Technical Brief 20140501 from Missing Link Electronics:

Zynq SSE for Network-Attached Storage for the Avnet Mini-ITX

For the evaluation of Zynq SSE MLE supports two separate hardware platforms: The Avnet Zynq Mini-ITX board, and the Xilinx ZC706 Development Kit plus the XM104 Adapter Board. This document is for the Avnet Zynq Mini-ITX board.

Network-Attached Storage (NAS) is a file-level data storage connected to a computer network, typically via Ethernet transporting TCP/IP and/or UDP communication.

MLE's Zynq SATA Storage Extension (Zynq SSE) is a fully integrated and pre-validated system stack comprising 3rd-party SATA Host Controller and DMA IP cores from ASICS World Services, a storage micro-architecture from MLE, Xilinx PetaLinux, and an Open Source SATA Host Controller Linux kernel driver, also from MLE. Zynq SSE utilizes the Xilinx GTX Multi Gigabit Transceivers to deliver SATA I (1.5 Gbps), SATA II (3.0 Gbps), or SATA III (6 Gbps) connectivity. When combined with Zynq's networking capabilities this effectively leads to a demonstration of Networked Storage, or NAS.

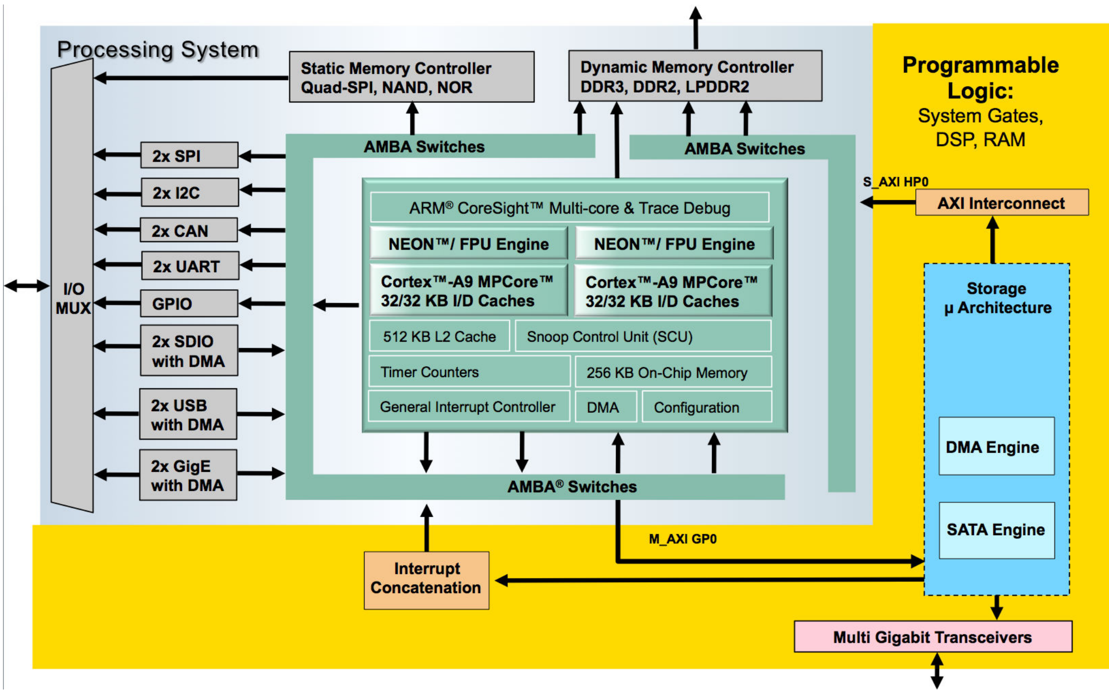
This Technical Brief shows how to setup the Zynq SSE to demonstrate NAS functionality. After going through the steps described herein, you will have a working Linux System running on the Zynq with an attached SATA HDD or SSD, making files stored on the attached disk available to other networked clients.

Team MLE has spent significant efforts to try and test all aspects of Zynq SSE. However, if you feel that you encounter something not right, or if you do have any questions, please do not hesitate to contact us. The best way to contact MLE is to fill out the Contact Request Form at

`http://MLEcorp.com/ZynqSSE`

Block Diagram

The block diagram shown below gives an overview over the Zynq SSE reference design: Within the Zynq Programmable Logic (PL) the MLE storage micro-architecture instantiates the DMA and the SATA Host Controller IP blocks. The storage micro-architecture itself interfaces with the Zynq Processing System (PS) via the high-performance AXI HP0 slave port. The ARM A9 in the PS runs Xilinx PetaLinux and the SATA Linux kernel driver.



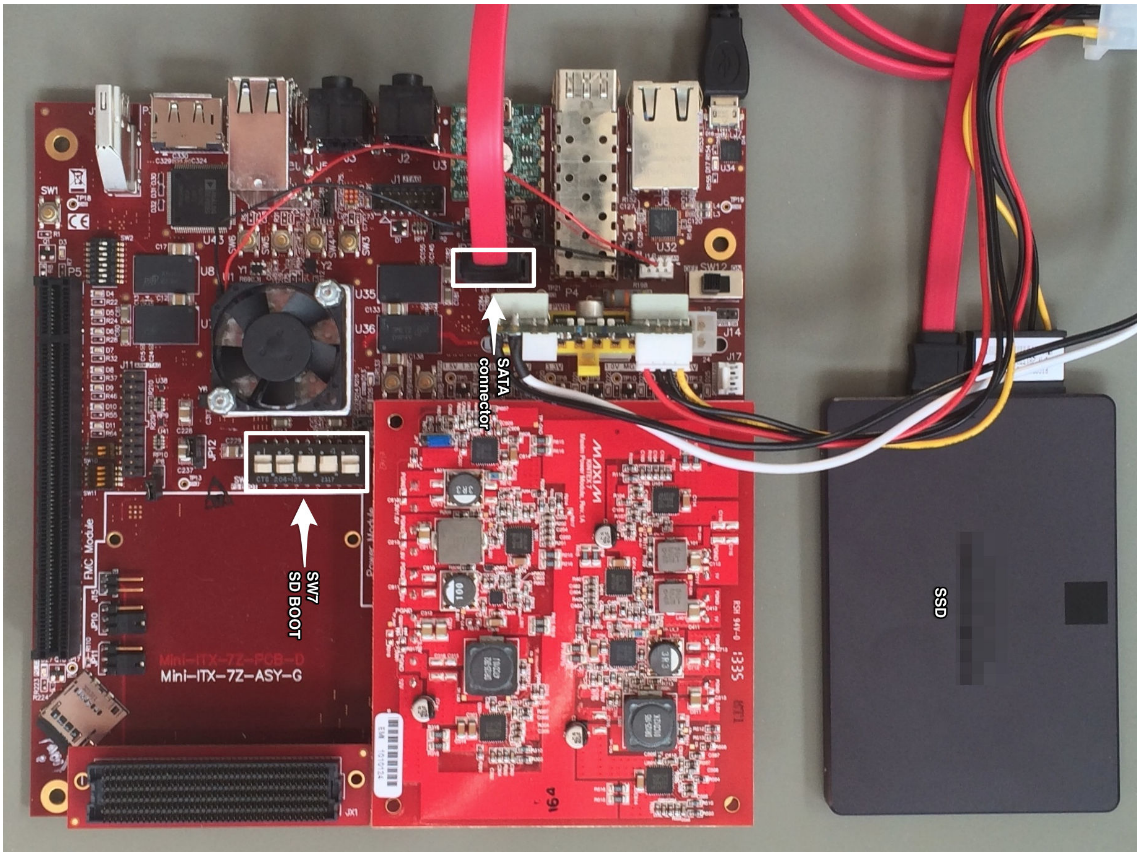
Implementation

Implementation Details	
Design Type	PS + PL
SW Type	Linux (Petalinux)
CPUs	2 CPUs 700 MHz
PS Features	DDR, USB, UART, ETHERNET
PL Cores	ASICS.WS SATA IP
Boards/Tools	Avnet Mini ITX Z100
Xilinx Tools Version	Vivado 2014.1, PETALINUX 2013-2
Other Details	SATA SSD(including Cable and Power Supply), SD-Card

Address Map			
	Base Address	Size	Interface
SATA IP	0x41000000	4K	S AXI
DMA IP	0x41010000	4K	S AXI, M AXI

Files Provided	
BOOT.bin	Compilation of Bitstream, FSBL and U-Boot
Image.ub	Linux Ramdisk Image

Step by Step Instructions



Hardware needed:

- Avnet Mini ITX Z100 Board (including Power supply)
  http://www.em.avnet.com/en-us/design/drc/Pages/Xilinx-Zynq-7000-All-Programmable-SoC-M
  aspx
- Micro USB Cable for USB Console
- Supported SSD (for Example Samsung 840)
- Power Supply for SSD
- Micro SD Card (2 GB or bigger)

- Ethernet Cable to connect Host PC and Avnet ITX board
- PC for UART console

Software Assembly:

1. Format the SD Card using FAT32 File system
2. Put image.ub and BOOT.bin into the root directory of the SD Card

Hardware Assembly:

1. Insert the SD Card into the Avnet Mini ITX board's SD Slot
2. Connect the micro USB cable to the UART port of the Avnet Mini ITX board and the USB Port of your PC
3. Connect the Ethernet port of the host pc to the ethernet port of the Avnet MINI ITX
4. Connect the SSD to the SATA connector on the Avnet Mini ITX board using the SATA Cable.
5. Connect the SSD to power
6. Switch the Avnet Mini ITX board's SW7 to SD Boot mode (as shown in picture)
7. Connect the Avnet Mini ITX board to the Power Supply

The system should now look like in the supplied image

Startup:

1. Switch on the Avnet Mini ITX board
2. On the PC open a Serial Terminal on the new serial port using the settings 115200 Baud 8N1
3. Observe the Linux System booting
4. After some time you should see a screen similar to the screenshot in the Expected Results.
5. Login using
    - Login:root
    - Password: root
6. configure the ethernet port on the host PC to have an IP address of 10.89.231.1 and a subnet mask of 255.255.255.0
7. The ZYNQ-board has an pre-supplied IP of 10.89.231.200
8. now connect to the ZYNQ-board using an FTP program and start transferring data to it

LED Description

Status LEDs can be found next to the PCIe connector. The associated meanings can be seen in the following table and in the Image below.

D7	Timeout LED, indicates the Timeout of the IP core.
D6	Gen3 Link, indicates 6 GBit/s connection
D5	Gen2 Link, indicates 3 GBit/s connection
D4	Linkup and Activity, Led will light up on Linkup and will go dark during data transfers

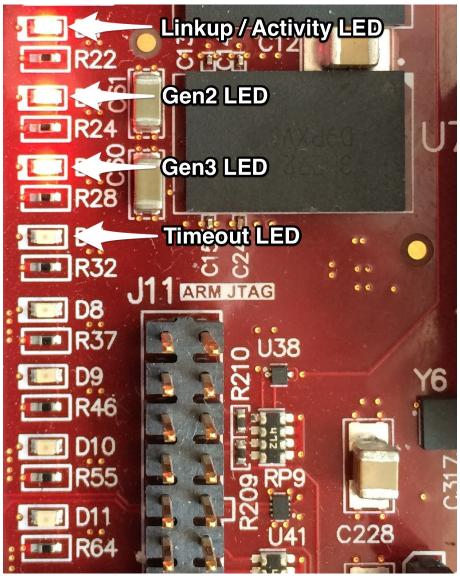
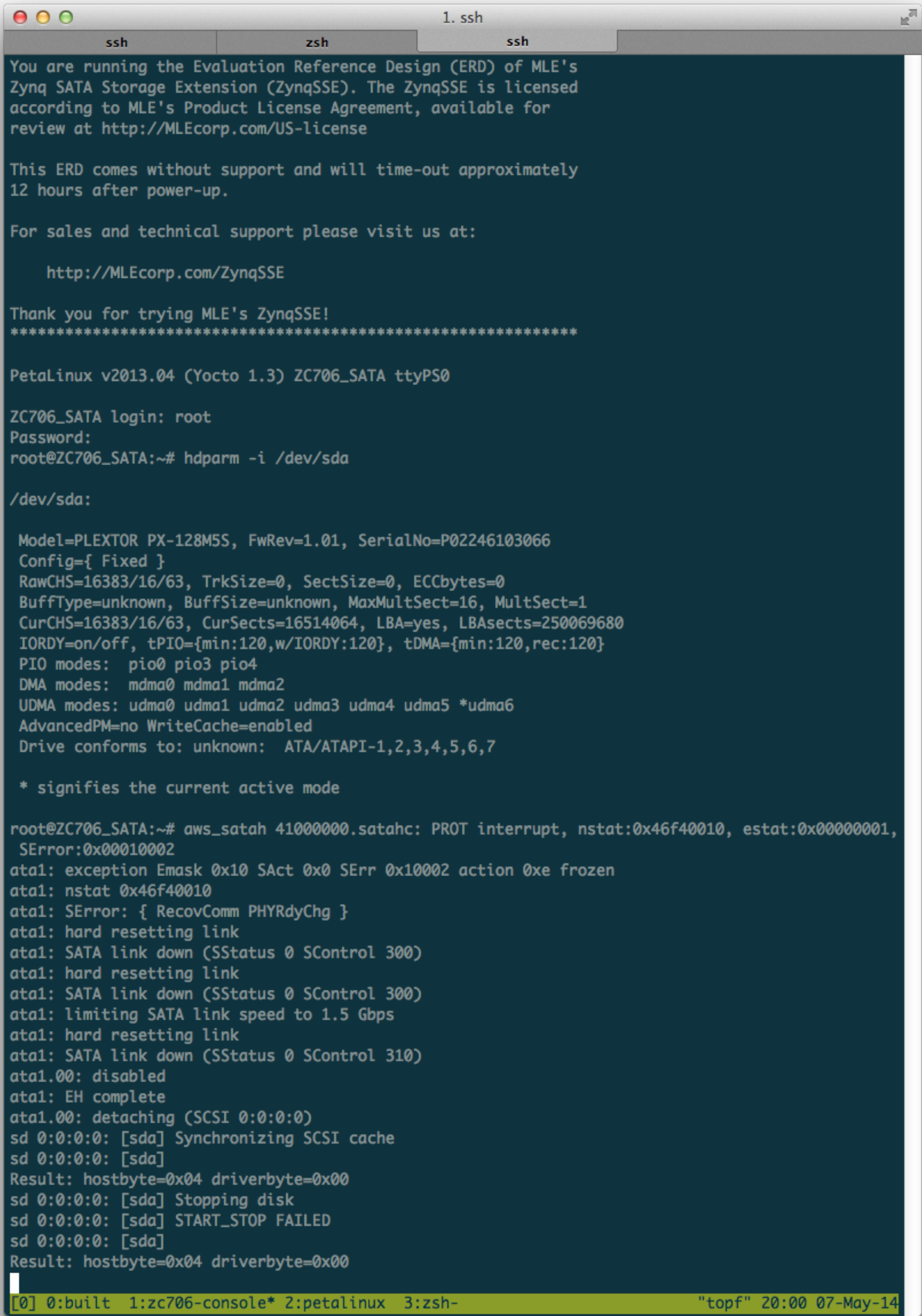


Figure 1: Location of the User LEDs on the Avnet Mini ITX Board

Expected Results

As a result you should be having a running Linux system on the Zynq board. The UART Console output should be similar to the screenshot below.
Also you will have file-system access to the attached SSD using FTP, and by this evaluate and test the Zynq Sata Storage extension.

The Evaluation Reference Design (ERD) of the Zynq SSE comprises a hardware license management which allows to run full SATA functionality for up to 12 hours after power-up. After approximately 12 hours the evaluation expires, which is indicated by illuminating the LED 'timeout'. You will also notice that the Linux kernel driver informs you of having lost the SATA link to the SSD/HDD.



```
You are running the Evaluation Reference Design (ERD) of MLE's
Zynq SATA Storage Extension (ZynqSSE). The ZynqSSE is licensed
according to MLE's Product License Agreement, available for
review at http://MLEcorp.com/US-license

This ERD comes without support and will time-out approximately
12 hours after power-up.

For sales and technical support please visit us at:

    http://MLEcorp.com/ZynqSSE

Thank you for trying MLE's ZynqSSE!
**************************************************************

PetaLinux v2013.04 (Yocto 1.3) ZC706_SATA ttyPS0

ZC706_SATA login: root
Password:
root@ZC706_SATA:~# hdparm -i /dev/sda

/dev/sda:

 Model=PLEXTOR PX-128M5S, FwRev=1.01, SerialNo=P02246103066
 Config={ Fixed }
 RawCHS=16383/16/63, TrkSize=0, SectSize=0, ECCbytes=0
 BuffType=unknown, BuffSize=unknown, MaxMultSect=16, MultSect=1
 CurCHS=16383/16/63, CurSects=16514064, LBA=yes, LBAsects=250069680
 IORDY=on/off, tPIO={min:120,w/IORDY:120}, tDMA={min:120,rec:120}
 PIO modes:  pio0 pio3 pio4
 DMA modes:  mdma0 mdma1 mdma2
 UDMA modes: udma0 udma1 udma2 udma3 udma4 udma5 *udma6
 AdvancedPM=no WriteCache=enabled
 Drive conforms to: unknown:  ATA/ATAPI-1,2,3,4,5,6,7

 * signifies the current active mode

root@ZC706_SATA:~# aws_satah 41000000.satahc: PROT interrupt, nstat:0x46f40010, estat:0x00000001,
 SError:0x00010002
ata1: exception Emask 0x10 SAct 0x0 SErr 0x10002 action 0xe frozen
ata1: nstat 0x46f40010
ata1: SError: { RecovComm PHYRdyChg }
ata1: hard resetting link
ata1: SATA link down (SStatus 0 SControl 300)
ata1: hard resetting link
ata1: SATA link down (SStatus 0 SControl 300)
ata1: limiting SATA link speed to 1.5 Gbps
ata1: hard resetting link
ata1: SATA link down (SStatus 0 SControl 310)
ata1.00: disabled
ata1: EH complete
ata1.00: detaching (SCSI 0:0:0:0)
sd 0:0:0:0: [sda] Synchronizing SCSI cache
sd 0:0:0:0: [sda]
Result: hostbyte=0x04 driverbyte=0x00
sd 0:0:0:0: [sda] Stopping disk
sd 0:0:0:0: [sda] START_STOP FAILED
sd 0:0:0:0: [sda]
Result: hostbyte=0x04 driverbyte=0x00

[0] 0:built  1:zc706-console* 2:petalinux  3:zsh-          "topf" 20:00 07-May-14
```