

# Devices for a Mobile Router

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# Contents

<b>1</b>	<b>Introduction</b>	<b>3</b>
<b>2</b>	<b>SOEKRIS net4521</b>	<b>4</b>
2.1	Main features . . . . .	4
2.2	Main issues . . . . .	5
2.3	The SOEKRIS net4521 as a Mobile Router . . . . .	5
<b>3</b>	<b>The SHARP Zaurus</b>	<b>6</b>
3.1	Main features . . . . .	6
3.2	Main issues . . . . .	7
3.3	The Zaurus SL6000L as a Mobile Router . . . . .	7
<b>4</b>	<b>The SONY VAIO Type U</b>	<b>8</b>
4.1	Main features . . . . .	8
4.2	Main issues . . . . .	9
4.3	The VAIO U70 as a Mobile Router . . . . .	9
<b>5</b>	<b>The OpenBrick</b>	<b>10</b>
5.1	Main features . . . . .	10
5.2	Main issues . . . . .	11
5.3	The OpenBrick as a Mobile Router . . . . .	11
<b>6</b>	<b>The OpenBrick NG</b>	<b>12</b>
6.1	Main features . . . . .	12
6.2	Main issues . . . . .	13
6.3	The OpenBrick NG as a Mobile Router . . . . .	13
<b>7</b>	<b>The OpenBlocks</b>	<b>14</b>
7.1	Main features . . . . .	14
7.2	Main issues . . . . .	15
7.3	The OpenBlocks as a Mobile Router . . . . .	15
<b>8</b>	<b>The Tiqit</b>	<b>16</b>
8.1	Main features . . . . .	16
8.2	Main issues . . . . .	17
8.3	The Tiqit as a Mobile Router . . . . .	17

<b>9 The OQO</b>	<b>18</b>
9.1 Main features . . . . .	18
9.2 Main issues . . . . .	18
9.3 The OQO as a Mobile Router . . . . .	19
<b>10 The Meshcube</b>	<b>20</b>
10.1 Main features . . . . .	20
10.2 Main issues . . . . .	21
10.3 The Meshcube as a Mobile Router . . . . .	21
<b>11 Motherboards</b>	<b>22</b>
11.1 Compulab 586BASE Board . . . . .	22
11.2 ESPT2 . . . . .	23
11.3 E!Kit-1100 . . . . .	24
11.4 PC Engines . . . . .	25
<b>12 Misceallenous devices</b>	<b>26</b>
12.1 The 3COM OfficeConnect Travel Router . . . . .	26
12.2 The Linksys WRT54G router . . . . .	26
<b>13 Conclusion</b>	<b>28</b>
<b>Bibliography</b>	<b>28</b>



# Chapter 1

## Introduction

In order to design a PAN (Personal Area Network) for the end-user, we need to use devices as small and light as possible. This include the Mobile Router, that is the master piece of the PAN. In this survey, we will try to summarize our investigations about small devices that could be used as a Mobile Router for a Personal Area Network.

Our survey will be based on the following criteria:

- Size and weight,
- Power supply,
- Communication ports (PCMCIA, Compact Flash, Ethernet, etc.),
- Supported Operating System,
- Price.

We will introduce some equipments we already use in our demonstrations, and some other new interesting devices that could be used in the near future. We will thus compare:

- SOEKRIS net4521 (Chapter 2),
- SHARP Zaurus SL6000 (Chapter 3),
- SONY VAIO U50/70 (Chapter 4),
- OpenBrick (Chapter 5),
- OpenBrick NG (Chapter 6),
- OpenBlocks (Chapter 7),
- Tigit (Chapter 8),
- OQO (Chapter 9),
- Meshcube (Chapter 10).
- Some motherboards that could be used as a base (Chapter 11).

## Chapter 2

# SOEKRIS net4521

### 2.1 Main features

SOEKRIS Engeneering [19] provides four compact, low-power, and low-cost mainboards. We will focus on the SOEKRIS net4521 model.

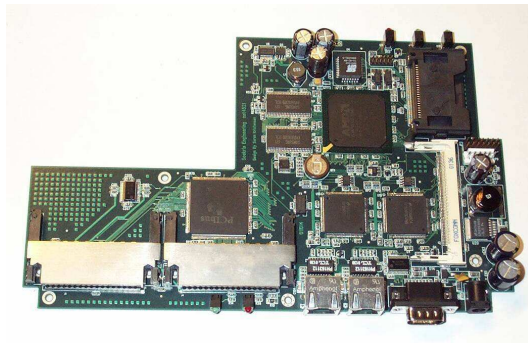


Figure 2.1: The SOEKRIS net4521 motherboard

- Size: 234mm x 145mm (board only), 245mm x 152mm x 33mm (with the case)
- Weight: around 600 grams
- Power supply: external power supply (11-56V DC, max 14 Watt), internal power supply (5V), Power over Ethernet (802.3af)
- Communication ports: two 10/100 Mbit ethernet ports, two PC-Card/Cardbus adapters, one MiniPCI type III socket
- Supported Operating Systems: FreeBSD 4.9, NetBSD 1.6.2, GNU/Linux (Debian-based Distribution)
- Architecture: 133 Mhz 486 class processor, 64 Mbyte SDRAM

- Misc: CompactFlash module for program and data storage (8 Mbyte FLASH to 1Gbyte IBM Microdrive)
- Price: around \$178 (board only), \$206 (board and case)

As this device uses CompactFlash module for program and data storage, it is more reliable than a device with a Hard Drive.

## 2.2 Main issues

The main problem of the SOEKTRIS cards is the way to provide electric power. There are 3 ways to provide power on these cards:

- Power using external power supply : 6-20V DC, max 15 Watt,
- Option for 5V supply using internal connector,
- Power over Ethernet (802.3af).

One can use 8 Ni-MH AA cells, it lasts around 4 hours. With a Panasonic VRLA 12V/7.2Ah battery [16], it lasts more than 8 hours.

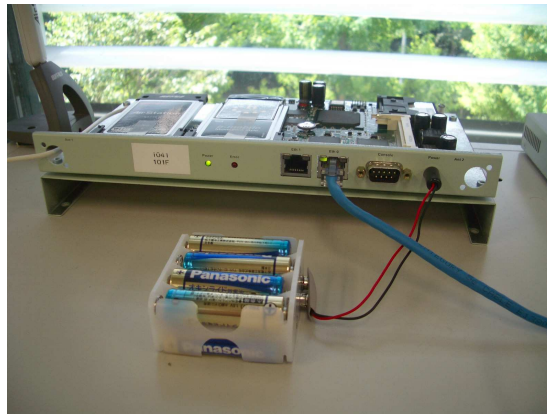


Figure 2.2: The SOEKTRIS net4521 is powered with 8 Ni-MH cells

## 2.3 The SOEKTRIS net4521 as a Mobile Router

The SOEKTRIS net4521 has been successfully tested with NetBSD 1.6.2 and KAME/SHISA. Several documentations are available on InternetCar wiki [5]. It has not been tested with Linux yet, but someone reported that it works with a debian-based distribution.



## Chapter 3

# The SHARP Zaurus

### 3.1 Main features

We will focus on the SHARP Zaurus SL6000 [18], since we can have several wireless devices at the same time on this PDA.



Figure 3.1: The SHARP Zaurus SL6000

- Size: 157mm x 81mm x 23mm (without expansion slot)
- Weight: 285 grams (without expansion slot)
- Power supply: 1500mAh Lithium Ion battery (lasts 3 hours using Wifi). A second battery can be used in the expansion slot
- Communication ports: 802.11b (SL6000L), 802.11b + bluetooth (SL6000W), one CompactFlash slot (two with the expansion slot)
- Supported Operating Systems: Linux-based operating system (OpenPDA), 2.4.18 kernel
- Architecture: Intel PXA255 400 MHz XScale processor

- Misc: SD card slot
- Price: around \$650

## 3.2 Main issues

No Linux 2.6 kernel runs on this Zaurus at the moment. Two people from OpenZaurus.org are working on it, but the progress is very slow. Also, \*BSD operating system is not available on SL6000, thus we cannot use KAME/SHISA.

As it is a ARM processor, we need to cross-compile every application, library or kernel we want to use on it, thus it can become really tiresome. A project such as OpenEmbedded.org [14] can make cross-compiling quite easy.

## 3.3 The Zaurus SL6000L as a Mobile Router

We tried to port the LIVSIX IPv6 stack [7] from Motorola Labs on Zaurus SL6000. This stack supports MobileIPv6 and NEMO basic Support, unfortunately we faced some issues with IPv6 routing on Zaurus with this IPv6 stack. We summarized our work in a document [8] available on Nautilus6 website [23].





## Chapter 4

# The SONY VAIO Type U

### 4.1 Main features

The new SONY VAIO type U50 or type U70 models [20] is one of the smallest x86-based laptop sold today in the market.



Figure 4.1: The SONY VAIO Type U

- Size: 167mm x 108mm x 26mm
- Weight: 550 grams
- Power supply: 1800mAh Lithium Ion battery (lasts 2h with intensive use), 3600mAh Lithium Ion battery (lasts 3h30 with intensive use)
- Communication ports: one ethernet port, one CompactFlash slot, embedded IEEE 802.11b/g
- Supported Operating Systems: Debian GNU/Linux, Fedora Core2, NetBSD 1.6.2
- Architecture: Pentium M 1Ghz (U70), Celeron M 900Mhz (U50)
- Misc: USB 2.0, touchscreen
- Price: around 210 000 yens (U70), 170 000 yens (U50)

## 4.2 Main issues

With Linux Operating System, almost all devices are supported (CF slot, atheros chipset for wireless, sound card etc.), but we experienced some issues with NetBSD 1.6.2: the wireless chipset is supported only from NetBSD 2.0, the VAIO freezes when trying to insert a CF card in the slot, the VAIO keyboard does not work (we need to use another generic USB keyboard).

## 4.3 The VAIO U70 as a Mobile Router

We released a documentation to setup Debian GNU/Linux and NetBSD 1.6.2 on the U70 model. Please check Nautilus6 website [23].



# Chapter 5

## The OpenBrick

### 5.1 Main features

The OpenBrick [12] is a small, light and silent open platform optimized for Open Source and Free Software solutions.



Figure 5.1: The OpenBrick

- Size: 180mm x 117mm x 40mm
- Weight: 500 gramms
- Power supply: +/-5V
- Communication ports: PCMCIA slot, CompactFlash slot, single or dual ethernet ports
- Supported Operating Systems: GNU/Linux
- Architecture: GX1 Geode 300Mhz processor
- Misc: internal ATA/33 2.5" slot, dual USB port
- Price: between 300 and 400 euros

## 5.2 Main issues

We need to provide power to the OpenBrick. A battery or cells providing 5V should work.

## 5.3 The OpenBrick as a Mobile Router

This device has not been tested as a Mobile Router. It has been successfully tested with a GNU/Linux operating systems. It has not been tested with \*BSD.

Its PCMCIA and Compact Flash slots would allow us to use both a 3G card and a WiFi card as egress interfaces. This device is light and quite small, and easy to supply with power, it then could be a good device for a Mobile Router.



# Chapter 6

## The OpenBrick NG

### 6.1 Main features

The OpenBrick NG [13] is a small, light and completely silent open platform which can be used as a router.



Figure 6.1: The OpenBrick NG

- Size: 235mm x 149mm x 68mm
- Weight: 1500 grams
- Power supply: 100/240V
- Communication ports: dual Ethernet RJ45, PCI slot
- Supported Operating Systems: GNU/Linux
- Architecture: 1 GHz x86 compatible VIA C3 processor
- Misc: quad USB 2.0 port, software can be installed on a USB 2.0 Flash Disk or on an optional USB 2.0 Hard Disk
- Price: from 390 euros

## 6.2 Main issues

The OpenBrick NG might be too heavy to be used in a Personal Area Network. Also, it requires a 100/240V power source.

## 6.3 The OpenBrick NG as a Mobile Router

This device has not been tested as a Mobile Router. It has been successfully tested with Linux (2.4 and 2.6 kernel). It has not been tested with \*BSD.

Its weight and the difficulty to supply power make it difficult to use in embedded environment.



# Chapter 7

## The OpenBlocks

### 7.1 Main features

The Openblocks [11] is a very small and light router designed for Linux Operating System.

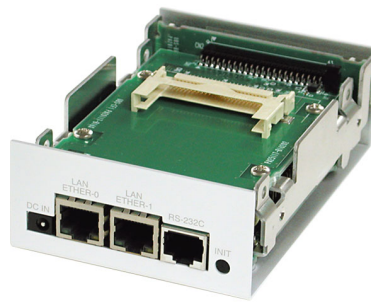


Figure 7.1: The OpenBlocks266

- Size: 114.5mm x 81mm x 38mm
- Weight: unknown
- Power supply: DC5V/3.0A
- Communication ports: dual Ethernet RJ45, CompactFlash slot, PC Card (PCMCIA) slot (in option)
- Supported Operating Systems: SSD/Linux 0.2 with 2.4.20 kernel, NetBSD 2.0
- Architecture: IBM PowerPC 405GPr 266MHz, 64MB SDRAM, 8MB Flash ROM
- Misc: Serial Port
- Price: around 30 000 yens (64Mo SDRAM) and 40 000 yens (128Mo SDRAM)

## 7.2 Main issues

This device is sold with the SSD/Linux 0.2 Operating System, based on 2.4.20 kernel. For our Mobile Router, we need 2.6 kernel for Linux. But on the BSD side, NetBSD 2.0 is now supported on the OpenBlocks thanks to NetBSD/openblocks [10].

## 7.3 The OpenBlocks as a Mobile Router

This device has not been tested as a Mobile Router. But it could be an interesting device since it is very small, and we can have PCMCIA slot (useful if we want to use a 3G card). The current supported Linux kernel does not fit to our constraints, but it can be interesting for our BSD platforms as it now supports NetBSD 2.0.





# Chapter 8

## The Tiqit

### 8.1 Main features

The Tiqit [21] is a personal computer that provides full notebook PC functionality in a PDA-class device.



Figure 8.1: The Tiqit

- Size: 150mm x 102mm x 30mm
- Weight: 560 grams
- Power supply: Internal lithium-ion battery (4 hours under normal usage)
- Communication ports: CardBus slot (32-bit PCMCIA)
- Supported Operating Systems: Unix, Linux, and other x86 OS that supports GX video driver
- Architecture: 300 MHz Pentium-class CPU
- Misc: USB 1.1 port, SD slot, touchscreen
- Price: unknown (not sold yet)

## 8.2 Main issues

This device may lack communications ports. But we can use the CardBus Slot for a PCMCIA card and the USB port to connect an ethernet RJ45 port. The SD slot could be used with a SD Wireless Card, unfortunately such cards are not yet supported with Linux, and SD slots are supported only on few devices (such as Zaurus, with a closed driver).

## 8.3 The Tiqit as a Mobile Router

This device has not been tested as a Mobile Router. It is known to support Linux Operating System. It has not been tested with \*BSD.

The only advantage this device has compared to the VAIO U70 is the CardBus slot that would allow us to use a 3G card. Otherwise the VAIO is more powerful and has more available communication devices.



## Chapter 9

# The OQO

### 9.1 Main features

The OQO model 01 [15] is one of the smallest and lightest personal computer.



Figure 9.1: The OQO model 01

- Size: 124mm x 86mm x 23mm
- Weight: 400 grams
- Power supply: Lithium Polymer battery (lasts about three hours)
- Communication ports: IEEE 802.11b, Bluetooth
- Supported Operating Systems: unknown
- Architecture: 1GHz Transmeta Crusoe
- Misc: FireWire 1394, USB 1.1, ethernet (with docking cable)
- Price: around \$1900

### 9.2 Main issues

The OQO has not been tested neither with Linux nor with \*BSD operating system. We do not have enough informations about the hardware to guess if it can run or not with these OS.

### 9.3 The OQO as a Mobile Router

This device has not been tested as a Mobile Router. This device is quite new, and nobody tested it with Linux or \*BSD yet. Also it may be too expensive for a mobile router.



# Chapter 10

## The Meshcube

### 10.1 Main features

The Meshcube [9] is a small, low-power consumption and multi-interfaced device.



Figure 10.1: The Meshcube

- Size: 70mm x 50mm x 70mm
- Weight: unknown
- Power supply: low power consumption (ca. 4W), power over ethernet (802.3af)
- Communication ports: one 100Mbps ethernet port, up to 2 WLAN (802.11a/b/g) interfaces (RP-SMA connectors)
- Supported Operating Systems: Nylon (a small but full featured GNU/Linux system), based on 2.4.27 kernel
- Architecture: 400MHz MIPS processor

- Misc: 32MB flash, 64MB RAM, USB, up to 8 MiniPci cards
- Price: from 200 euros

## 10.2 Main issues

The operating system (Nylon) is based on a standard linux 2.4.27 kernel, with some additions and patches so it will run on the cube hardware. There is no support yet for 2.6 kernel series. Nylon is based on and fully integrated within the OpenEmbedded project [14]. OpenEmbedded is a build system for embedded devices (small linux systems) which makes cross-compiling quite easy.

## 10.3 The Meshcube as a Mobile Router

This device has not been tested as a Mobile Router. If Meshcube plans to support 2.6 kernel, it could definitely be an interesting solution, as it provides very interesting features.



# Chapter 11

## Motherboards

### 11.1 Compulab 586BASE Board

The Compulab 586BASE Board [1] contains a Card Bus controller and slots. Off-the-shelf PCMCIA modules can extend the system with capabilities such as wireless LAN or 3G.

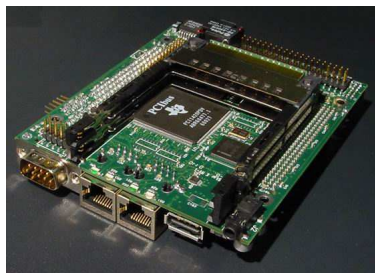


Figure 11.1: The 586base Board

- Size: 116mm x 96mm x 10 to 22mm.
- Weight: unknown
- Power supply: 3.3V, 5V, 12V
- Communication ports: Single or dual 10/100BaseT Ethernet ports, Single or Dual CardBus (PCMCIA) slots
- Supported Operating Systems: Linux
- Architecture: ElanSC520 CPU @100-133 MHz itemMisc: USB port
- Price: around \$100 (depends on the options)

## 11.2 ESPT2

The ESPT2 board [3] can easily be extended with PCMCIA or CF slots [4].



Figure 11.2: The ESPT2 Board

- Size: 91mm x 55mm x 18mm
- Weight: unknown
- Power supply: 3.3V
- Communication ports: dual 10/100BaseT Ethernet ports, CF slot
- Supported Operating Systems: Linux
- Architecture: SH7710 (32-bit RISC CPU @200MHz)
- Misc: PCMCIA and CF slots extensions
- Price: around 80 000 yens





### 11.3 E!Kit-1100

The E!Kit-1100 board [2] is an embedded Linux board.



Figure 11.3: The E!Kit-1100 Board

- Size: 110mm x 90mm
- Weight: unknown
- Power supply: 5V
- Communication ports: one 10/100BaseT Ethernet port, CF slot
- Supported Operating Systems: Linux 2.4 and 2.6 kernels
- Architecture: AMD Au1100-400MHz
- Misc: USB port
- Price: unknown



## 11.4 PC Engines

The PC Engines board [17] is a small motherboard that provides a Compact Flash slot, 2 ethernet ports, and up to 2 mini-PCI slots. It can be powered using Power-over-Ethernet.

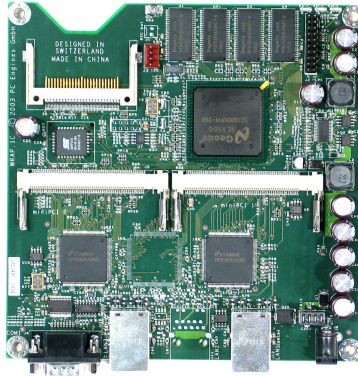


Figure 11.4: The PC Engines WRAP board

- Size: 152mm x 152mm
- Weight: unknown
- Power supply: About 3 to 5W at 12V DC, through DC jack or passive Power over Ethernet. Acceptable range +7V to +18V DC.
- Communication ports: 2 10/100BaseT Ethernet port, CF slot, 2 mini-PCI
- Supported Operating Systems: FreeBSD (m0n0wall)
- Architecture: 266 MHz National Geode SC1100 CPU
- Price: \$140



## Chapter 12

# Misceallenous devices

### 12.1 The 3COM OfficeConnect Travel Router

The Travel Router [22] is a light-weight and compact (102mm x 70mm x 22mm) router. It can be supplied with DC5V/2A, and supports IEEE802.11b/g and Ethernet.



Figure 12.1: The Travel Router

Unfortunately, at the moment we cannot modify or change the operating system of this box. Then it is unuseful for our use.

### 12.2 The Linksys WRT54G router

The WRT54G router [6] is a Wireless-G Broadband Router. It includes IEEE 802.11b/g and a 4-ports ethernet switch.



Figure 12.2: The Linksys WRT54G

It runs with Linux, based on 2.4 kernel. Unfortunately the kernel version does not fit to our constraints. Also, it only has one wireless interface and ethernet interface, which is not enough to support multihoming (if we want multiple access technologies, such as WiFi and 3G, for example).



## Chapter 13

# Conclusion

In this section we will summarize all devices we introduced in this survey.

Name	Size (mm)	Weight (g)	Power Supply
SOEKRIS	245x152x33	600	5V / PoE / 11-56V
Zaurus SL6000	157x81x23	285	1 or 2 1500mAh Lithium Ion battery (3h)
VAIO U50/70	167x108x26	550	1800mAh (2h) or 3600mAh Lithium Ion battery (3h30)
OpenBrick	180x117x40	500	+/-5V
OpenBrick NG	235x149x68	1500	100/240V
OpenBlocks	114.5x81x38	?	DC5V/3.0A
Tiqit	150x102x30	560	Internal Lithium Ion battery (4h)
OQO	124x86x23	400	Lithium Polymer battery (3h)
Meshcube	70x50x70	?	PoE (Power over Ethernet)

Table 13.1: Summary of the size, weight and power supply for each devices

Name	Communication ports	Operating System	Price
SOEKRIS	2 ethernet, 2 PC-Card, 1 MiniPCI	FreeBSD, NetBSD, Linux	\$206
Zaurus SL6000	802.11b + bluetooth, 1 or 2 CF slot	Linux 2.4.18	\$650
VAIO U50/70	1 ethernet, 1 CF slot, 802.11b/g	Linux, NetBSD 1.6.2	210000 yens
OpenBrick	1 PCMCIA, 1 CF, 1 or 2 ethernet	Linux	300-400 euros
OpenBrick NG	2 ethernet, 1 PCI slot	Linux	from 390 euros
OpenBlocks	2 ethernet, 1 CF , 1 PCCard slot	Linux 2.4, NetBSD 2.0	30000-40000 yens
Tiqit	CardBus slot (32-bit PCMCIA)	Linux	?
OQO	IEEE 802.11b, Bluetooth, Ethernet	?	\$1900
Meshcube	1 ethernet, 2 WLAN, 8 MiniPci cards	Linux 2.4.27	from 200 euros

Table 13.2: Summary of the communication ports, operating system and price for each devices

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