Hitachi SH-3 for Windows CE
Project Description (Preliminary) –

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6th November 1998

1 Overview

The Hitachi SH-3 microprocessor features a 32-Bit RISC processor core, on-chip cache, memory management unit and peripheral control. Together with the dedicated companion chip HD64461 it is designed to run the Windows CE operating system for handheld computing devices. The extensive I/O capabilities of the companion chip with UART, IrDA, timer, interrupt controller, GPIO, PCMCIA interface, AFE (analog frontend for software modem) and 640x480 color LCD simplify the integration of a whole system.

The SH-3 core has been available for quite some time and is well established for different handheld applications. The Hitachi-Microsoft alliance eases the evaluation through availability of development tools and ready made software components.

The EBX7709 Reference Platform is a good foundation to start evaluating the performance and capabilities of the SH7709, HD64461 twin components. The evaluation will include operating system specific requirements for a highly integrated processor module as well as application specific requirements for the I/O capabilities and on-board functionality as well as the possibilities for external extensions.

An integration of the GPS-MS1 system, now running on a Hitachi SH-1 microprocessor, either as subsystem or fully integrated will be evaluated as well. There are numerous possibilities for integrating the GPS-MS1 system into a mobile computing device: as daughterboard next to a minimal microprocessor system based on SH-3/Windows CE and designed to serve only the GPS functionality, as daughterboard on a more general SH-3/Windows CE system with capabilities for extension and upgrade (PCMCIA, GPIO, memory) or integrated into one module, possibly omitting the SH-1 microprocessor on the GPS-MS1 system.

2 Roadmap

The following steps and deadlines are rough guidelines.

1. **System evaluation** (from October 1998)
• Functional system specification (October 1998)
• Evaluation of components and packaging (mid October 1998)
• Feasibility: cost, energy consumption, form factor (mid October 1998)
• Availability of components (end October 1998)

2. System design (November 1998)
   • Block structure
   • I/O and peripherals

3. Physical design (mid December 1998)

4. Prototype production (January 1998)

5. Test and demoapplications (February 1998)

3 Introduction to Ubiquitous Computing

Computing devices have contributed to extensive changes in professional as well as in everyday life. Trends show, that the amount of devices is steadily growing with no end of the scale. Not only powerful desktop computers, but also embedded systems and mobile computer systems are present everywhere. The market for small self contained systems dedicated to special functions but able to communicate interactively with other devices is ever growing. Todays examples are mobile telephones (GSM), laptop and palmtop computers, pagers, mobile sales and remote control equipment, wristwatches with special functions, digital cameras and handheld navigation systems. Future products will be integrated into a whole, comprising several of the above mentioned functions into one device. With better quality communication devices will not be in need to operate fully self contained but will use offline and online services as well as network with other mobile devices to be remotely accessible at all times.

The focus for future application and devices lies on user interfaces, form factor, energy consumption, the ability to communicate and thus to deploy external resources. Consumer devices are getting more and more important and taking large market shares already, but the prices for these devices are plunging. The component count as well as the form factor of components and systems are the most important factors.

4 System Specification

4.1 Hardware Specifications

The following lineup of hardware features is supposed to give a general overview of the capabilities of the SH-3/HD64461 devices. It is for evaluation purposes and not meant to specify the features of a future integrated device.
4.1.1 SH7709 32-bit microprocessor

- **Features**
  - 32-bit RISC architecture
  - 4 Gbyte logical address space
  - 8 kbyte cache for mixed instruction/data
  - Powersaving operating modes
  - Bus and interrupt controller
  - 2 Mhz timer
  - Realtime clock
  - Serial communication interfaces
  - DMA controller
  - 16 general purpose I/Os
  - A/D and D/A converter

- **Operation**
  - 3.3 Volt, 100 mA @80Mhz
  - 15 μA in standby mode
  - Sleep and Standby modes

- **Form Factor**
  - Quad Flat Pack
  - Ball Grid Array
  - Chip Size Packaging
  - Bonded Bare Dies

4.1.2 HD64461 companion chip

- **Features**
  - SH7709 CPU interface
  - Color LCD interface, 640x480
  - CRT interface support
  - EDO-DRAM 256kx16
  - PCM CIA controller
  - Analog frontend (AFE) for SGS Thompson modem
  - General purpose I/O
  - Timer
  - IrDA support
  - 16550 compatible UART

- **Operation**
  - 3.3 Volt, 50 mA
  - 35 μA in standby mode
- Standby mode with power management of peripherals

- **Form Factor**
  - Quad Flat Pack (208-pin LQFP)
  - Ball Grid Array
  - Chip Size Packaging
  - Bonded Bare Dies

### 4.1.3 Other Devices

- Memory components
- Color display
- Touch screen input
- Communications I/O
- Audio I/O
- Power supply

### 4.2 Software Components

#### 4.2.1 Windows CE Operating System

The Microsoft Windows CE operating System is designed to run on the SH-3, HD64461 pair, just like on the HP 620LX Palmtop PC. Various development systems and tools are available.

#### 4.2.2 Peripheral Drivers

To be specified.
4.2.3 Software Modem

There are different possibilities to implement a software modem on the SH-3, HD64461 analog frontend (AFE). One solution is offered by RAS Communication, called Native Modem Technology. It features faxmodem capabilities with V.34/V.17 and eliminates the need for external components, reducing energy consumption for 600mW.

4.2.4 Application Software

Different vendors offer application software, ranging from simple tools like calculators, email, and notepads to Microsoft's Word and Powerpoint as well as specialized navigation and handwriting recognition software. Porting software from the Windows 95 and NT platforms is simplified by using the Microsoft/Hitachi Toolchains.

4.3 Integration of Global Positioning System

The need for positioning information in handheld devices and miniature subsystems is ever-growing. The integration of GPS and mobile computing equipment is to be analyzed.

4.3.1 The GPS-MS1 System

The GPS-MS1 features full GPS functionality with various low power operation modes on a form factor of only 30x30mm. For operation only an external Antenna (active or passive) and a 3.3 Volt power supply are needed. The system is self-contained and issues the GPS information via serial I/O. Several other general purpose I/Os can be defined for user specific purposes.

4.3.2 GPS oriented Platform

In order to communicate with an enduser a consumer oriented navigation device needs either visual or acoustical I/O possibility, a database with navigation information (map) and communication abilities for updates, regional and time variant information. A GPS oriented system would comprise full navigation functionalities and database but only few other applications (notes, SMS, email, calculator) or extension possibilities (PCMCIA, memory modules). Well established interfaces to link the device with a PC or network for updates and ample storage capacity would make extension ports and hardware upgrades not necessary and therefore bringing down the amount of I/Os and the form factor. A simple system would be made of GPS, processor, memory, user interface and serial I/O.

4.3.3 Handheld Computing device with GPS functionality

The trend in mobile computing shows evergrowing CPU performance and memory capacities. More and more operating systems and concepts are lookalikes of the normal desktop computers, but incorporate less functionality and only very limited communication links. Several well established handhelds like the Apple Newton, US Robotics PalmPilot and HP
620LX Palmtop PC feature very different concepts but offer basically a very small version of a normal desktop office PC in hardware and software. To attach a GPS device to these systems lessens the effort to only plugging in to an external port and installing the appropriate software. An integrated device could hold a GPS-MS1 in one of these palmtops. The need for a smaller form factor would mean to only integrate the palmtop system.

4.3.4 Fully Integrated Device

The smallest solution would be a GPS system and computing device integrated into a whole. As long as GPS chipset and code are still dependant on a simple external microcontroller this would mean to integrate a chain of GPS-microcontroller-CPU-userinterface. Future GPS systems might be able to reduce this chain to only GPS-CPU-userinterface. (A port of the GPS program code from SH-1 to SH-3 and Windows CE operating interface is being evaluated.)

5 System Integration

µ-blox ag is in contact with various suppliers of navigation equipment and software. Some customers already implement navigation equipment, mainly for automotive applications, using databases and software that are part of the system. Different systems offering online data sources such as RDS traffic information, regional databases and locally restricted navigational aids, such as differential GPS and positioning within GSM cells are slowly becoming commercial.

A survey of possible partners for the development of commercial software systems and an endconsumer device is being conducted.

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