



**KaeilOS ®**  
**un ambiente integrato**  
**per la generazione di sistemi**  
**Linux embedded**

*relatore*  
**Marco Cavallini - KOAN s.a.s.**

## **KOAN s.a.s. – Bergamo**

- ❑ fondata nel 1996**
  
- ❑ Sistemi software embedded**
- ❑ Sistemi software Real-Time**
- ❑ Sviluppo software**
- ❑ Sviluppo device drivers**
- ❑ Consulenza**
- ❑ Formazione**



## Tipico approccio a GNU/Linux Embedded

- ❑ Riducendo una distribuzione esistente
- ❑ Da zero *‘from scratch’*

KaeilOS è una distribuzione GNU/Linux creata *‘from scratch’*

### Motivazioni

- ❑ Maggiore controllo dei componenti
- ❑ Garanzia della riproducibilità
- ❑ Utilizzo non limitato a PC (x86)

## KaeilOS a confronto con altre soluzioni

	KaeilOS	DIY*	Altri
Full GPL	SI	SI	NO
Royalty free	SI	SI	forse
Toolchain	Cross CPU	Singola CPU	Singola CPU
Toolkit (KTX)	KTX	NO	alcuni
Real Time	RTAI / Xenomai	vari	alcuni
IDE	Anjuta / Eclipse	varie	alcuni
GUI	SI	vari	NO
Time to market	giorni	settimane	dipende
Supporto	SI	NO	alcuni

\*Do It Yourself

## Vantaggi di KaeilOS vs. DIY (Do It Yourself)

- ❑ Entrambi basati su componenti GPL (GNU/Linux)
- ❑ Selezione dei componenti
- ❑ Integrazione di librerie e applicativi
- ❑ Con server grafico Xfree86
- ❑ Time to market
- ❑ Supporto e assistenza

***KaeilOS offre i vantaggi  
di una distribuzione proprietaria (supporto)  
e quelli di una distribuzione GPL (open source)***

## Perchè è nata KaeilOS

- ❑ **Embedded e Real-Time**
- ❑ **Kernel 2.4.x**
- ❑ **Modulare e configurabile con un Toolkit**
- ❑ **Completa di tools di sviluppo**
- ❑ **Con server grafico Xfree86**
- ❑ **Libreria grafica**
- ❑ **Supporto e assistenza in italiano**



## Architettura e Requisiti



## Processori target supportati

- ARM con MMU
- ARM senza MMU
- X86
- PPC\*
- ColdFire\*
- MIPS\*
- SuperH\*

\*opzionali





## Requisiti minimi di KaeilOS ...

### PC con distribuzione linux per sviluppo

- Kubuntu\***
- Ubuntu\***
- Debian\***
- RedHat**
- Slackware**
- ...altre**

**\*consigliate**



## Requisiti minimi di KaeilOS ...

### Kernel e filesystem senza grafica

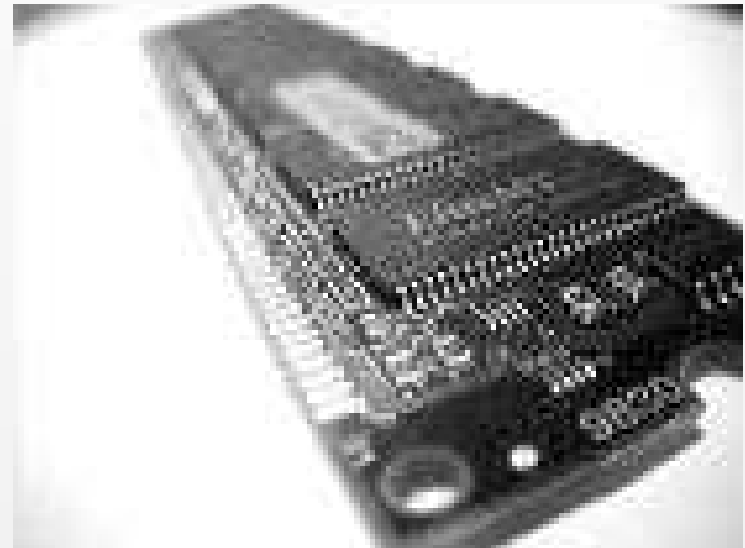
- 4MB ROM (disco o flash)**
- 4MB RAM**

### con grafica TinyX

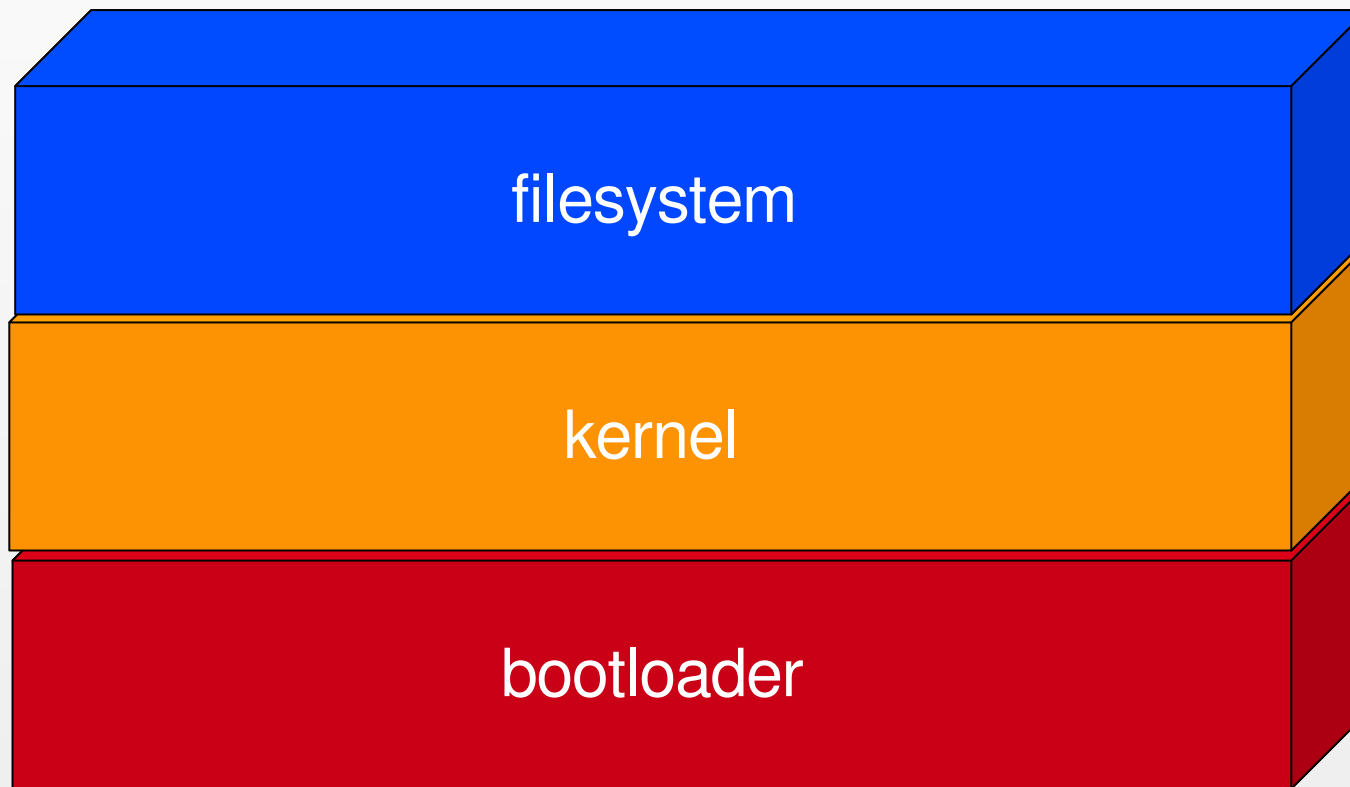
- 16MB ROM**
- 16/32MB RAM**

### con grafica TinyX e wxWidgets-GTK

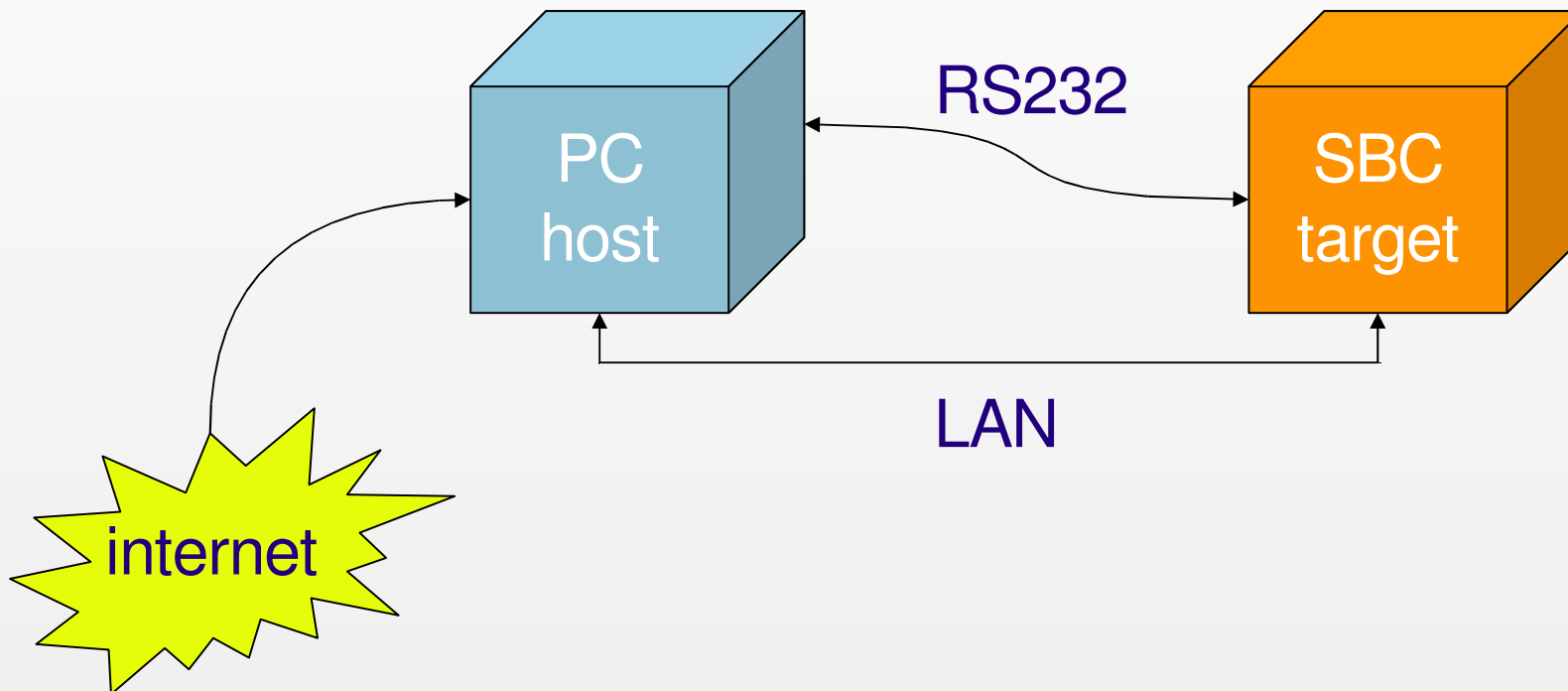
- >64MB ROM**
- 128MB RAM**



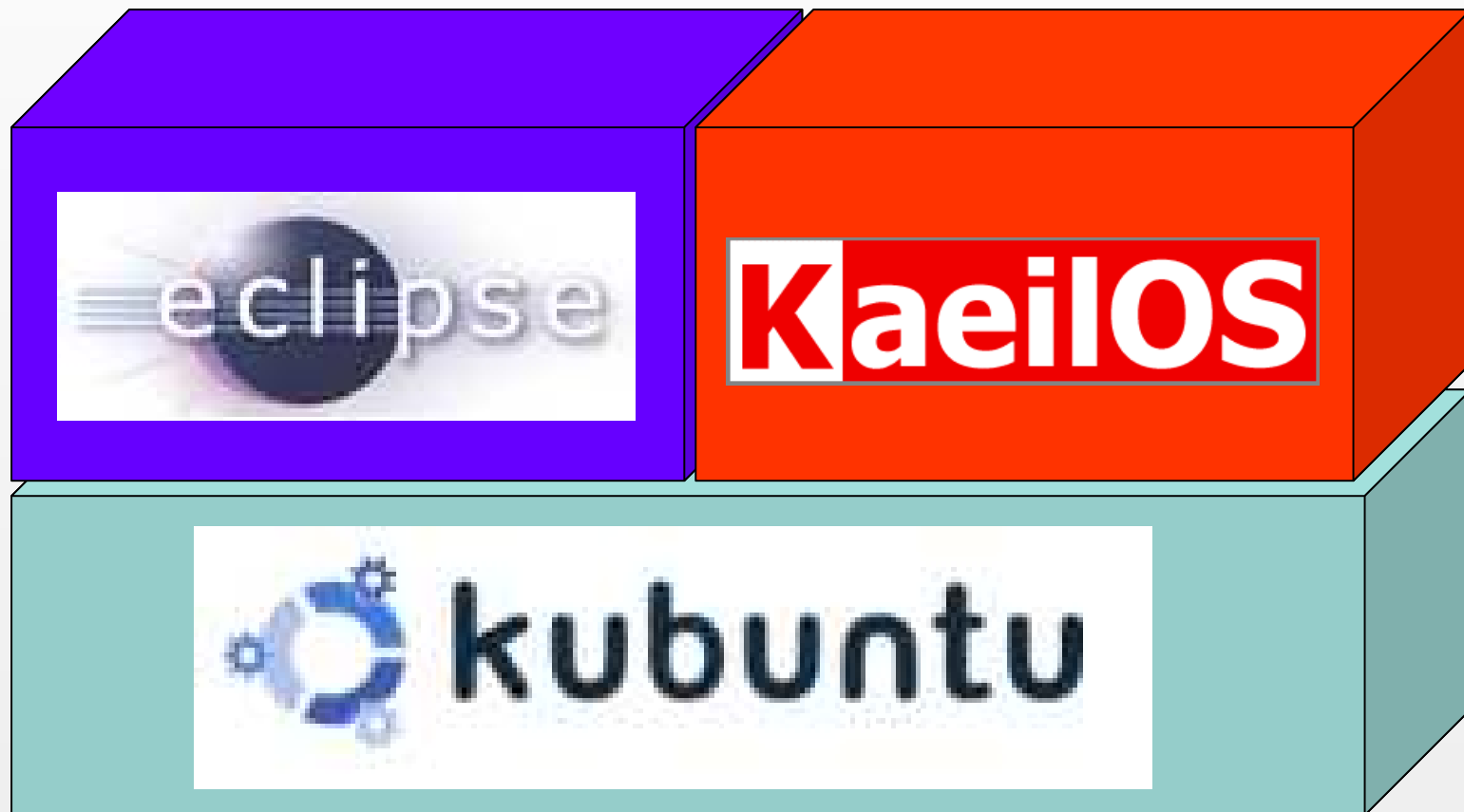
## Architettura del sistema Linux



## Architettura per lo sviluppo



## Strategia di integrazione KaeilOS 3.0



## Futuro di KaeilOS

- ❑ **Versione 3.0 (Settembre 2006)**
- ❑ **Nuovo Toolkit KTX grafico**
- ❑ **Integrazione Xenomai**
- ❑ **Integrazione migliorata RTAI**
- ❑ **Integrazione JavaVM™**
- ❑ **Nuovo IDE : Eclipse™**
- ❑ **Debugging remoto**



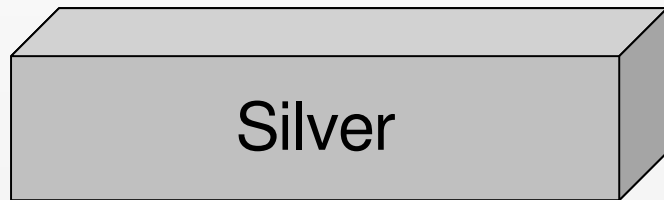
## **Alcuni settori in cui è utilizzato KaeilOS**

- ☒ Bordo macchina**
- ☒ Sistemi palmari per diagnosi motore**
- ☒ Sistemi automotive generici**
- ☒ Controllo presenze / accessi**
- ☒ Supervisione e raccolta dati**
- ☒ Gateway**
- ☒ Domotica**
- ☒ Sistemi avionici di bordo**
- ☒ Sistemi navali di bordo**
- ☒ ecc...**

## Versioni di KaeilOS



- ❑ CD con software e documentazione



- ❑ CD con software e documentazione
- ❑ Supporto email e Aggiornamento



- ❑ CD con software e documentazione
- ❑ Supporto email e Aggiornamento
- ❑ 3 giorni di consulenza



- ❑ CD software documentazione
- ❑ Supporto, Aggiornamento
- ❑ Consulenza a progetto



## KTX

Koan Toolkit eXtension  
il tool di configurazione



## Configurazione con KTX ...

### Selezione modulare dei componenti

- Target options
- Cross toolchain
- Root filesystem
- Debugging tools
- Kernel version
- RTAI extension
- C library

```
koan@kfedora:~/ktx-0.5.2-k1 - Shell - Konsole
KTX v0.5.2-cvs Configuration

----- KTX Toolkit Configuration -----
Arrow keys navigate the menu. <Enter> selects submenus ----. Highlighted
letters are hotkeys. Pressing <Y> includes, <N> excludes, <M> modularizes
features. Press <Esc><Esc> to exit, <?> for Help. Legend: [*] built-in [ ]
excluded <M> module < > module capable

[*386-koan] Project Name
---- General Options ----
Code maturity          ---->
Target Options        ---->
Cross Toolchain       ---->
Root Filesystem       ---->
Debugging Tools       ---->
Host Tools            ---->
---- Core System ----
Kernel                ---->
C Library             ---->
C++ Library           ---->
---- Core Tools ----
Pdksh                 ---->
Bash                  ---->
BusyBox               ---->
mgetty & sendfax     ---->
Gawk                  ---->

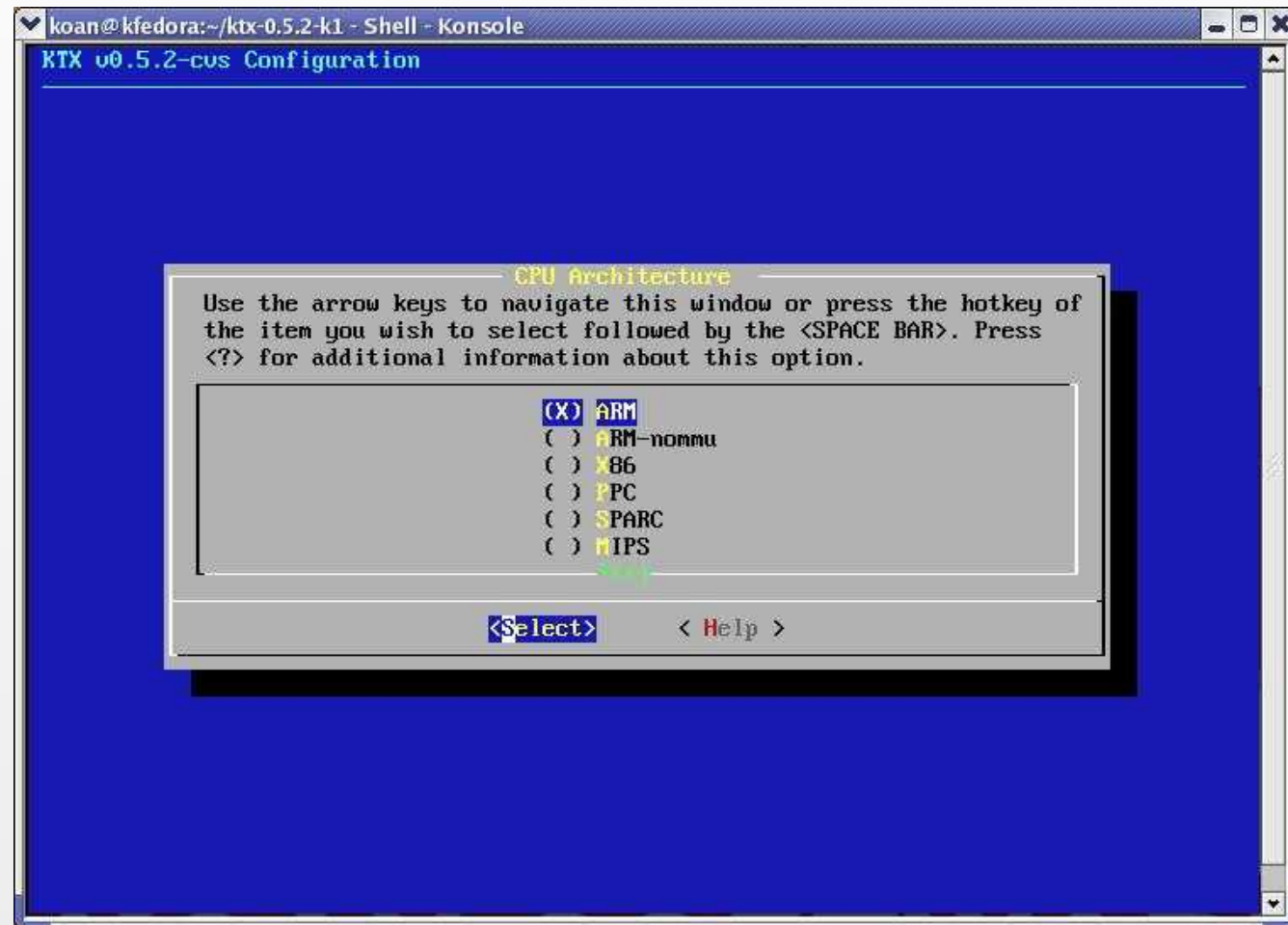
<Select>  < Exit >  < Help >
```

## Configurazione con KTX ...

### Supporto CPU

- X86
- ARM MMU
- ARM noMMU
- PPC
- MIPS\*
- SuperH\*

\*opzionali



## Configurazione con KTX ...

### Creazione della Toolchain

- gcc
- glibc
- binutils

```
koan@kfedora:~/ktx-0.5.2-k1 - Shell - Konsole
KTX v0.5.2-cvs Configuration

Cross Toolchain
Arrow keys navigate the menu. <Enter> selects submenus --->. Highlighted
letters are hotkeys. Pressing <Y> includes, <N> excludes, <M> modularizes
features. Press <Esc><Esc> to exit, <?> for Help. Legend: [*] built-in [ ]
excluded <M> module < > module capable

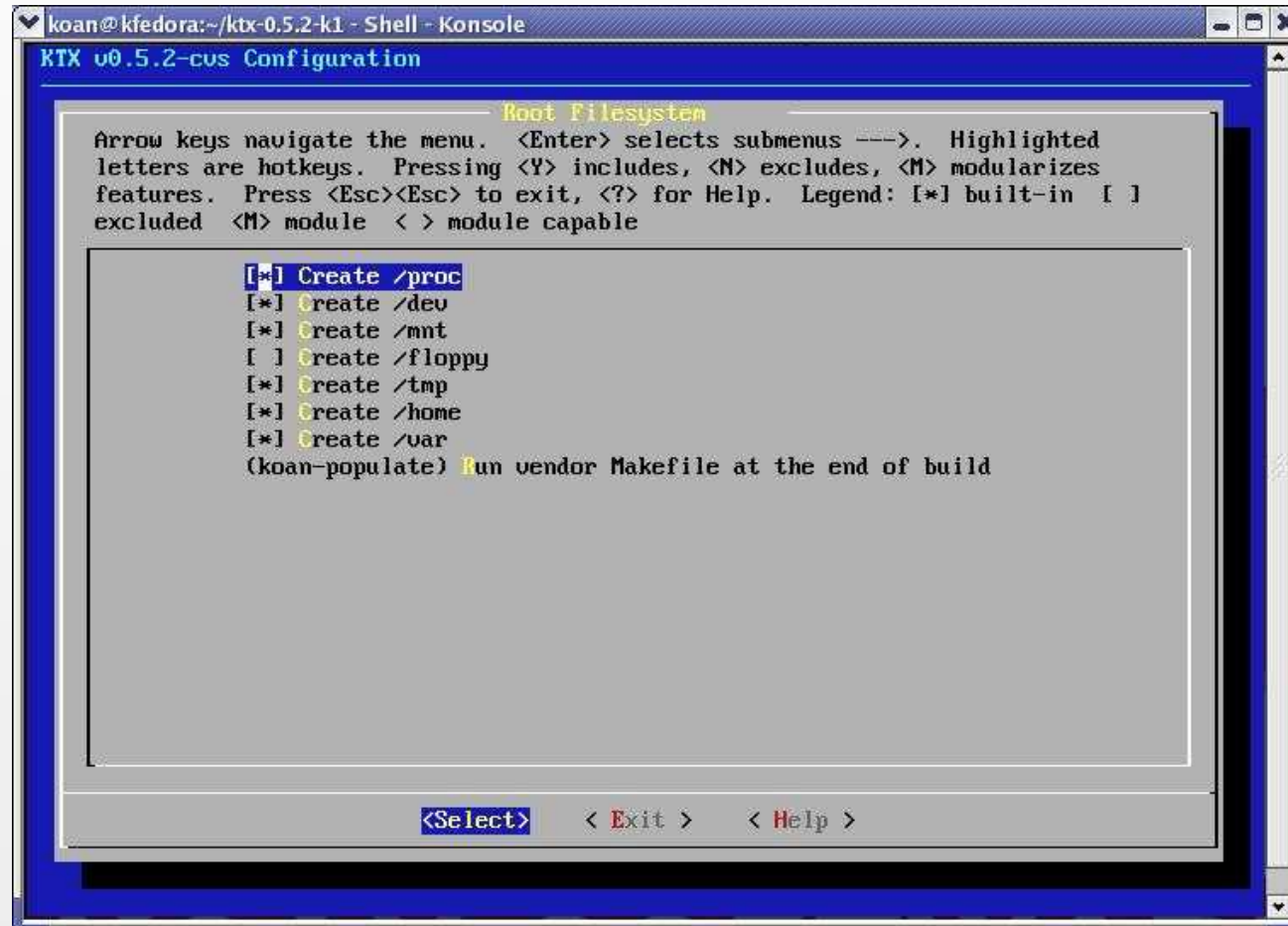
[*] Build Cross Toolchain
    binutils Version (2.13.2.1) --->
    GCC Version (2.95.3 ) --->
[*] build gcc shared
[ ] build gcc with multilib support
[ ] Build distcc
[ ] Build scon (see help)

<Select> < Exit > < Help >
```

## Configurazione con KTX ...

### Creazione del root filesystem

- /proc**
- /home**
- /dev**
- /mnt**
- /tmp**
- /var**
- Personalizzazione**



```
koan@kfedora:~/ktx-0.5.2-k1 - Shell - Konsole
KTX v0.5.2-cvs Configuration

Root Filesystem
Arrow keys navigate the menu. <Enter> selects submenus --->. Highlighted
letters are hotkeys. Pressing <Y> includes, <N> excludes, <M> modularizes
features. Press <Esc><Esc> to exit, <?> for Help. Legend: [*] built-in [ ]
excluded <M> module < > module capable

[*] Create /proc
[*] create /dev
[*] create /mnt
[ ] create /floppy
[*] create /tmp
[*] create /home
[*] create /var
(koan-populate) Run vendor Makefile at the end of build

<Select> < Exit > < Help >
```

## Configurazione con KTX ...

### Supporto per debug

- basato su GDB**
- gdbserver**
- cross-gdb**
- ksymoops**
- strace**

```
koan@kfedora:~/ktx-0.5.2-k1 - Shell - Konsole
KTX v0.5.2-cvs Configuration

                                Debugging Tools
Arrow keys navigate the menu. <Enter> selects submenus --->. Highlighted
letters are hotkeys. Pressing <Y> includes, <N> excludes, <M> modularizes
features. Press <Esc><Esc> to exit, <?> for Help. Legend: [*] built-in [ ]
excluded <M> module < > module capable

[*] Build Cross GDB
[*] Build gdbserver for target
[*] Build shared (NEW)
[ ] Build GDB for target
[ ] Build cross-GDB wrapper
[*] ksymoops
[ ] Linux Trace Toolkit (LTT)
[ ] libbfd on target (needed for profiling)
[ ] mntest
[ ] oprofile
[*] strace
[*] build shared

<Select> < Exit > < Help >
```



## Configurazione con KTX ...

### Versione del Kernel

- 2.6.15**
- fino a 2.4.27**
- fino a 2.6.11**

```
koan@kfedora:~/ktx-0.5.2-k1 - Shell - Konsole
KTX v0.5.2-cus Configuration

Kernel Version
Use the arrow keys to navigate this window or press the hotkey of
the item you wish to select followed by the <SPACE BAR>. Press
<?> for additional information about this option.

( ) 2.4.21
( ) 2.4.25
(X) 2.4.26
( ) 2.6.0
( ) 2.6.1
( ) 2.6.6

<Select> < Help >
```

## Configurazione con KTX ...

### Opzioni del Kernel

- zImage**
- ulmage**
- vmlinux**
- bzImage\***

\*solo x86

```
koan@kfedora:~/ktx-0.5.2-k1 - Shell - Konsole
KTX v0.5.2-cvs Configuration

Kernel
Arrow keys navigate the menu. <Enter> selects submenus --->. Highlighted
letters are hotkeys. Pressing <Y> includes, <N> excludes, <M> modularizes
features. Press <Esc><Esc> to exit, <?> for Help. Legend: [*] built-in [ ]
excluded <M> module < > module capable

(kernel-2.4.19-i386-generic-20030808-1) Name of config in $KTX/config/kernel to
Kernel Version (2.4.26) --->
[ ] Don't compile kernel
Kernel Image (zImage) --->
[*] Install kernel into /boot on target
---
() Patch 1 URL
() Patch 1 Name
--- Extensions
--- RTAI/epoll should be ported to patchstack mechanism, please send patch! :->
RTAI --->

<Select> < Exit > < Help >
```



## Configurazione con KTX ...

### Estensioni Real-Time

- basato su RTAI**
- rtai-3.1 vesuvio**
  
- RTAI/fusion-0.9.1**
- Xenomai**

```
koan@kfedora:~/ktx-0.5.2-k1 - Shell - Konsole
KTX v0.5.2-cvs Configuration

                                RTAI
Arrow keys navigate the menu. <Enter> selects submenus --->. Highlighted
letters are hotkeys. Pressing <Y> includes, <N> excludes, <M> modularizes
features. Press <Esc><Esc> to exit, <?> for Help. Legend: [*] built-in [ ]
excluded <M> module < > module capable

[*] Realtime Extension: RTAI
(rtai-24.1.10-) Name of config in $KTX/config/rtai to be used
| RTAI Version (24.1.12) --->
  Select RTAI technology
[*] Real-Time Networking for RTAI
[ ] build 3Com 59x driver (see help)
[ ] build Realtek 8139 driver
[*] build Intel EtherExpressPro/100 driver
[ ] build AMD PCnet32 driver
[ ] build VIA Rhine driver
[ ] build loopback driver
[ ] build tulip driver

<Select> < Exit > < Help >
```

## Configurazione con KTX ...

### C library

- K** completa  
selezione delle  
opzioni di  
configurazione  
della  
compilazione

```
koan@kfedora:~/ktx-0.5.2-k1 - Shell - Konsole
KTX v0.5.2-cvs Configuration

C Library
Arrow keys navigate the menu. <Enter> selects submenus --->. Highlighted
letters are hotkeys. Pressing <Y> includes, <N> excludes, <M> modularizes
features. Press <Esc><Esc> to exit, <?> for Help. Legend: [*] built-in [ ]
excluded <M> module < > module capable

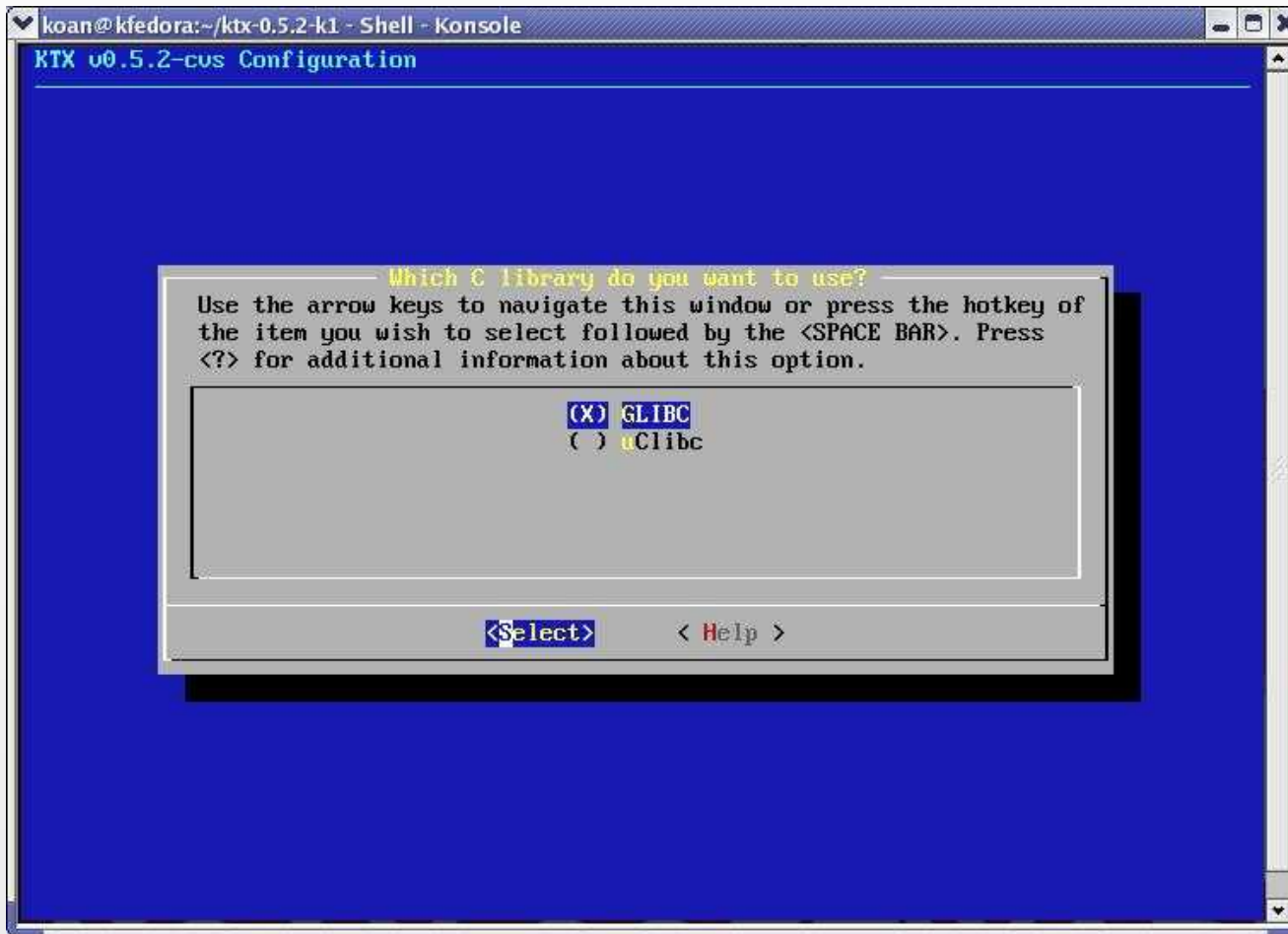
Which C library do you want to use? (GLIBC) --->
--- C Library options
C-Lib Version (2.3.2) --->
[*] Compile glibc with pthreads
[ ] Build in GNU libio instead of GNU stdio
[*] Build shared library
[ ] Include profiling support
[ ] Build undebuggable optimized library
[ ] Build with runtime bounds checking
[ ] Optimize glibc for selected kernel version
[ ] Don't strip debugging symbols
--- Install options
[*] Install libthread_db on the target
[*] Install libdl on the target
[*] Install libcrypt on the target
[*] Install libutil on the target
[*] Install libm on the target
[*] Install libnss_dns

<Select> < Exit > < Help >
```

## Configurazione con KTX ...

### uClibc

- K** uClibc per processori senza MMU



```
koan@kfedora:~/ktx-0.5.2-k1 - Shell - Konsole
KTX v0.5.2-cvs Configuration

Which C library do you want to use?
Use the arrow keys to navigate this window or press the hotkey of
the item you wish to select followed by the <SPACE BAR>. Press
<?> for additional information about this option.

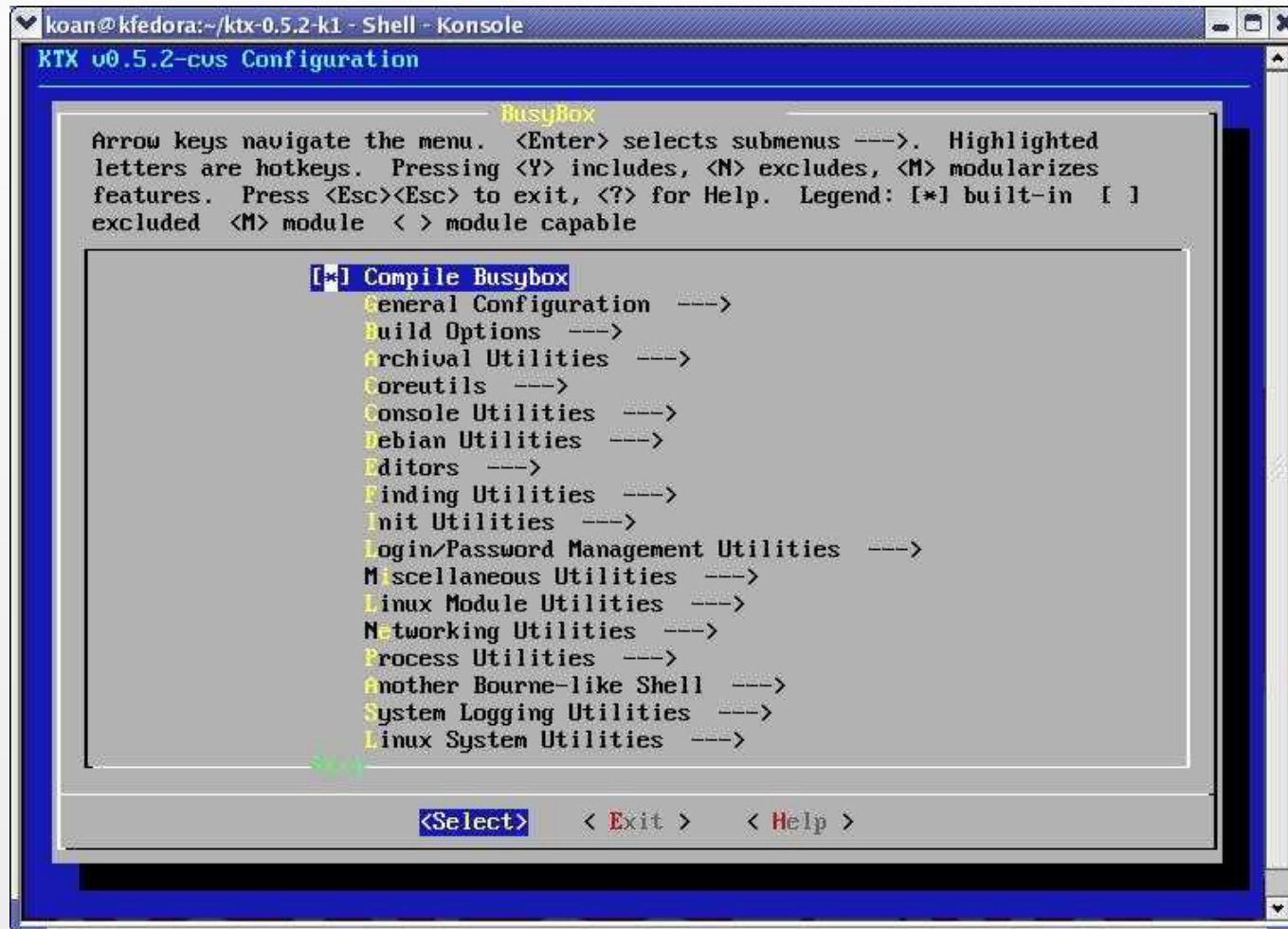
(X) GLIBC
( ) uClibc

<Select>    < Help >
```

## Configurazione con KTX ...

### Busybox

- K** completa selezione delle opzioni di configurazione



```
koan@kfedora:~/ktx-0.5.2-k1 - Shell - Konsole
KTX v0.5.2-cvs Configuration

BusyBox
Arrow keys navigate the menu. <Enter> selects submenus --->. Highlighted
letters are hotkeys. Pressing <Y> includes, <N> excludes, <M> modularizes
features. Press <Esc><Esc> to exit, <?> for Help. Legend: [*] built-in [ ]
excluded <M> module < > module capable

[*] Compile Busybox
  General Configuration --->
  Build Options --->
  Archival Utilities --->
  Coreutils --->
  Console Utilities --->
  Debian Utilities --->
  Editors --->
  Finding Utilities --->
  Init Utilities --->
  Login/Password Management Utilities --->
  Miscellaneous Utilities --->
  Linux Module Utilities --->
  Networking Utilities --->
  Process Utilities --->
  Another Bourne-like Shell --->
  System Logging Utilities --->
  Linux System Utilities --->

<Select>  < Exit >  < Help >
```

## Configurazione con KTX ...

### Network security

- OpenSSL**
- OpenSSH**

```
koan@kfedora:~/ktx-0.5.2-k1 - Shell - Konsole
KTX v0.5.2-cus Configuration

Network Security
Arrow keys navigate the menu. <Enter> selects submenus ---->.
Highlighted letters are hotkeys. Pressing <Y> includes, <N> excludes,
<M> modularizes features. Press <Esc><Esc> to exit, <?> for Help.
Legend: [*] built-in [ ] excluded <M> module < > module capable

shorewall firewall ---->
LSH ---->
OpenSSL ---->
OpenSSH ---->
Dropbear SSH-Server ---->

<Select> < Exit > < Help >
```



## Configurazione con KTX ...

### Applicazioni networking

- iptables**
- ppp**
- utelnetsd**
- inetutils**
- netcat**
- proftpd**
- nfs-utils**
- wireless tools**

```
koan@kfedora:~/ktx-0.5.2-k1 - Shell - Konsole
KTX v0.5.2-cvs Configuration

Networking Apps
Arrow keys navigate the menu. <Enter> selects submenus ---->.
Highlighted letters are hotkeys. Pressing <Y> includes, <N> excludes,
<M> modularizes features. Press <Esc><Esc> to exit, <?> for Help.
Legend: [*] built-in [ ] excluded <M> module < > module capable

  bing ---->
  ppp ---->
  nmap ---->
  utelnetsd ---->
  inetutils ---->
  netcat ---->
  proftpd ---->
  betaftpd ---->
  nfs-utils ---->
  Portmapper ---->
  tcpwrapper ---->
  Wireless Tools ---->
  GNU Zebra ---->
  libnet ---->

<Select> < Exit > < Help >
```

## Configurazione con KTX ...

### Grafica

- Xfree86**
- TinyX**
- GTK**
- Fltk GUI**
- wxWidgets GUI**
- Blackbox WM**

```
koan@kfedora:~/ktx-0.5.2-k1 - Shell - Konsole
KTX v0.5.2-cvs Configuration

Graphics Libraries
Arrow keys navigate the menu. <Enter> selects submenus --->.
Highlighted letters are hotkeys. Pressing <Y> includes, <N> excludes,
<M> modularizes features. Press <Esc><Esc> to exit, <?> for Help.
Legend: [*] built-in [ ] excluded <M> module < > module capable

  glib-1.2.10  ---->
  gtk-1.2.10   ---->
  glib-2.2.2   ---->
  gtk-2.4.2    ---->
  XFree86-4.3.0 ---->
  Clementine WM ---->
  FLTK GUI Toolkit ---->
  wxWidgets GUI ---->
  Qt embedded GUI ---->
  Blackbox WM  ---->

<Select>  < Exit >  < Help >
```

## Configurazione con KTX ...

### Pseudo Java™ VM

- K Kaffe VM**
- K completa selezione delle opzioni di configurazione**

```
koan@kfedora:~/ktx-0.5.2-k1 - Shell - Konsole
KTX v0.5.2-cvs Configuration

      Kaffe
Arrow keys navigate the menu. <Enter> selects submenus --->.
Highlighted letters are hotkeys. Pressing <Y> includes, <N> excludes,
<M> modularizes features. Press <Esc><Esc> to exit, <?> for Help.
Legend: [*] built-in [ ] excluded <M> module < > module capable

[*] Compile Kaffe
--- Target Options
Engine (JITv3) ---->
Threading System (unix-jthreads) ---->
API (J2SE) ---->
[ ] Use Jikes or other Java compiler (NEW)
--- Debugging Options
[ ] Enable run-time debugging machinery (NEW)
[ ] Enable debugging symbol generation for jitted code (xdebugging)
[ ] Compile with gprof(1) profiling support (NEW)
[ ] Enable profiling for C and jitted code (xprofiling) (NEW)
[ ] Gather statistics on vm execution (NEW)
--- Features
[ ] Enable GCJ support (NEW)

<Select> < Exit > < Help >
```



## Caratteristiche di KaeilOS



**BSP**

**Board Support Package**  
esempio di piattaforme  
preconfigurate

## BSP di KaeilOS ...



### Boser HS2603 (e altre)

- ❑ **Cyrix Geode GX1/CX5530**
- ❑ **SO-DIMM 128MB**
- ❑ **I/O Chipset: SMC 37C669,  
Winbond W83977**
- ❑ **VGA Cyrix CX5530**
- ❑ **LAN 10/100 Realtek**
- ❑ **Audio Cyrix CX5530**
- ❑ **IDE, FDD, Parallel, 4 Serial**
- ❑ **PC/104 connector 16-bit ISA**
- ❑ **USB 1.1 ports (12Mbit/s)**



KaeilOS certified

## BSP di KaeilOS ...

### Icop Vortex86 (tutti)

- ❑ **Vortex86 166 MHz SoC**
- ❑ **Memory 128MB**
- ❑ **VGA**
- ❑ **LAN 10/100 Realtek**
- ❑ **IDE, FDD, Parallel, 2 Serial**
- ❑ **PC/104**
- ❑ **USB 1.1 ports (12Mbit/s)**



KaeilOS certified

## BSP di KaeilOS ...



### VIA EPIA Mini ITX

- ❑ VIA C3/EDEN 133MHz
- ❑ 1 DDR266 DIMM socket
- ❑ VGA
- ❑ LAN 10/100 Realtek
- ❑ 1 PCI Expansion Slots
- ❑ IDE, FDD, Parallel, 1 Serial
- ❑ USB 2



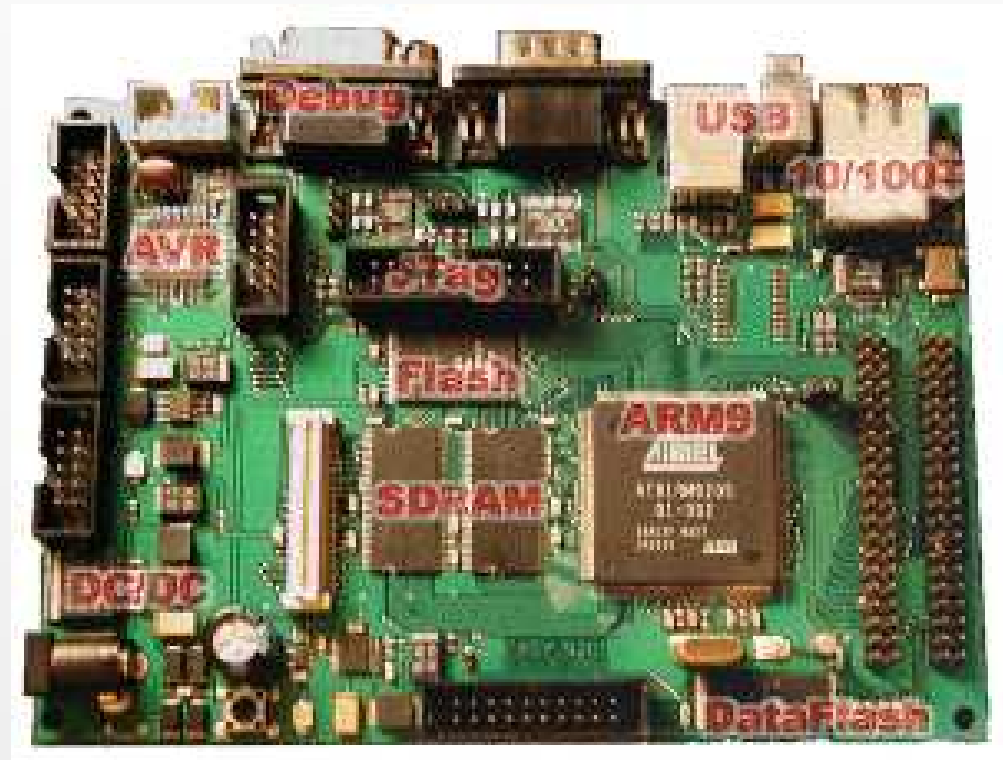
KaeilOS certified

## BSP di KaeilOS ...



### Easy9201

- ❑ Atmel ARM AT91RM9200
- ❑ +AVR ATmega
- ❑ 32MB SDRAM
- ❑ 2MB parallel flash
- ❑ 4MB serial flash
- ❑ RS232
- ❑ LAN 10/100
- ❑ USB 2 Host
- ❑ USB 2 Device
- ❑ JTAG

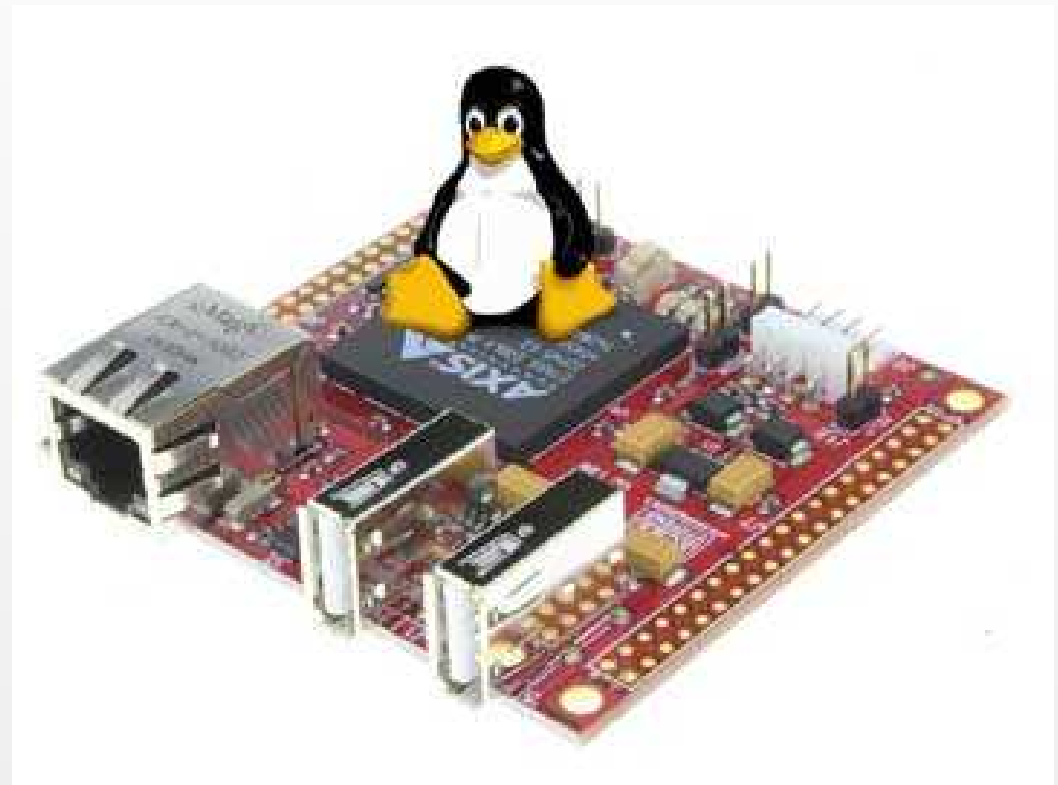


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## BSP di KaeilOS ...

### FOX Board\*

- ❑ **AXIS Etrax SoC**
- ❑ **32 bit RISC CPU core**
- ❑ **10/100 MBit Ethernet**
- ❑ **4 async serial ports**
- ❑ **2 sync serial ports**
- ❑ **2 USB ports**
- ❑ **2 Parallel ports**
- ❑ **4 ATA (IDE) ports**



\*work in progress...

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## BSP di KaeilOS ...

Sviluppo personalizzato per  
schede OEM



- ❑ Porting di Linux su nuove piattaforme
- ❑ Sviluppo kernel device drivers
- ❑ X11 e graphics device drivers
- ❑ User space drivers

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## IDE

Integrated **D**evelopment **E**nvironment  
sviluppo e debugging





## Anjuta IDE ...

Fully customizable integrated editor

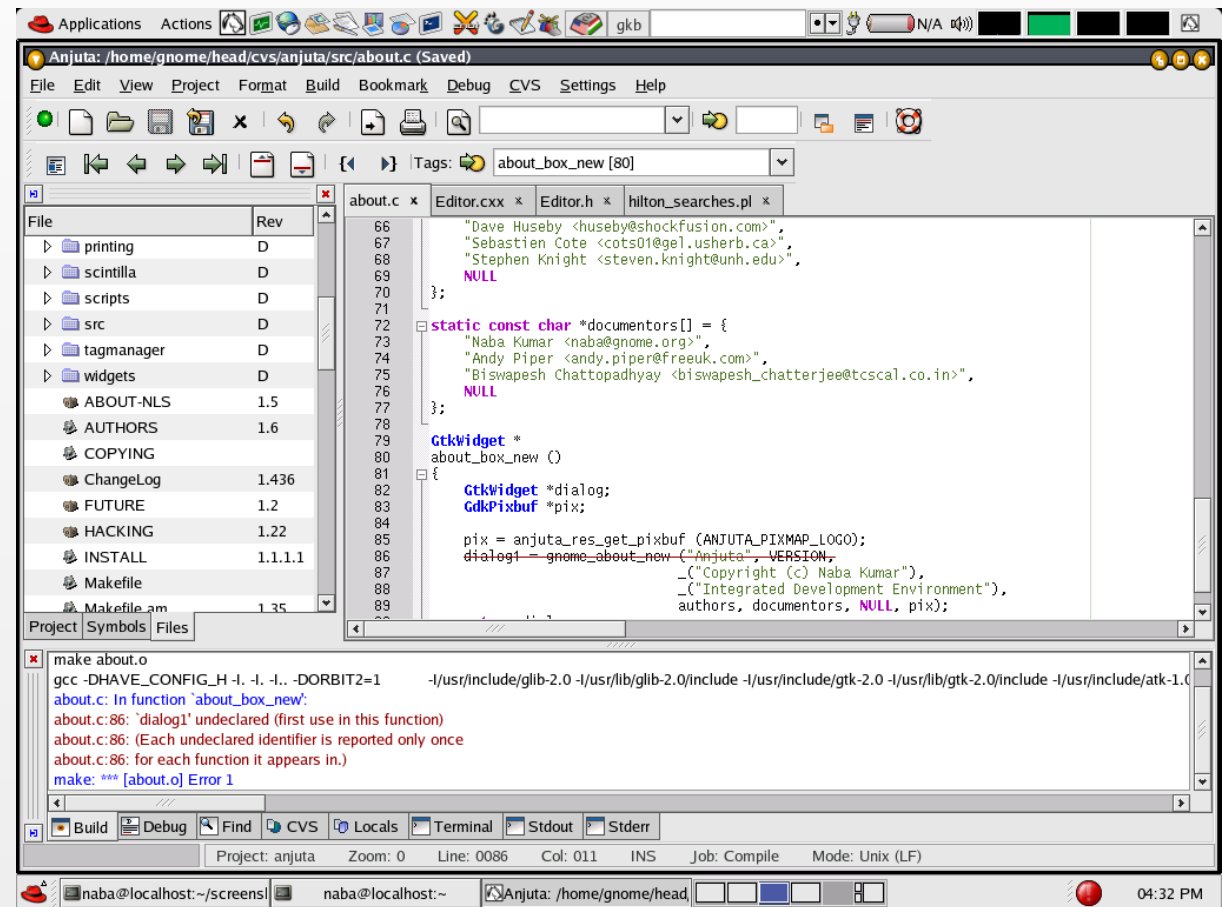
- ❑ Automatic syntax highlighting
- ❑ Automatic code formatting
- ❑ Code folding/hiding
- ❑ Line numbers/markers display
- ❑ Text zooming
- ❑ Code autocompletion
- ❑ Automatic indentation and indentation guides
- ❑ ... and much more.



## Anjuta IDE ...

### Debugger grafico

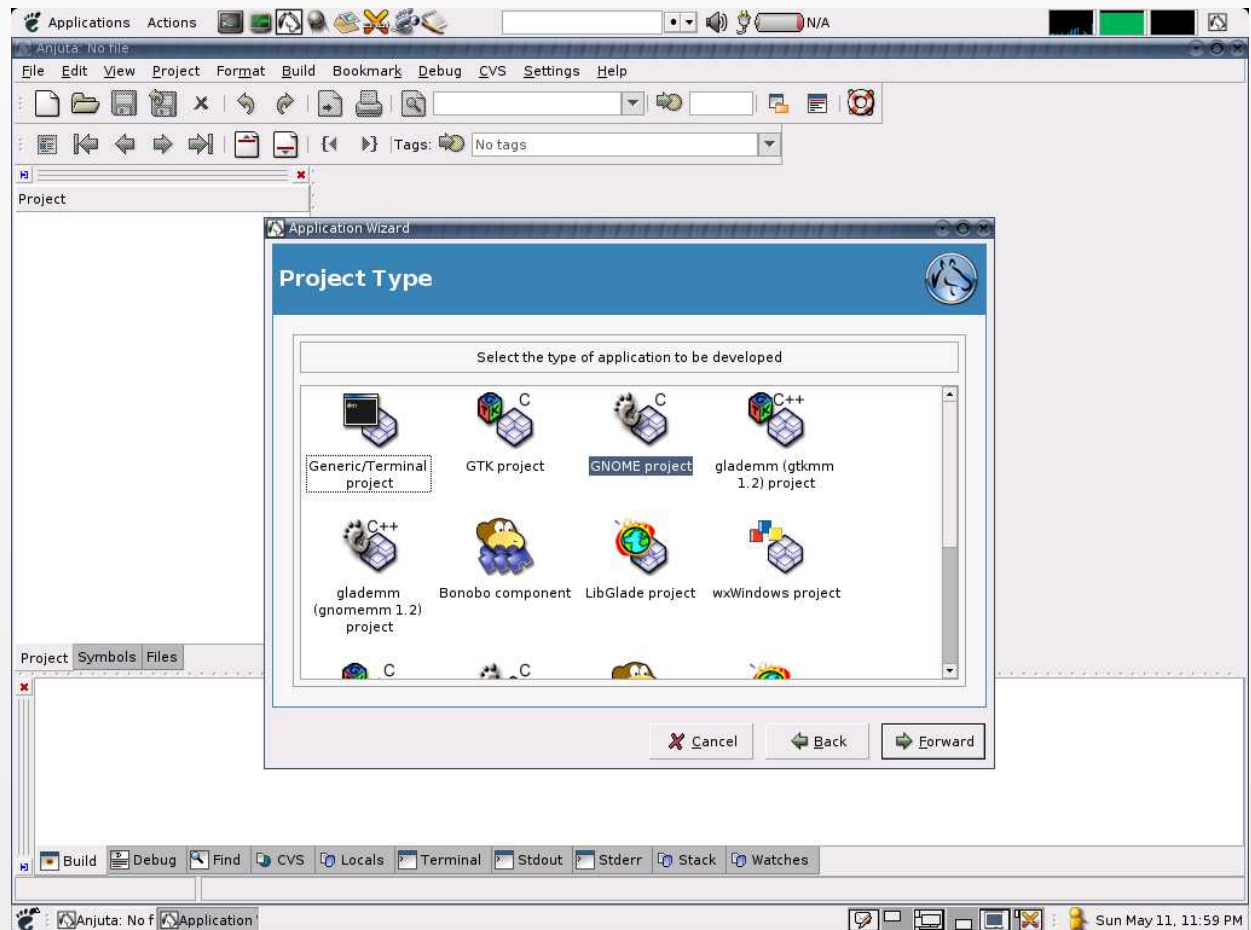
- K** Highly interactive source-level debugger (built over gdb)
- K** Interactive execution
- K** Breakpoints manipulation
- K** Watches manipulation
- K** Signal manipulation
- K** Stack manipulation
- K** ... and much more.



## Anjuta IDE ...

### Wizards

- K** Terminal applications
- K** Gtk applications
- K** Gnome applications
- K** wxWidgets applications



**Grazie per l'attenzione**

*[m.cavallini@koansoftware.com](mailto:m.cavallini@koansoftware.com)*

**La presentazione sarà disponibile sul sito**  
<ftp.KoanSoftware.com>

Tutti i nomi e i marchi registrati citati appartengono ai rispettivi proprietari