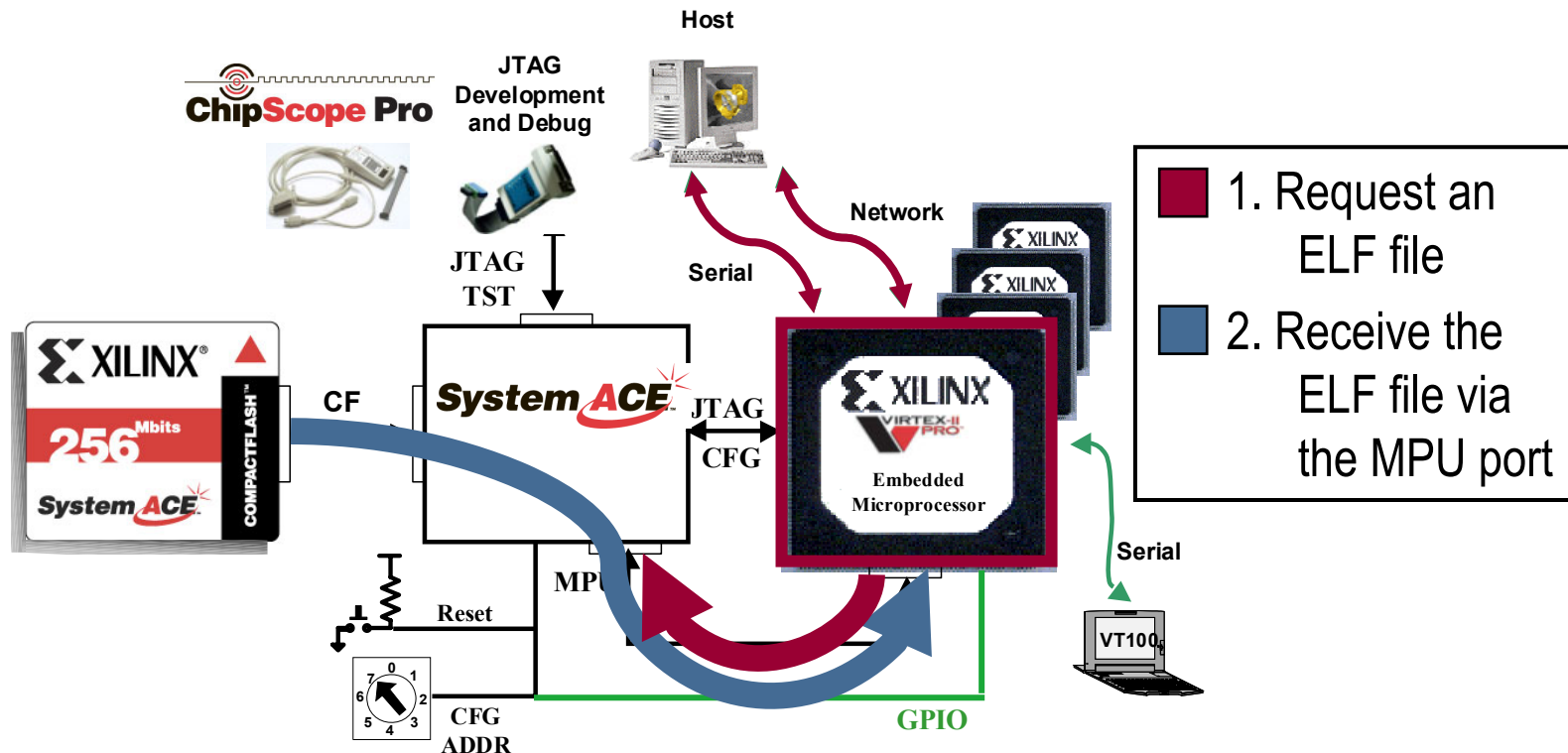
```
ml300seg - HyperTerminal
File Edit View Call Transfer Help
viewbmp: Reading file /cf0/bmp/hw_upgrade.bmp
sysacempu2jtag: File /cf0/pr_ace/partial_inv.ace: 16278 bytes
sysacempu2jtag: 16278 bytes read from binary file /cf0/pr_ace/partial_inv.ace
sysacempu2jtag: Re-configuration successful
Connected 0:00:45  Auto detect  115200 8-N-1  SCROLL  CAPS  NUM  Capture  Print echo
```



Step 4

Dynamically Load Software Module

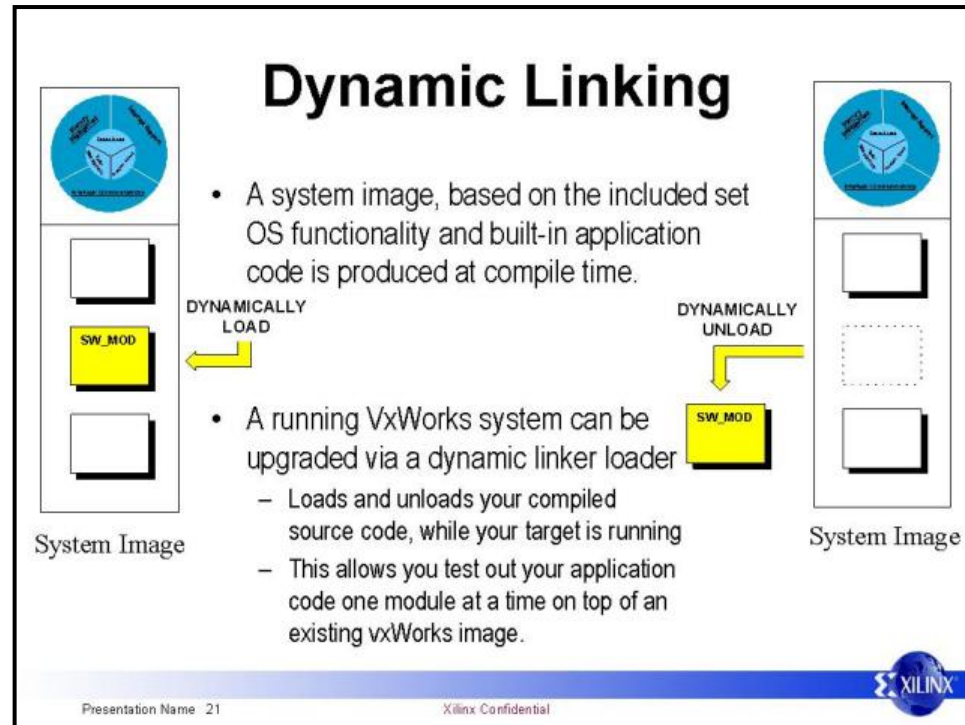
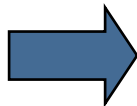
- Use VxWorks' Loader to dynamically update the system image while maintaining a running VxWorks system. System ACE-CF provides local file system



Step 4

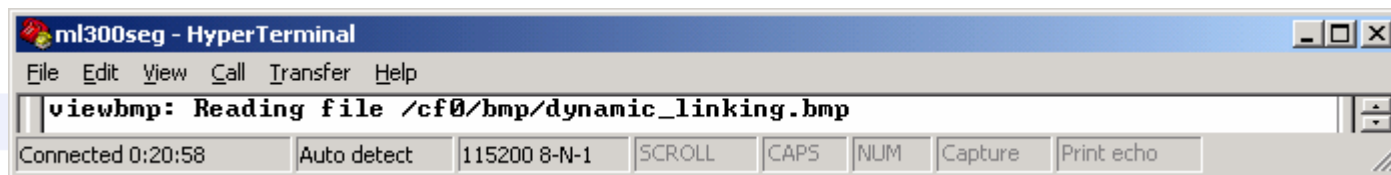
- Software Upgrade #1
 - LED Pattern D

ML300
Screen



First Software Upgrade

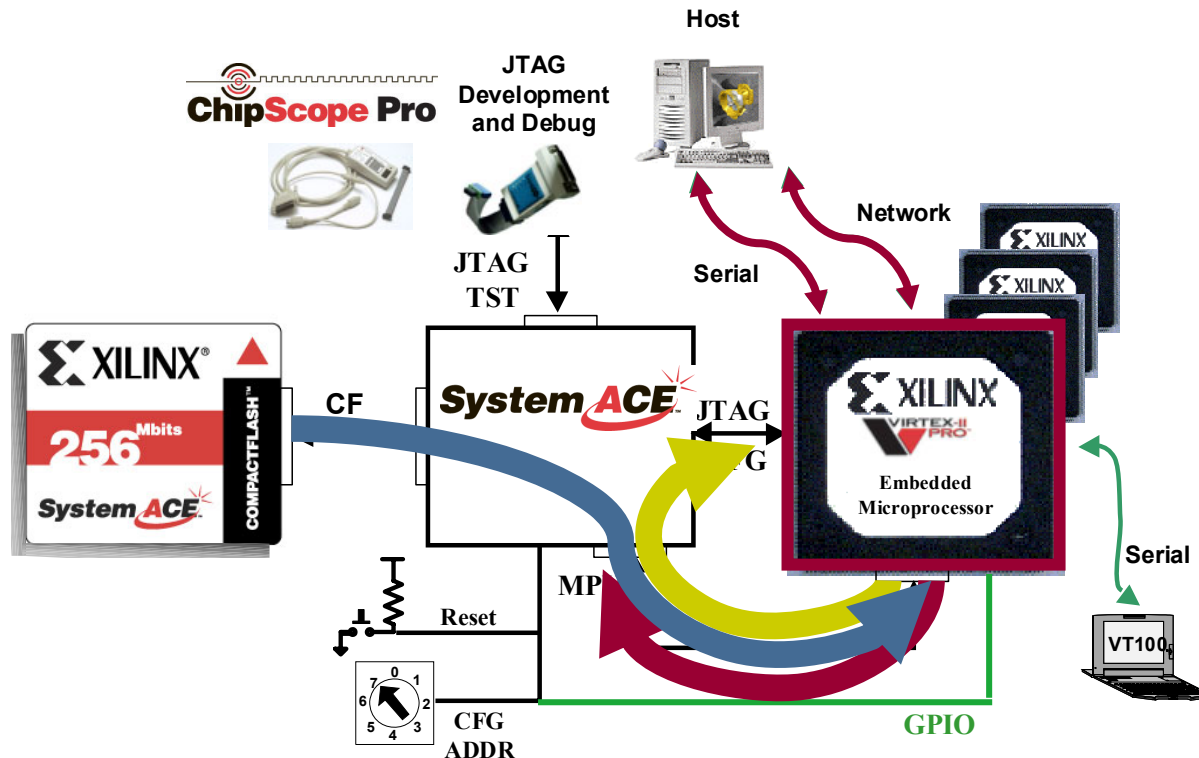
- Dynamic linking
 - Done using VxWorks loader (ld)
 - Loads `m1300walk_one_inv.out` software module
 - Initially booted VxWorks image stays up and running
- Allows upgrade of the software "driver"
 - After performing a hardware upgrade
 - New SW drivers may be necessary to take full advantage of the new functionality provided in any hardware upgrade.



Step 5

Partial Reconfig Local File System

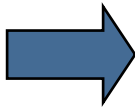
1. Request an ACE file from System ACE-CF / Local file system
2. Receive the ACE file via the MPU port, loading it into RAM
3. Send the ACE file back to the MPU port; System ACE plays the ACE file over JTAG CFG Port, performing a Partial reconfiguration of the FPGA



Step 5

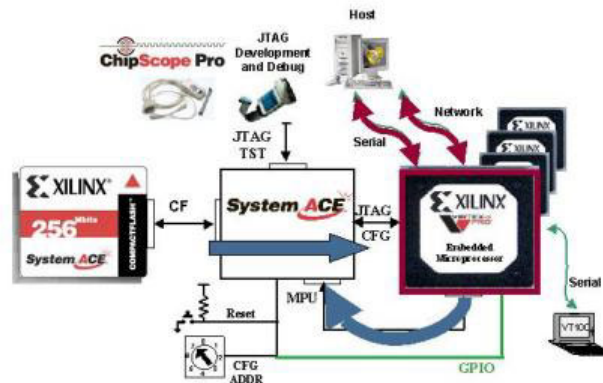
- Hardware Upgrade #2
 - Partial Reconfiguration of IOBs
 - Removes inverters on LED outputs
 - LED Pattern E

ML300
Screen



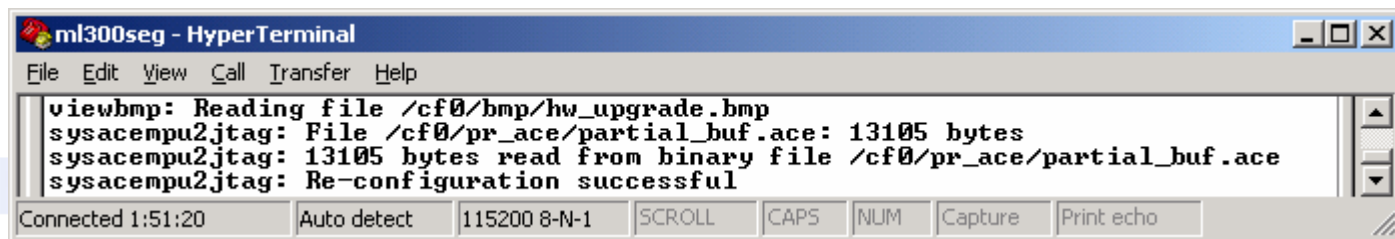
Partial Hardware Reconfiguration

- MPU port and Xilinx.sys controlled partial reconfiguration through the JTAG CFG port while maintaining a running VxWorks system



Second Hardware Upgrade

- Retrieves an ACE file through the MPU port from the Compact Flash (`/cf0/pr_ace/partial_buf.ace`)
 - Reads it into RAM
- Plays this ACE file back out to the MPU port
- System ACE plays it to the JTAG CFG port
 - Partial reconfiguration of FPGA
 - Changes the LED Inverters back to buffers, from Pattern E to Pattern D



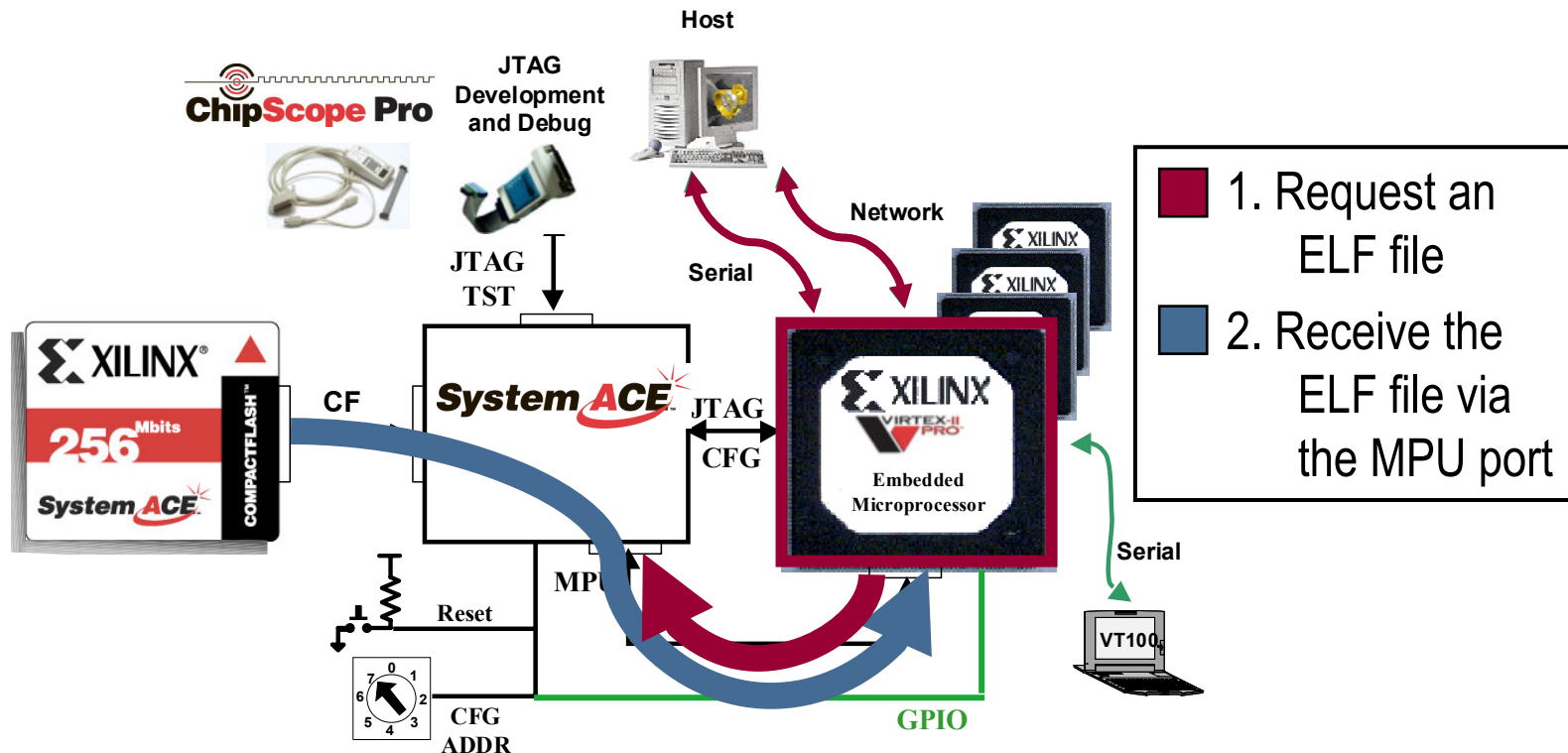
```
ml300seg - HyperTerminal
File Edit View Call Transfer Help
viewbmp: Reading file /cf0/bmp/hw_upgrade.bmp
sysacempu2jtag: File /cf0/pr_ace/partial_buf.ace: 13105 bytes
sysacempu2jtag: 13105 bytes read from binary file /cf0/pr_ace/partial_buf.ace
sysacempu2jtag: Re-configuration successful
Connected 1:51:20 Auto detect 115200 8-N-1 SCROLL CAPS NUM Capture Print echo
```



Step 6

Dynamically Load Software Module

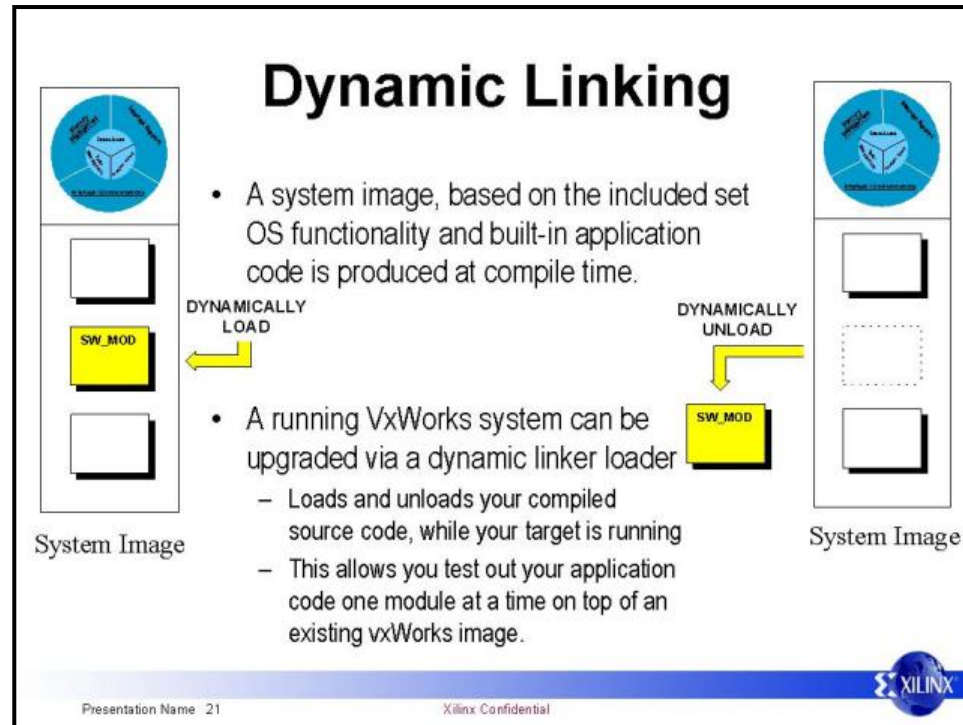
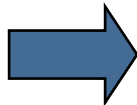
- Use VxWorks' Loader to dynamically update the system image while maintaining a running VxWorks system. System ACE-CF provides local file system



Step 6

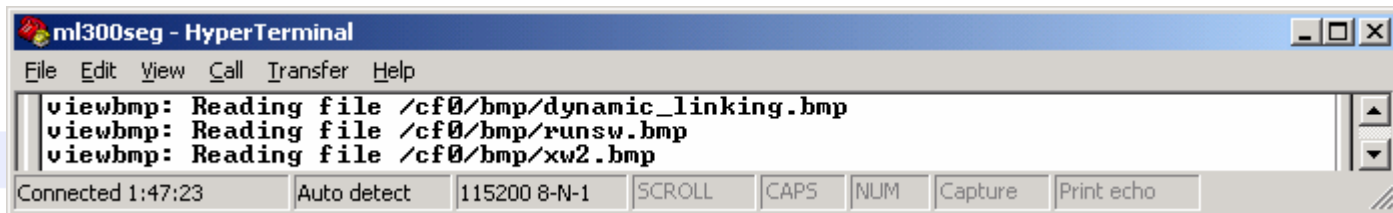
- Software Upgrade #2
 - LED Pattern B

ML300
Screen



Second Software Upgrade

- Dynamic linking
 - Done using VxWorks unloader (`unld`)
 - Unloads `m1300walk_one_inv.out` software module
 - Initially booted VxWorks image stays up and running
- Allows removal of the software "driver"
 - After restoring the hardware to original condition



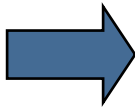
```
m1300seg - HyperTerminal
File Edit View Call Transfer Help
viewbmp: Reading file /cf0/bmp/dynamic_linking.bmp
viewbmp: Reading file /cf0/bmp/runsw.bmp
viewbmp: Reading file /cf0/bmp/xw2.bmp
Connected 1:47:23 Auto detect 115200 8-N-1 SCROLL CAPS NUM Capture Print echo
```



Step 7

- After Software Upgrade #2
 - System is restored to initial hardware and software

ML300
Screen

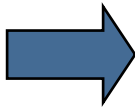


**RUNNING SOFTWARE
FROM
BOOTED VXWORKS IMAGE**

Step 8

- Logo Screen reappears
- LED Pattern runs again

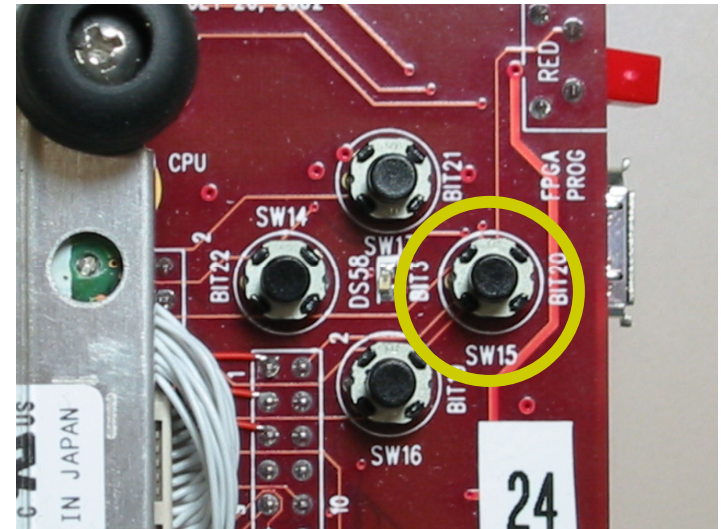
ML300
Screen



Step 9

Configure FPGA & File System Bootloader

- FPGA is configured & DDR Memory loaded with local file system Bootloader
- SysACE configures FPGA & loads bootloader
- Bootloader retrieves VxWorks image from Microdrive
- **Press SW15** (top of ML300, to the right)
 - Performs PPC Self-Upgrade of HW and OS



Step 9

- Bootloader program
 - System ACE via JTAG control moves bootloader program to RAM (DDR)
 - Runs in DDR memory
 - Retrieves VxWorks image from the local file system (Microdrive)



```
ml300seg - HyperTerminal
File Edit View Call Transfer Help

CPU: ML300 UirtexII Pro PPC405 Rev D
Version: 5.4.2
BSP version: 1.2/0/p
Creation date: Nov 13 2002, 09:06:49

Press any key to stop auto-boot...
0
auto-booting...

boot device          : sysace=1
unit number         : 0
processor number     : 0
file name           : /cf0/uxworks/images/uxWorks
flags <f>           : 0x0

Attaching to System ACE MPU... done.
Loading /cf0/uxworks/images/uxWorks...1110600
Starting at 0x10000...
```

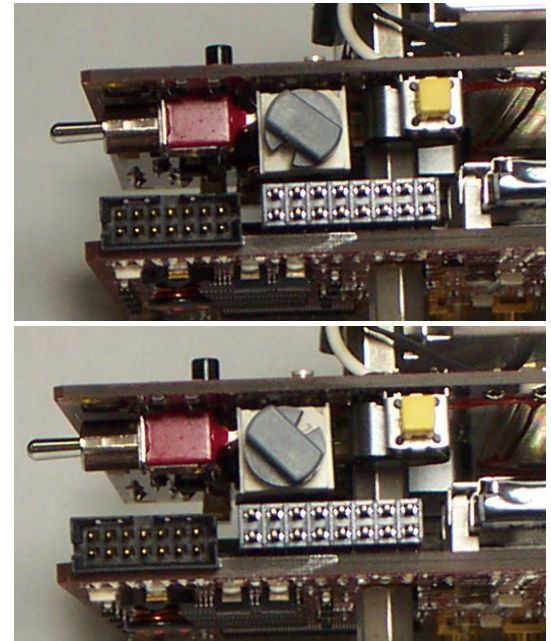
Connected 1:11:09 Auto detect 115200 8-N-1 SCROLL CAPS

ML300 Buttons

- Buttons on ML300
 - Cause actions as listed below
 - The buttons are polled by SW; hold for a long moment then release
- SW7 - All Board LEDs on
- SW9 - Walk Board LEDs
CCW
- SW10 - LED Pattern A
- SW13 - ML300 Loader
- SW14 - ML300 Loader
- SW15 - VxWorks bootloader
- SW16 - VxWorks bootrom
- SW19 - Print Help Info
- SW6, 8, 11, 12, 17, 18 - NOP

Summary

- Virtex-II Pro system bring up from power on or system reset
 - Multiple switch selectable configurations
 - Hardware and SW bring-up
 - SW3 - FPGA configuration and System ACE-CF bootloader
 - Retrieve system image from CF via ACE MPU port & boot VxWorks
 - SW7 - FPGA configuration and System ACE-CF bootrom
 - ACE via JTAG loads system image from CF and boot VxWorks



Summary

- Virtex-II Pro self-upgrade using System ACE-CF
 - SW15 & 16 Polled by PPC SW
 - PPC selection via ACE-CF MPU Port
 - Hardware and SW system upgrade
 - SW15 - FPGA configuration and System ACE-CF bootloader
 - Retrieve system image from CF via ACE MPU port & boot VxWorks
 - SW16 - FPGA configuration and System ACE-CF bootrom
 - ACE via JTAG loads system image from CF and boot VxWorks

