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Contact us

di**V**a

ARM Cortex-A8 CPU Module Family

Lite Line

Diva Embedded Linux Kit (*DIVELK*)

Quick Start Guide

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Table of Contents

1   Preface

1.1   About this manual

This manual describes the DIVA Embedded Linux Kit (DIVELK) and serves as a quick guide for start working with the development kit.

1.2   Copyrights/Trademarks

Ethernet® is a registered trademark of XEROX Corporation.

All other products and trademarks mentioned in this manual are property of their respective owners.

All rights reserved. Specifications may change any time without notification.

1.3   Standards

DAVE Embedded Systems is certified to ISO 9001 standards.

1.4   Disclaimers

DAVE Embedded Systems does not assume any responsibility for availability, supply and support related to all products mentioned in this manual that are not strictly part of the DIVA CPU module, the DIVAEVB-Lite carrier board and the DACU carrier board.

DIVA CPU Modules are not designed for use in life support appliances, devices, or systems where malfunctioning of these products can reasonably be expected to result in personal injury. **DAVE Embedded Systems** customers who are using or selling these products for use in such applications do so at their own risk and agree to fully indemnify **DAVE Embedded Systems** for any damage resulting from such improper use or sale.

1.5 Warranty

DIVA SOM, DIVAEVB-Lite and DACU are guaranteed against defects in material and workmanship for the warranty period from the shipment date. During the warranty period, **DAVE Embedded Systems** will at its discretion decide to repair or replace defective products. Within the warranty period, the repair of products is free of charge provided that warranty conditions are observed.

The warranty does not apply to defects resulting from improper or inadequate maintenance or handling by the customer, unauthorized modification or misuse, operation outside of the product's specifications or improper installation or maintenance.

DAVE Embedded Systems will not be responsible for any defects or damages to other products not supplied by **DAVE Embedded Systems** that are caused by a faulty DIVA module, DIVAEVB-Lite or DACU.

1.6 Technical Support

We are committed to making our products easy to use and will help customers use our CPU modules in their systems.

Technical support is delivered through email for registered kits owners. Support requests can be sent to support-diva@dave.eu. Software upgrades are available for download in the restricted download area of **DAVE Embedded Systems** web site: http://www.dave.eu/reserved-area. An account is required to access this area.

Please refer to our Web site at http://www.dave.eu/dave-cpu-module-am335x-diva.html for the latest product documents, utilities, drivers, Product Change Notices, Board Support Packages, Application Notes, mechanical drawings and additional tools and software.

1.7 Related documents

Document	Location
DAVE Embedded Systems Developers Wiki	http://wiki.dave.eu/index.php/Main_Page
AM335x Technical Reference Manual	http://www.ti.com/lit/ug/spruh73k/spruh73k.pdf
DIVA main page on **DAVE Embedded Systems** Developers Wiki	http://wiki.dave.eu/index.php/Category:Diva
DIVA Hardware Manual	http://www.dave.eu/sites/default/files/files/diva-hm.pdf
DIVA Software Manual	http://wiki.dave.eu/index.php/Software_Manual_(Diva)
AM335x Portal (on TI Embedded Processors Wiki)	http://processors.wiki.ti.com/index.php/Sitara_AM335x_Portal
DIVAEVB-Lite page on **DAVE Embedded Systems** Developers Wiki	http://wiki.dave.eu/index.php/DivaEVB-Lite
DACU User's Guide	Provided with kit documentation
Building Embedded Linux Systems By Karim Yaghmour.	This book covers all matters involved in developing software for embedded systems. It is not a reference guide, but it provides a complete and exhaustive overview that helps the developer save a lot of time in searching for such information on the Internet

Document	Location
Training and Docs sections of Free Electrons website.	Brief but still exhaustive overview of the Linux and Embedded Linux world.

Tab. 1: Related documents

1.8   Conventions, Abbreviations, Acronyms

Abbreviation	Definition
BTN	Button
DIVELK	DIVA Embedded Linux Kit
EMAC	Ethernet Media Access Controller
GPI	General purpose input
GPIO	General purpose input and output
GPO	General purpose output
PCB	Printed circuit board
PMIC	Power Management Integrated Circuit
PRU	Programmable Real-Time Unit
PSU	Power supply unit
RTC	Real time clock
SOC	System-on-chip
SO-DIMM	Small Outline Dual In-line Memory Module
SOM	System-on-module
WDT	Watchdog

Tab. 2: Abbreviations and acronyms used in this manual

Revision History

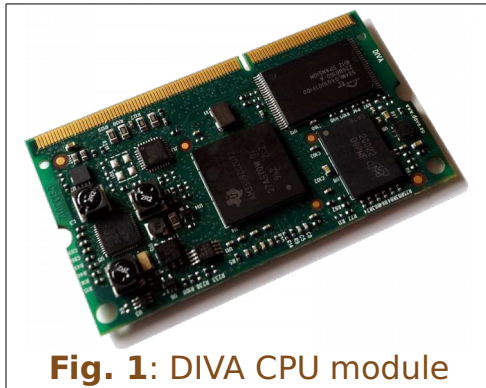| Version	Date	Notes
1.0.0	June 2013	First official release
1.0.1	June 2013	Added pictures Minor fixes
1.0.2	January 2014	Minor fixes
1.0.3	October 2014	Updated for DIVELK 2.0.0 release
1.0.4	November 2014	Minor fixes
1.0.5	June 2015	Updated for DIVELK 2.1.0 release
1.0.6	July 2015	Minor fixes

2   Introduction

2.1   DIVA SOM

Fig. 1: DIVA CPU module

DIVA is a family of system-on-modules (SOM) that belongs to **DAVE Embedded Systems *Lite* Line** product class. DIVA is based on Texas Instruments "Sitara" AM335x Cortex-A8 application processor and is built with SO-DIMM 204 pin form factor.

DIVA offers lots of graphics, processing, peripherals and industrial interface options, allowing customers to implement cost-effective design. The Programmable Real-Time Unit and Industrial Communication Subsystem (PRU-ICSS) adds further flexibility and enables additional peripheral interfaces and real-time protocols such as EtherCAT, PROFINET, EtherNet/IP, PROFIBUS, Ethernet Powerlink.

Typical applications for DIVA are:

● Industrial sensors and I/O units

● Industrial drives with integrated communications and multi-axis motor control

● Programmable logic/automation controllers (PLC/PAC) with integrated industrial communications such as PROFIBUS, CAN and Ethernet

● Home and Building Automation

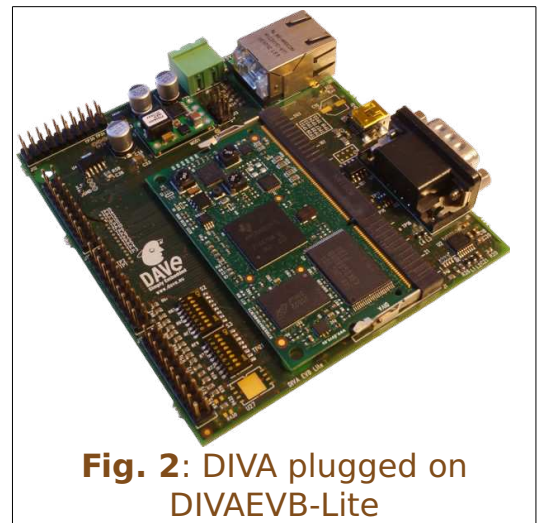For further information, please refer to DIVA Hardware Manual.

Fig. 2: DIVA plugged on DIVAEVB-Lite

2.2   Embedded Linux

When we talk in general about Embedded Linux[1], we refer to an embedded system running Linux operating system. As the reader probably knows, Linux was first developed on the PC platform, based on the famous x86 architecture. Typical embedded systems using an operating system (O.S. for short), are equipped with much lighter software. Recent hardware advances made these systems so powerful that now they can run a complex O.S. such as Linux. This choice has several benefits:

● The developer can count on a reliable and efficient software, developed and maintained by a large community all over the world

● The software is open-source, so developers have access to the whole source code

● Since Linux runs on many different platforms (x86, PowerPC, ARM, SuperH, MIPS etc.), applications are portable by definition

● There are a lot of open-source applications running on top of Linux that can easily be integrated in the embedded system

● Last but not least, there are no license fees.

The typical Embedded Linux system is composed of:

● the bootloader – this software is run by the processor after exiting the reset state. It performs basic hardware initialization, retrieves the Linux kernel image (for example from a remote server via the TFTP protocol) and launches it by passing the proper arguments (command line and tags)

● the Linux kernel

● the root file system – this file system is mounted (which means "made available", "attached") by the kernel during the boot process on the root directory ("/").

The typical developing environment for an Embedded Linux system is composed of a host machine and a target machine. The host is used by the developer to compile the code that will

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1   An exhaustive description of this topic is beyond the scope of this document. We recommend reading specific documents, eg Building Embedded Linux Systems By Karim Yaghmour.

run on the target. In our case the target is obviously the DIVA module, while the host is assumed to be a PC running the Linux operating system. The Linux kernel running on the target can mount the root file system from different physical media. For example, during the software development, we strongly recommend using a directory exported via NFS by the host for this purpose (see the example configuration called net_nfs); however, for system deployed to the field, the root file system is usually stored into a flash device.

2.3 DIVELK

DIVA Embedded Linux Kit (DIVELK for short) provides all the necessary components required to set up the developing environment for:

● building the bootloader (U-Boot)

● building and running Linux operating system on DIVA-based systems

● building Linux applications that will run on the target

The heart of DIVA SOM is Texas Instruments "Sitara" AM335x microprocessors. From a software point of view, Texas Instruments supports this processor family through so-called Linux EZ Software Development Kit (EZSDK for short). EZSDK releases are published on a regular basis. For more details please refer to:

● http://www.ti.com/tool/linuxezsdk-sitara

● http://processors.wiki.ti.com/index.php/Category:EZSDK

DIVA Embedded Linux Kit, in turn, is directly derived from EZSDK. Hence DIVELK documentation often refers to EZSDK resources.

DAVE Embedded Systems adds to the latest EZSDK from Texas Instruments the customization required to support the DIVA platform. For this reason most of the documentation provided by TI remains valid for the DIVELK development kit. However, some customization is required, in particular at bootloader and linux kernel levels.

DIVELK 2.0.0 introduces support for the **Yocto** build system,

an open source collaboration project that provides templates, tools and methods to help creating custom Linux-based systems for embedded products. It is derived from OpenEmbedded, but it provides a less steep learning curve, a graphical interface for Bitbake and very good documentation. **DAVE Embedded Systems** provides the so-called recipes/meta-repositories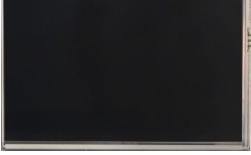 required to build all the DIVELK software components (bootloader, kernel and root file system) with the **Yocto** build system. For further details, please refer to https://wiki.yoctoproject.org/wiki/FAQ.

2.3.1   Kit Contents

The following table lists the DIVELK components

Component	Description
	DIVA SOM CPU: TI AM3359 SDRAM: 512 MB DDR3 NOR: bootable SPI flash 32 MB NAND: 1GB
	DIVAEVB-Lite Carrier board
	DACU Carrier board
	Ampire AM-800480STMQW 7" 800x480 LCD display LVDS interface
	AC/DC Single Output Wall Mount adapter Output: +12V – 2.0 A
	DB9 Male Serial port adapter
	MicroSDHC card with SD adapter and USB adapter

2.3.2   DIVELK Release Notes

2.3.2.1   Version 2.1.0

Notes

- Maintenance release
- Updated kernel and u-boot versions
- Bug fixes

Known limitations:

Issue #	Component	Subsystem	Description
0001	Linux	USB	USB0, when configured as OTG, requires loading of the gadget module for detecting devices (and entering host mode)
0002	Yocto	ADT	The Yocto ADT plugin for Eclipse doesn't work
0003	Linux	Audio	Codec on the DACU board doesn't work out-of-the-box. A software patch is required, please contact support-diva@dave.eu for information on how to enable the audio codec.

2.3.2.2   Version 2.0.0

Notes

- First major update
- Added Yocto support
- Updated kernel and u-boot versions

Known limitations:

Issue #	Component	Subsystem	Description
0001	Linux	USB	USB0, when configured as OTG, requires loading of the gadget module for detecting devices (and entering host mode)

Issue #	Component	Subsystem	Description
0002	Yocto	ADT	The Yocto ADT plugin for Eclipse doesn't work

2.3.2.3 Version 1.0.0

First official release

2.3.2.4 Releases history

	DIVELK Version		
Release number	1.0.0	2.0.0	2.1.0
Status	Released	Released	Released
Release date	June 2013	October 2014	June 2015
Release notes	Version 1.0.0	Version 2.0.0	Version 2.1.0
SOM PCB version	CS133012A	CS133012A	CS133012A
Supported carrier boards	DIVAEVB-Lite DACU	DIVAEVB-Lite DACU	DIVAEVB-Lite DACU
U-Boot version	2012.10-divelk-1.0.0	2013.10-divelk-2.0.0	2013.10-divelk-2.0.0
Linux version	3.2.0-divelk-1.0.0	3.12.10-divelk-2.0.0	3.12.10-divelk-2.0.0
Drivers	SPI NOR Flash (boot) NAND 8 bit (boot) UART0 (2-wire) USB Host SD/MMC1 GPIO LCD Touch screen controller EMAC0 RMII (Fast Ethernet) PMIC RTC (battery powered) Audio (ALSA)	SPI NOR Flash (boot) NAND 8 bit (boot) UART0 (2-wire) USB Host SD/MMC1 GPIO LCD Touch screen controller EMAC0 RMII (Fast Ethernet) PMIC RTC (battery powered) Audio (ALSA) USB OTG CAN ADC	SPI NOR Flash (boot) NAND 8 bit (boot) UART0 (2-wire) USB Host SD/MMC1 GPIO LCD Touch screen controller EMAC0 RMII (Fast Ethernet) PMIC RTC (battery powered) Audio (ALSA) USB OTG CAN ADC Splash screen in u-boot ConfigID
TI EZSDK	05.06.00.00	07.00.00.00	07.00.00.00
Build Sytem	-	Yocto Dylan (1.4)	Yocto Dylan (1.4)
Graphic libraries	Qt 4.8.4	Qt 4.8.4 Qt 5.3.2	Qt 4.8.4 Qt 5.3.2

3   DIVELK Quick Start

This chapter describes how to quickly start working with the DIVELK kit. The following paragraphs will guide you through the setup and installation procedures.

3.1   Unboxing

Once you've received the kit, please open the box and check the kit contents with the packing list included in the box and using the table on chapter 2.3.1 as a reference. The hardware components (SOM, carrier boards and display) are pre-assembled and fixed on a supporting plate, as shown in the picture below:

3.2   Hardware setup

This section describes how to quick start a DIVA system composed of a DIVA SOM plugged into the DIVAEVB-Lite and then mounted on the DACU carrier board, provided that it is programmed according to DIVELK configuration.

The MicroSD provided with the DIVELK can be used to boot the system, since it contains a bootable partition (mmcblk0p1) and a root file system partition (mmcblk0p2).

1.   connect the serial cable, provided with the board, to the J25 pin-strip connector on the DACU board

2.   insert the MicroSD card provided with the development kit into the MicroSD slot

3.   connect the 12Vcc power supply to JP2 on the DACU board

4.   (optional) connect the serial cable to PC COM port through a NULL-modem cable (not provided)

5.   (optional) start your favorite terminal software on PC; communication parameters are:

Parameter	Value
Baud rate	115200 bps
Data bits	8
Stop bits	1
Parity	None

6.   (optional) to connect the system to Ethernet LAN, please plug cable on connector J7 of the DIVAEVB-Lite

The system is configured to boot automatically when powered up, loading u-boot, kernel and root file system from the MicroSD card.

3.3   First boot

Once power has been applied, U-Boot bootloader will be executed and the debug messages will be printed on the serial console. U-Boot automatically runs the `mmcboot` macro, that loads the kernel and launches it with the options for mounting

the root file system from the mmcblk0p2 partition. At the end of the boot process, the **Matrix** demo application (http://processors.wiki.ti.com/index.php/Matrix_Users_Guide) is launched and you can interact with the system using the touchscreen:

Moreover, the Linux shell is available on the serial console.

Lastly, both telnet and ssh services are available to connect to the system through the network.

3.4   DVDK installation

DAVE Embedded Systems Virtual Development Kit is a virtual machine, based on Oracle VirtualBox, that allows developers to start using **DAVE Embedded Systems** platform without wasting time in installing and configuring a full development environment from scratch. The Virtual Machine comes with all the development tools and source code pre-configured, and requires only a minimal setup by the end user (usually just adapting the network interface to the user environment).

DVDK can also be converted, easily, into a physical environment, for example to increase speed on slower machines. Please note that DVDK can also be used with VMWare. Please refer to DVDK page (http://wiki.dave.eu/index.php/Category:DVDK) on **DAVE Embedded Systems** Developer's Wiki for further information.

3.4.1   DVDK features

- VirtualBox virtual machine (.OVA archive)
- Based on Lubuntu 12.04 LTS (64-bit version)
- Pre-installed VirtualBox Guest Additions
- LXDE desktop environment available
- Boot disk with pre-installed Lubuntu Linux 12.04.2 LTS and pre-configured basic Linux services (TFTP, NFS, ...)
- Secondary disk containing source code and tools:
  - Bootloader (u-boot) source tree cloned from **DAVE Embedded Systems** public git repository
  - Linux kernel source tree cloned from **DAVE Embedded Systems** public git repository
  - External pre-built toolchain
  - Yocto bsp for DIVA
  - Pre-installed Yocto-based root file systems with setup scripts, makefiles, example applications, ...

- Administrator account (dvdk) with autologin. Please note that the user account credentials are provided with the development kit (you can find them into the `README` file contained in the `sw/dvdk` folder of the kit distribution)

3.4.2   MicroSD contents

The microSD provided with DIVELK is used to store:

- A <u>bootable</u> partition (**mmcblk0p1**, **vfat**) containing:
  - binary images (MLO, u-boot and kernel images)
  - DIVELK documentation
  - DVDK virtual machine image (in an .OVA archive)
- DIVELK root file system partition (**mmcblk0p2**, **ext3**)

DIVELK contains all the required software and documentation to start developing Linux application on the DIVA platform

3.4.3   Importing the virtual machine

DIVELK provides a virtual machine image as a .OVA file, which is a virtual application exported in Open Virtualization Format (OVF). Please find below the instructions for importing the virtual machine into Virtualbox:

1.   Start the Oracle VM VirtualBox Manager
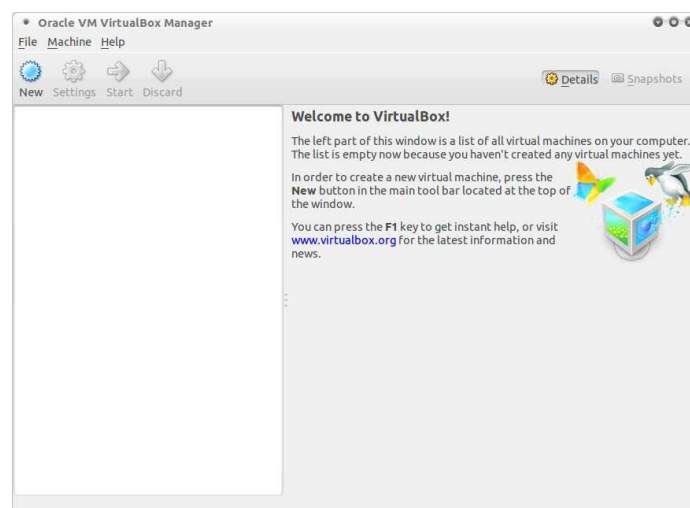
2.   Click on File and select "Import Virtual Application", then click on "Open Virtual Application"

3.   Navigate your file system to the MicroSD card provided with the DIVEL, move to the `sw/dvdk` directory and select the .ova file:
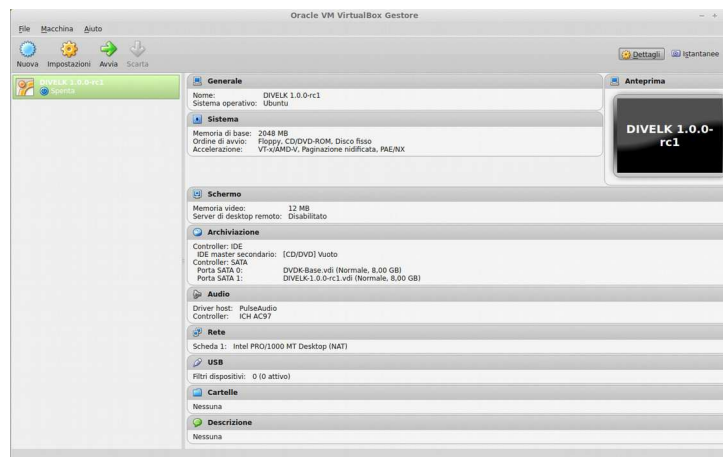

4.   Click "Next" and on the next window click on "Import"
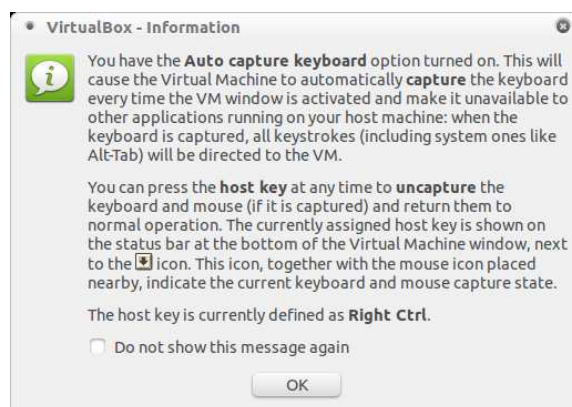
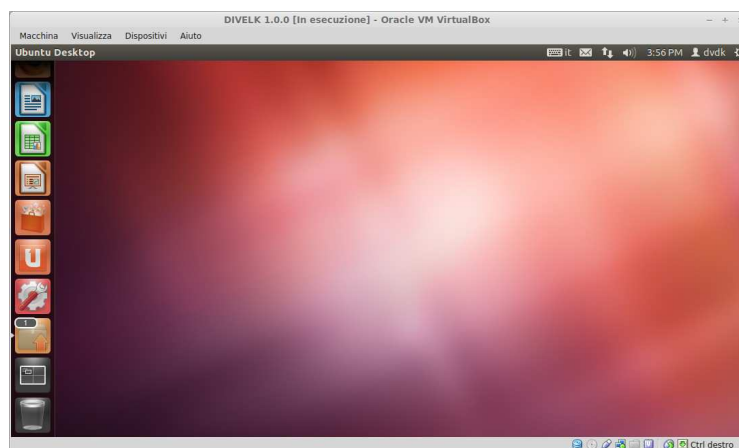### 3.4.4   Launching the virtual machine

1.   Once the virtual machine is ready, launch it by clicking on the start icon

2.   VirtualBox will open some message windows like the following, you can click "Ok" to close them
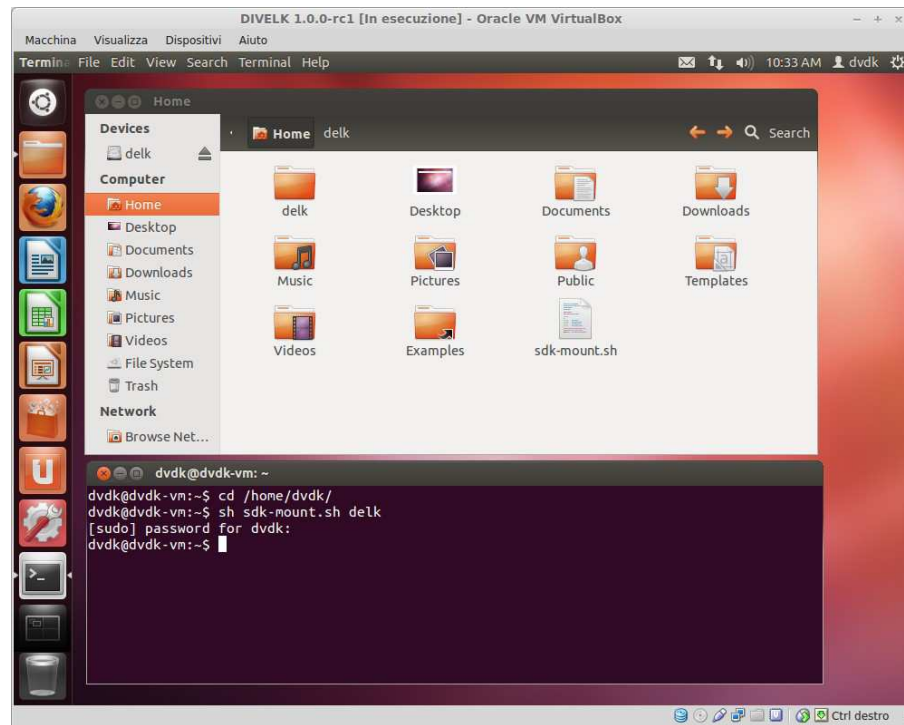
3.   At the end of the boot process, the Ubuntu/Lubuntu desktop will be available.

4.   Mount the DIVELK disk launching the following commands from a shell terminal:

```
cd /home/dvdk
```

```
sh sdk-mount.sh divelk
```

5.   Once logged in, the system could suggest to update the Virtualbox Guest Additions package. You can follow the on-screen instructions to easily install the updated package.

6.   Check if your keyboard layout matches the Ubuntu keyboard settings. You can change the keyboard layout selecting System->Preferences->Keyboard from the top panel menù.

7.   Configure the Virtual Machine network interface, as described in this page: http://wiki.dave.eu/index.php/VirtualBox_Network_Configuration