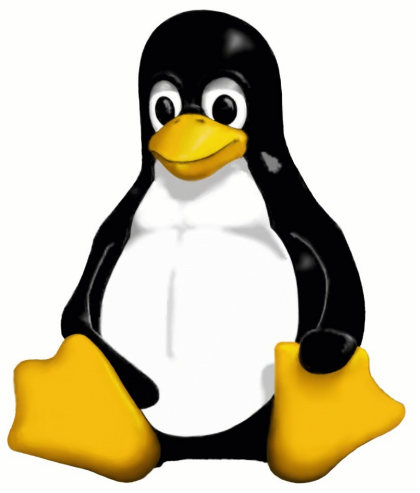
Linux Kernel Configuration Tool

Kacper Bak & Karim Ali

CS 889 – Spring 2010



Agenda

- Background
- Motivation
- User Studies
  - Why does our tool have its current design?
- Conclusion
- Future Work

Linux Kernel

- Core of any GNU/Linux based distribution
- Very modular
- Highly customizable
  - > 5500 features, 89% are user-selectable
- Linux Kernel Configurator (LKC) engine
  - *KConfig* to define variability and dependencies
- *menuconfig*, *xconfig*, *gconfig*

Motivation

- Huge variation space
- Lack of Linux auto configuration tools
  - Improved by adding *localmodconfig* target
- Bloated Linux
  - Torvalds @ Linuxcon, 2009
- Current Linux configurators target advanced users
  - No progressive disclosure for less experienced users
  - Inconsistent .config files can be generated

User Study 1 – Current Tools

Are the current GUI tools useful to less experienced users?

User Study 1 – Feedback

- Tree view (default) has too many entries
- Confusing selection modes
- Less cryptic feature names and description
- Search needs to be enhanced
- Hardware discovery/configuration is frustrating

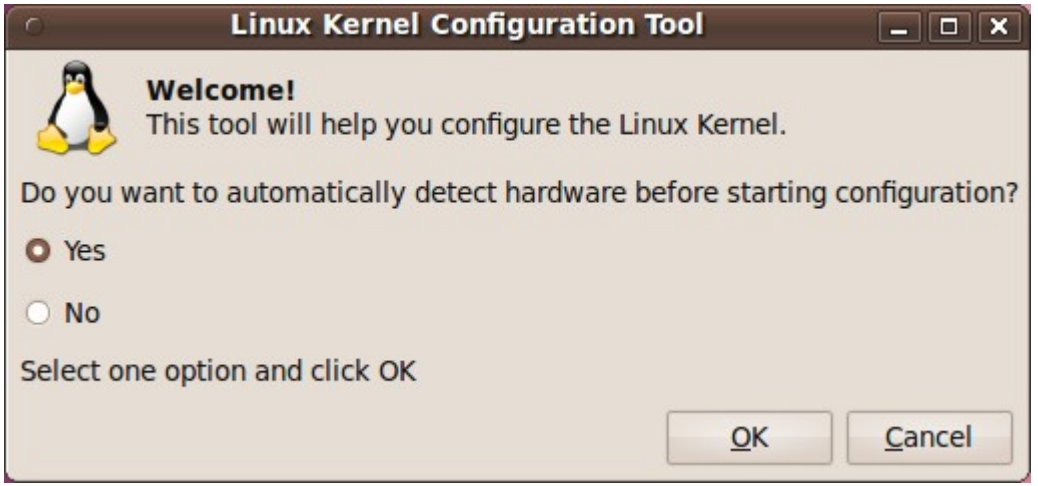
User Study 2 – Suggested Designs

Comments/feedback on design mockups

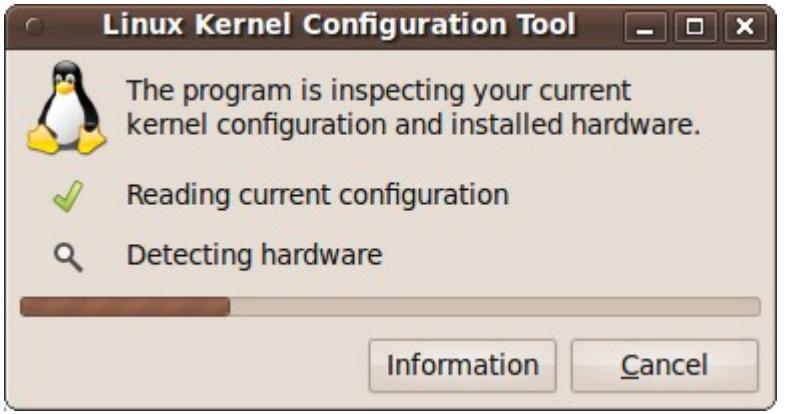
User Study 2 – Feedback

- Hardware Detection Dialog
  - I would like to know what's going on
  - Without it getting in the way
  - Report crashes

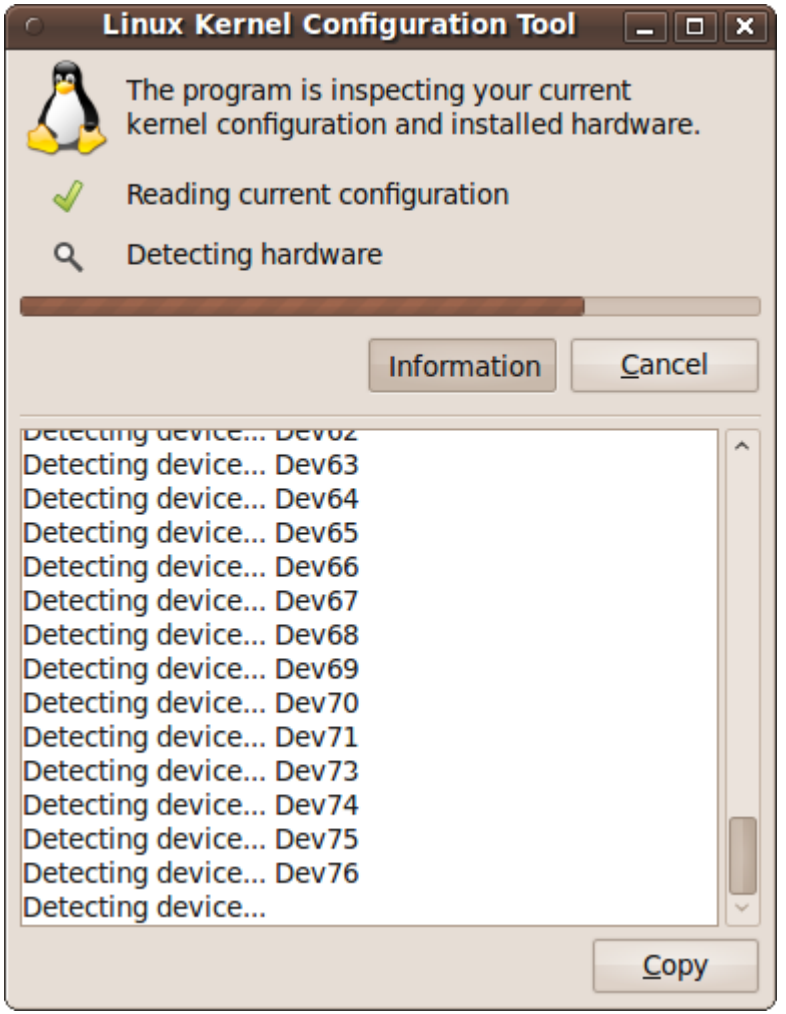
Hardware Detection Dialog



Hardware Detection Dialog



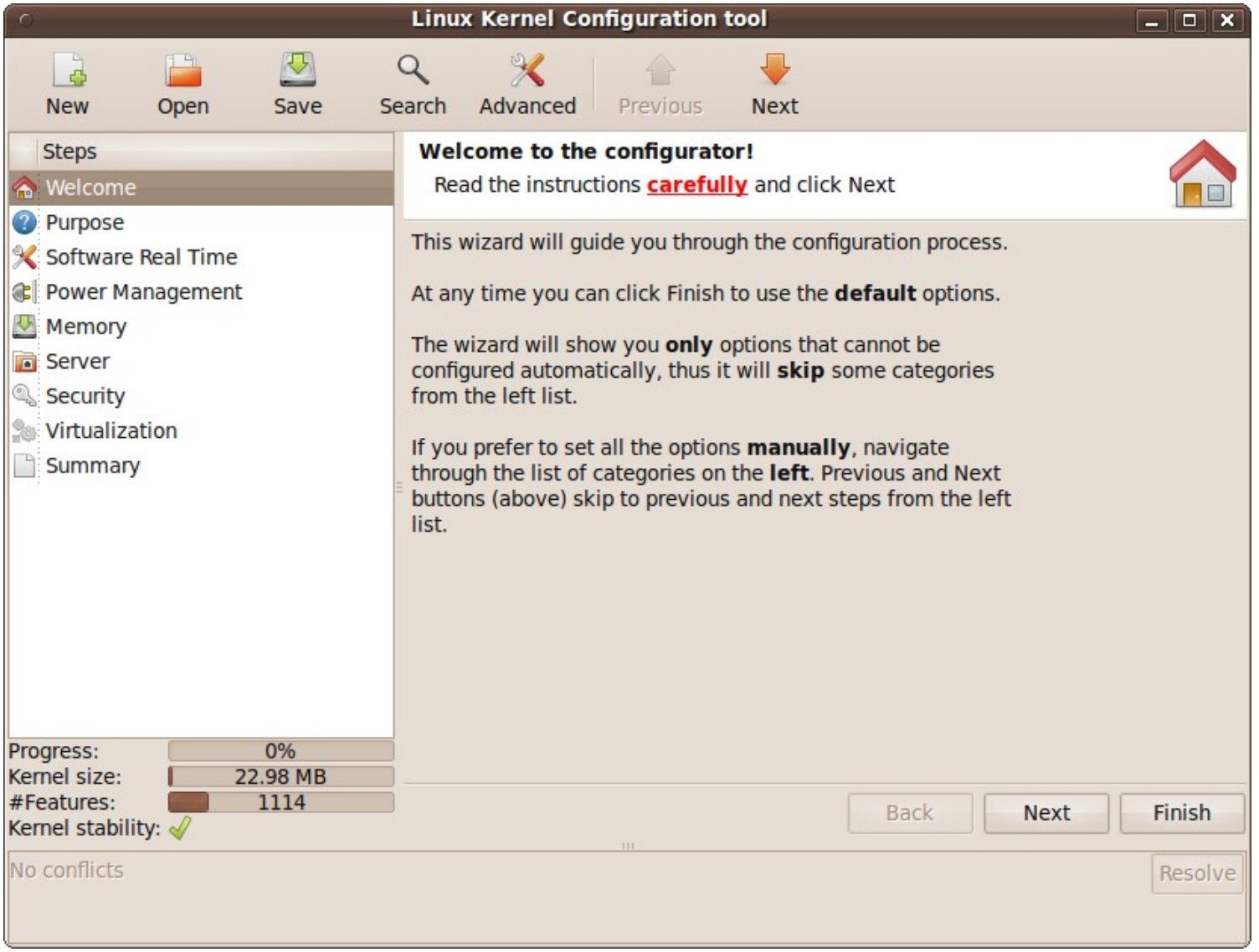
Hardware Detection Dialog



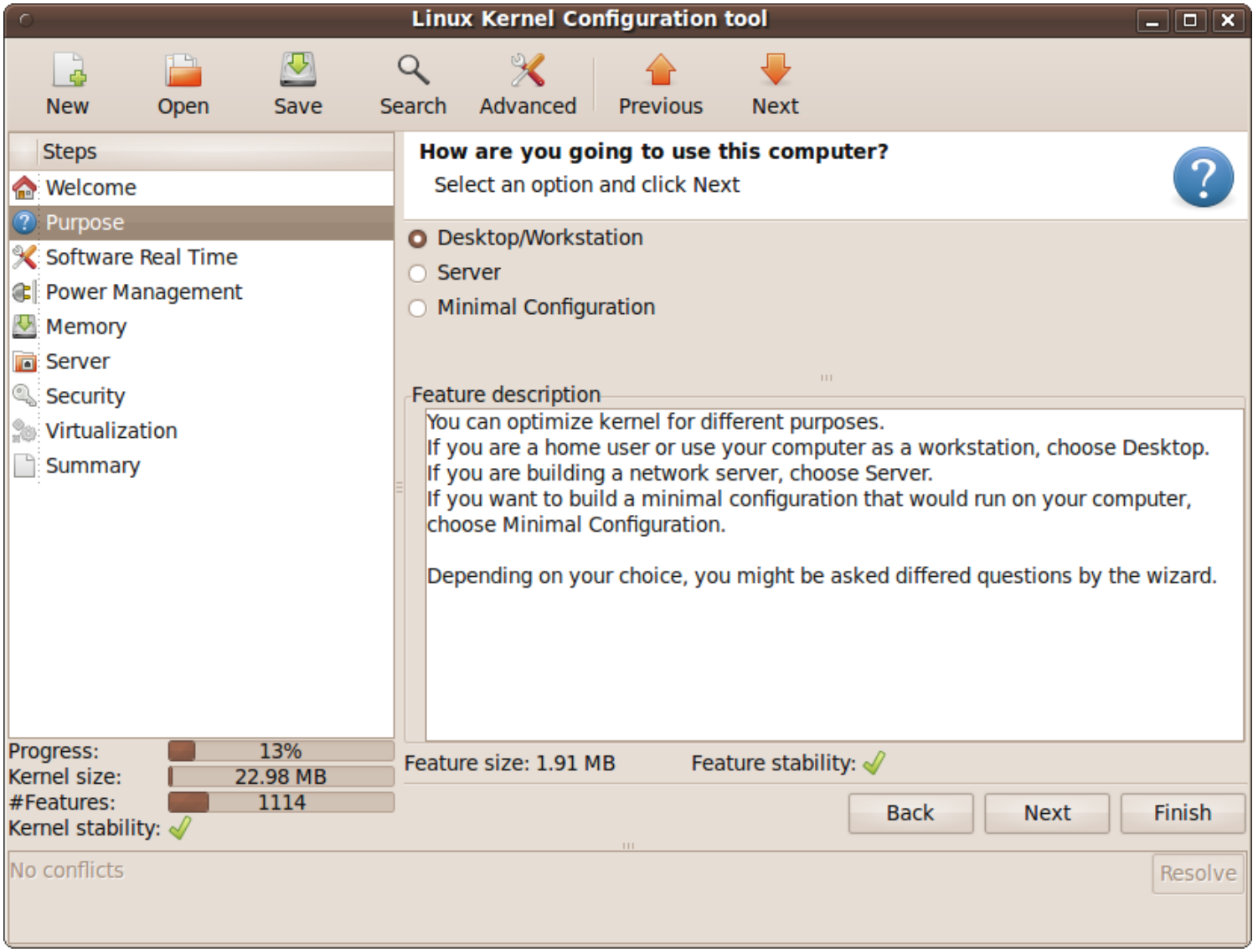
User Study 2 – Feedback

- LKC Tool
  - Help text
  - Easy navigation through different categories of features
  - Few categories
  - Wizard if quick navigation and search is provided
  - Review the final .config file
  - Question format
    - Better understanding of the effect of selecting a feature

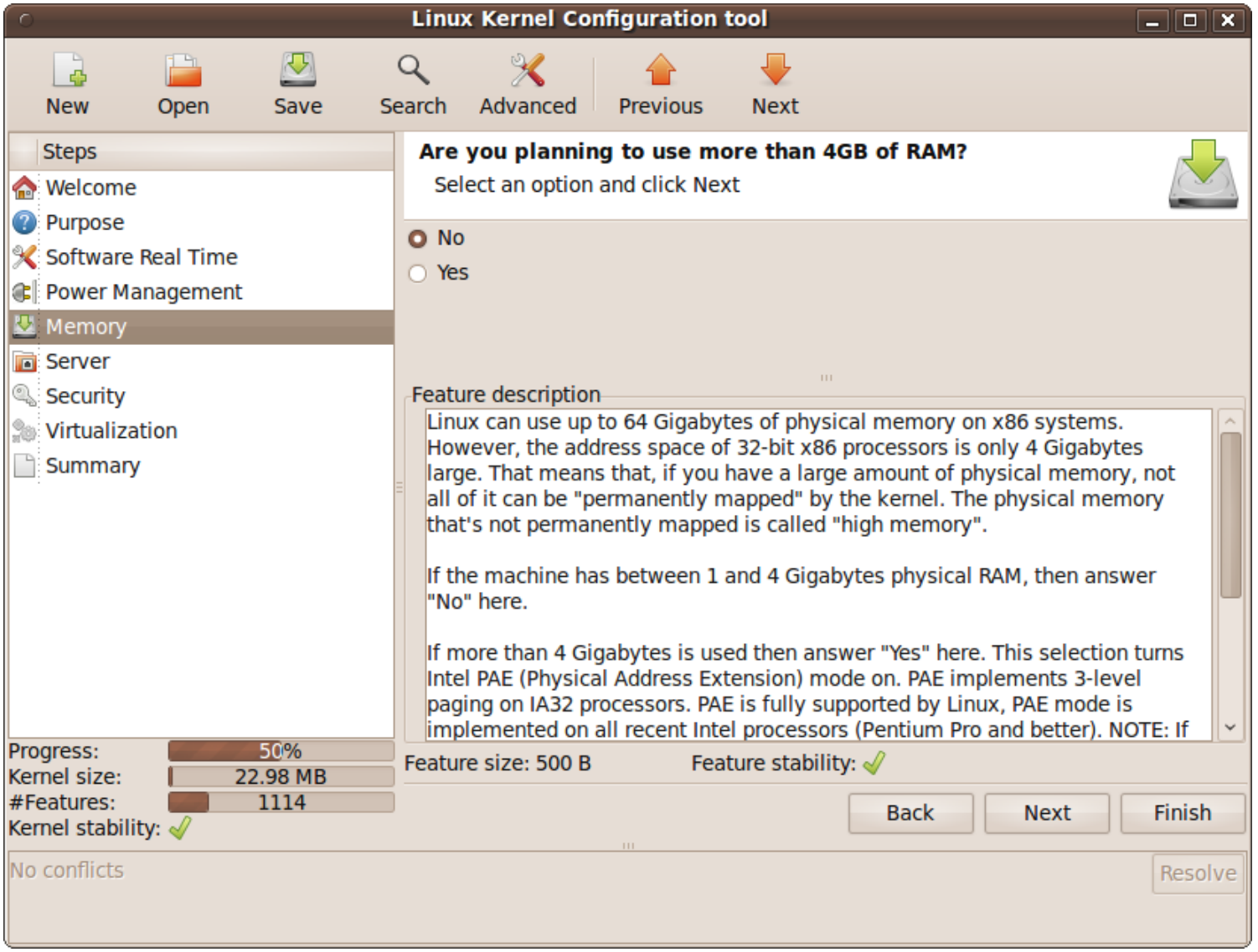
lkc Tool


Linux Kernel Configuration tool
New
Open
Save
Search
Advanced
Previous
Next
Steps
Welcome
Purpose
Software Real Time
Power Management
Memory
Server
Security
Virtualization
Summary
Welcome to the configurator!
Read the instructions carefully and click Next
This wizard will guide you through the configuration process.
At any time you can click Finish to use the default options.
The wizard will show you only options that cannot be configured automatically, thus it will skip some categories from the left list.
If you prefer to set all the options manually, navigate through the list of categories on the left. Previous and Next buttons (above) skip to previous and next steps from the left list.
Progress: 0%
Kernel size: 22.98 MB
#Features: 1114
Kernel stability:
Back
Next
Finish
No conflicts
Resolve

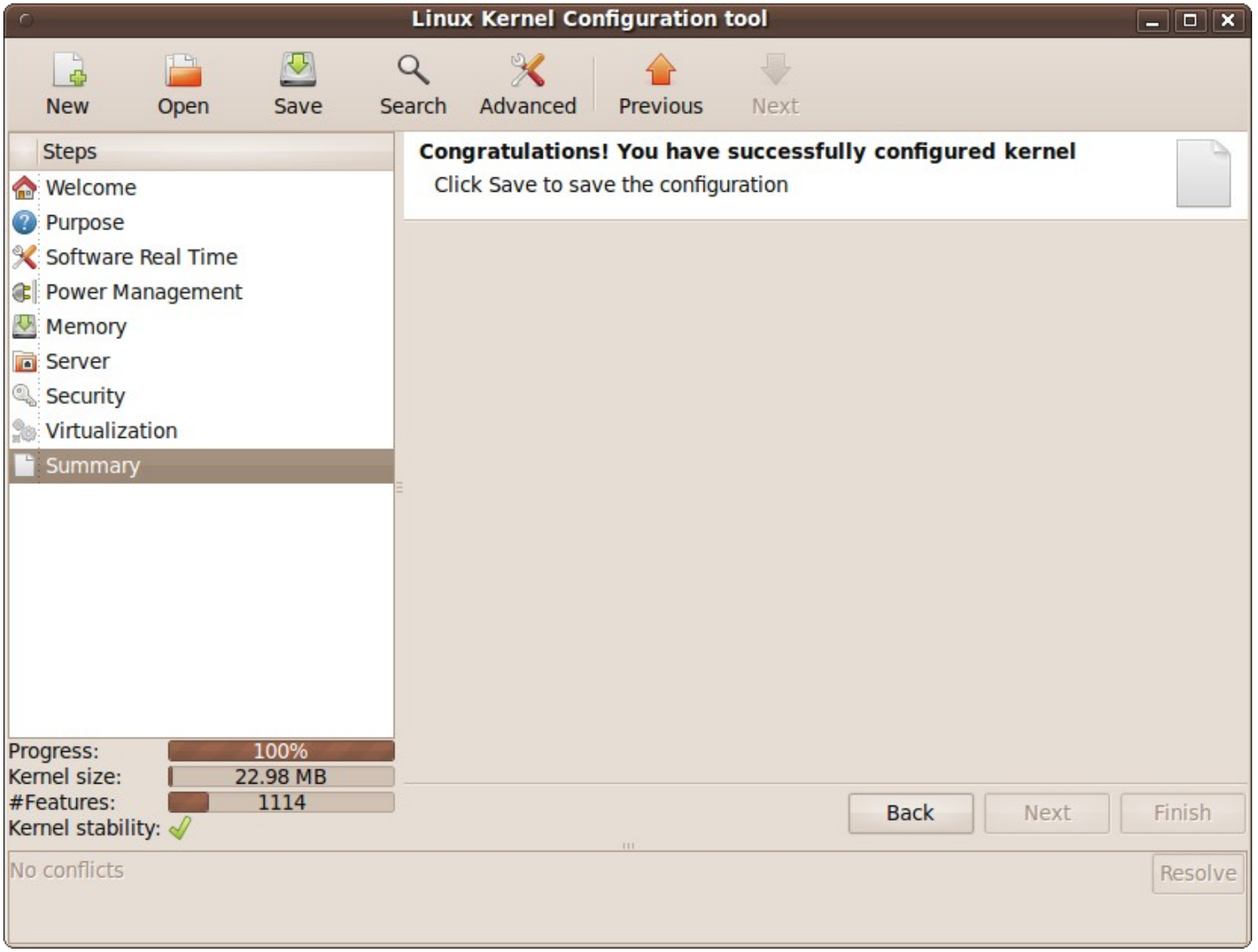
lkc Tool


Linux Kernel Configuration tool
New
Open
Save
Search
Advanced
Previous
Next
Steps
Welcome
Purpose
Software Real Time
Power Management
Memory
Server
Security
Virtualization
Summary
How are you going to use this computer?
Select an option and click Next
Desktop/Workstation
Server
Minimal Configuration
Feature description
You can optimize kernel for different purposes.
If you are a home user or use your computer as a workstation, choose Desktop.
If you are building a network server, choose Server.
If you want to build a minimal configuration that would run on your computer, choose Minimal Configuration.
Depending on your choice, you might be asked differed questions by the wizard.
Progress: 13%
Kernel size: 22.98 MB
#Features: 1114
Kernel stability:
Feature size: 1.91 MB
Feature stability:
Back
Next
Finish
No conflicts
Resolve

lkc Tool


Linux Kernel Configuration tool
New
Open
Save
Search
Advanced
Previous
Next
Steps
Welcome
Purpose
Software Real Time
Power Management
Memory
Server
Security
Virtualization
Summary
Are you planning to use more than 4GB of RAM?
Select an option and click Next
No
Yes
Feature description
Linux can use up to 64 Gigabytes of physical memory on x86 systems. However, the address space of 32-bit x86 processors is only 4 Gigabytes large. That means that, if you have a large amount of physical memory, not all of it can be "permanently mapped" by the kernel. The physical memory that's not permanently mapped is called "high memory".
If the machine has between 1 and 4 Gigabytes physical RAM, then answer "No" here.
If more than 4 Gigabytes is used then answer "Yes" here. This selection turns Intel PAE (Physical Address Extension) mode on. PAE implements 3-level paging on IA32 processors. PAE is fully supported by Linux, PAE mode is implemented on all recent Intel processors (Pentium Pro and better). NOTE: If
Progress: 50%
Kernel size: 22.98 MB
#Features: 1114
Kernel stability:
Feature size: 500 B
Feature stability:
Back
Next
Finish
No conflicts
Resolve

lkc Tool


Linux Kernel Configuration tool
New
Open
Save
Search
Advanced
Previous
Next
Steps
Welcome
Purpose
Software Real Time
Power Management
Memory
Server
Security
Virtualization
Summary
Congratulations! You have successfully configured kernel
Click Save to save the configuration
Progress:
100%
Kernel size:
22.98 MB
#Features:
1114
Kernel stability:
Back
Next
Finish
No conflicts
Resolve

Final User Study

- Provided users with a scenario where the user is Tiësto
  - Configure Linux according to:
    - Machine usage
    - Installed hardware
- Compare *xconfig* and *lkc tool*

Findings – *xconfig*

- General problems
  - Too many options
  - Confusing categories
- Search
  - Useless
  - Some users used Google instead
    - Adam's tool might be useful to offer help here
- Hardware configuration
  - Hard to find drivers
  - Difficult to match hardware with modules

Findings – lkc Tool pros

- Improvement compared to *xconfig*
  - Simple, intuitive
  - Statistics
  - Two-mode navigation: wizard, free navigation
  - Hiding unnecessary details

Findings – lkc Tool cons

- One user didn't know what "feature" means in statistics
- Two users didn't know what stability means in our app
- "Minimal Configuration" was confusing for one user
- The study seems biased, because task can be easily accomplished by answering the questions

lkc Tool – suggestions

- Progressive disclosure: hackers and less experienced users
- Hardware detection
  - Have the ability to re-detect hardware
  - Provide info about detected hardware
- Change position of Save button
- Finish button should always be enabled
  - Show a save/save&quit/cancel dialog when clicked
- Previous/Next buttons should be closer to the left panel, another user suggested removing them

Conclusion

- Current LKC tools are not suitable for less experienced users
- Compared to *xconfig*, *lkc tool*
  - is simple, intuitive
  - provides better navigation
  - hides unnecessary details
- However
  - More understandable description is needed
  - Modify some design aspects based on suggestions

Future Work

- Implement some of the design suggestions
  - Re-detecting hardware
  - Provide more info about detected hardware
  - Finish button related suggestions
- Resolve conflicts
- Keep history
- Perform more user studies

Thanks!