Development of an Optical Time-Domain Reflectometer (OTDR)

Customer
A manufacturer of measuring instruments.

Objective
Develop an OTDR for optical data transmission networks, which helps:

- Read the parameters of optical networks, determine the length of the cables, as well as detect and locate damaged and broken cables
- Visualize measurements in the form of graphs and analyze the data obtained
- Use a multi-lingual user interface with easy addition of new languages
- Control the device via hardware keys and touch screen
- Receive data from a USB microscope - an optic endoscope (a cross-section optics image)
- Save the data to local NAND memory, a USB drive or a MicroSD card
- Function as a USB drive when connected to a computer
- Send and receive data via Bluetooth
- Maintain a fault-tolerant firmware update system

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The device should be small-sized and powered from a 220 V / 50 Hz network, 24x7, or from a built-in battery for at least 8 hours.

Solution

A processor board based on the Texas Instruments AM3505 (Cortex a8) 600 MHz with 128 MB LpDDR and 256 MB NAND memory. USB 2.0 OTG, USB 2.0 Host, MicroSD and Bluetooth interfaces are installed on the compact board.

The following program components have been adapted for the device to function:

- X-loader
- U-Boot loader
- Linux kernel
- Buildroot-based root file system

The boot loader (U-Boot) performs basic system initialization (RAM, ROM, network interface) and loads the operating system. It is also used for primary flashing of the product's firmware and diagnostics of the basic components.

The software part of the device includes standard Open Source components:

<table>
<thead>
<tr>
<th>Software component</th>
<th>Features / what it is used for</th>
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<tbody>
<tr>
<td>The Linux core (version 2.6.37, adapted by Texas Instruments for the AM3505)</td>
<td>Includes the drivers of OTDR peripherals</td>
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<td>Provides APIs for applications and services</td>
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<td>Implements support for major network protocols and interaction with external devices</td>
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<tr>
<td>We developed special software based on Qt4.7 (industry standard for Embedded Linux graphic applications)</td>
<td>Device setup and control</td>
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<td>Increased development speed and simplified application debugging</td>
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<td>Qt Linguist which is part of Qt4</td>
<td>Multilingual support</td>
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<td>QWT library</td>
<td>Displays graphs (ensures faster and better imaging of OTDR traces)</td>
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<td>v4l2 library</td>
<td>Works with a USB microscope (fiberscope); it sets its parameters and receives images</td>
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<tr>
<td>bluez4 library</td>
<td>Works with a bluetooth interface</td>
</tr>
<tr>
<td>mdev</td>
<td>Works with connected devices: USB flash, MicroSD, fiberscope</td>
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</table>
Busybox | Uses basic internal console utilities
---|---
she| Scripting
Buildroot distribution | Builds the entire system
Codesourcery compiler | Compiles the system using NEON commands

Block diagram of the software:

![Block diagram of the software](image)

Advantages
- The use of Qt4 helps reduce the development time
- Small dimensions: 118 mm (L) x 76 mm (W) x 43 mm (H)
- Low power consumption: an average of under 5 watts in a typical application
- Low cost