Configuration Revolution
Why it needed 13 years and how it will be done

FOSDEM 2018
Main Track

Markus Raab <markus@libelektra.org>
Time is valuable

➢ 25% reinvented the same wheel (me included)
How to (not) change the situation?

(see: A/C chargers, character encodings, instant messaging, etc.)

**Situation:**
There are 14 competing standards.

**14?! Ridiculous!**
We need to develop one universal standard that covers everyone's use cases. **Yeah!**

**Soon:**

**Situation:**
There are 15 competing standards.

(Thanks to xkcd.com)
What is **wrong** with Configuration?

**Gnome platform with GSettings**
- Xfce
- DConf
- Webmin

**KDE platform with KConfig XT**
- envvars
- KConfig

**No Access**
- NIH* 
  *not invented here
- /etc/distribution_specific

**Others**
- INI
- JSON
- YAML
- Augeas
- App
- App
- App

**DBus**

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What is right with Configuration?

Gnome platform with GSettings

KDE platform with KConfig XT

DConf

Webmin

Xorg

CM

INI

DBus

/etc/distribution_specific

Not invented here

NIH*

✔ modularity

✗ not integrated

✔ great technology available: diversity

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Misconfiguration

configuration is a user interface

not only for developers but also:

• for end users and
• for system administrators

misconfiguration often lead to system failures
Ladder of Abstraction

➢ Abstract Nonsense
➢ …
➢ Config Management
➢ Key/Value Specification
➢ Key/Value Registry
➢ File System
➢ Block Devices
➢ Bits on Harddisc

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Content for Today

I. Introduction

II. Popular Ways for Configuration

III. Trend in Number of Configuration Options

IV. Configuration Specification (Demo)

V. Elektra
II. Popular Ways for Configuration

Questions? https://issues.libelektra.org/1808
Markus Raab <markus@libelektra.org>
What we did

➢ **Online Questionnaire**
  ➢ from 672 persons 286 gave answers, 162 completed

➢ **Source Code Analysis**
  ➢ 50 million LOC

<table>
<thead>
<tr>
<th>Application</th>
<th>Domain</th>
<th>Application</th>
<th>Domain</th>
</tr>
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<tbody>
<tr>
<td>Oad</td>
<td>Game, Network</td>
<td>Gimp</td>
<td>Desktop</td>
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<tr>
<td>Akonadi</td>
<td>Server, Network</td>
<td>Inkscape</td>
<td>Desktop</td>
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<tr>
<td>Chromium</td>
<td>Browser, Mobile</td>
<td>Ipe</td>
<td>Desktop</td>
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<tr>
<td>Curl</td>
<td>Command-line, Network</td>
<td>LibreOffice</td>
<td>Desktop</td>
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<td>Eclipse</td>
<td>Development</td>
<td>Lynx</td>
<td>Browser</td>
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<tr>
<td>Evolution</td>
<td>Development</td>
<td>Man</td>
<td>Command-line</td>
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<tr>
<td>Firefox</td>
<td>Browser, Mobile</td>
<td>Smlplayer</td>
<td>Desktop</td>
</tr>
<tr>
<td>GCC</td>
<td>Development</td>
<td>Wget</td>
<td>Command-line, Network</td>
</tr>
</tbody>
</table>

➢ **Case Study+User Study (presented tomorrow 12:30)**

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And the Winners are...

command-line arguments
environment variables
configuration files
freedesktop
registry
qsettings
gsettings
dconf
plist
kconfig
xsettings
Abstraction: Cascading Namespaces

/sw/org/myapp/#0/current uses all of below (cascading):

- **proc** namespace is for the current process (**cmdline+env**)
- **dir** namespace is stored in cwd like .git or .htaccess
- **user** namespace is stored below ~/.config/
- **system** namespace is stored below /etc/config/
**Abstraction: Key/Value**

- **INI**
  ```ini
  [env]
  ls = ls -FH
  vnc = vncserver
  ```

- **XML**
  ```xml
  <?xml version="1.0" encoding="UTF-8"?>
  <keyset xmlns="" xsi:schemaLocation=""
  parent="user/env/alias">
  <key basename="ls" type="string" value="ls -FH">
    <comment></comment>
  </key>
  <key basename="vnc" type="string">
    <value>vncserver</value>
    <comment></comment>
  </key>
  </keyset>
  ```

- **Augeas**
  - **Hosts**
  - **Fstab**
  - **XML**
  - **JSON**
  - **YAML**
  - **Line**
  - **CSV**
  - **Hosts**
  - ...
key/value abstraction is not enough
III. Trend in Number of Configuration Options

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➢ 52% of configuration options are rarely used
For environment vars/`getenv` we have a similar trend.

10,000 lines
1 `getenv`
Then let us reduce

Why do you think configuration should be reduced?

- to simplify code maintenance
- to prevent errors and misconfiguration
- to provide better user experience
- auto-detection should always be overridable
- I do not think it should be reduced
- because auto-detection should be preferred
- eliminate rare use-cases

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Current Situation

What users want

What developers implement

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Customization is needed everywhere

➢ Shortcuts
➢ EditorConfig
➢ Favourite Places
➢ Language
➢ Power Management
➢ Sorting Criteria
➢ Size of Icons
➢ Proxy Settings
➢ ...

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Good Defaults

Which effort do you think is worthwhile for providing better configuration experience?
Detection of other sources

Which effort do you think is worthwhile for providing better configuration experience?

>50% would not do the effort

answers:
- access ext. api
- access sys env.
- add dep. lib det.
- det. network conf
- disagree
- good defaults
- read envvar
- read OS src
- read other conf.

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Cascading Namespaces (again)

/sw/org/myapp/#0/current uses all of below (cascading):

- **spec** namespace allows you to specify default values, validations, overrides, visibility, etc. (via metadata)

- **proc** namespace is for the current process (cmdline+env)

- **dir** like .git or .htaccess

- **user** namespace is stored below ~/.config/

- **system** namespace is stored below /etc/config/
IV Configuration Specification

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Back to Misconfiguration

IPv4, 5
CSI has it
State of the Art

Use the source

```c
1563  case CFG_LTHREADS:
1564  --------{ int mask = 0;
1565  --------/* use a power of two */
1566  --------while (c->value_uint > 1) {
1567  --------c->value_uint >>= 1;
1568  --------mask <<= 1;
1569  --------mask |= 1;
1570  --------}
```

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mountpoint = /etc/hosts
infos/plugins = hosts

[ipv4/localhost]
type = ipv4
default = 127.0.0.1
check/ipaddr = ipv4
check/validation = ^127\..*
check/validation/message = "localhost ip must be within 127.0.0.0/8"

specification
generate
provides
documentation, manuals

persistence
into configuration files
validation
defaults
integration

Shell-Code
(e.g. auto completion)
C/C++-code
(e.g. option parsing)

GUIs,
WebUIs,
CLIs

https://www.libelektra.org
Markus Raab <markus@libelektra.org>
Thomas Waser <thomas.waser@tuwien.ac.at>
introspection
reusable
safe
Ways to use Elektra ("Elektrify")

- **Code Generator**
  - Elektra's Specification
  - KeySet (data structure)
    - Key database
    - Plugin assembly
      - Assembles plugins
    - Delegates work
      - Uses
        - bindings
        - Unchanged source code
          - Uses
            - Type-safe APIs
              - Uses elektrified source code
                - Code Generator

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V. Elektra

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https://www.libelektra.org
What is libelektra?

- small, fast library
- access to global configuration
- portable, no deps required (ANSI C)
- no daemon: security by OS

sh$ ldd /lib/libelektra.so
  libc.so.6 => /lib/tls/libc.so.6
  /lib/ld-linux.so.2 => /lib/ld-linux.so.2
Available Bindings

Language
- ✔ C/C++
- ✔ Shell
- ✔ Lua
- ✔ Python
- ✔ Java
- ✔ Ruby
- ✔ Haskell

Interception
- ✔ Getenv
- ✔ GSettings
- Filesystem
Available Plugins

> 80

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The *kdb* Command

$ kdb get /filesystems/boot/mpoint

# kdb set /sw/xorg/Screen/Display/Modes 1280x1024

$ kdb editor system/sw/xorg/

- Perfect for scripts: administrative work+package install
- **Easy** to write tools like this
- Also for **specifications**! It has **tab completion**!
Web UI and GUIs

Configuring instance 'Studenten' http://localhost:33333

### System:
- `/`  
  - `hello/`  
  - `pk/`  
  - `student/`  

#### Info:
- `age/`  
  - 21
- `gender/`  
  - Male
- `name/`  
  - Daniel
- `registered/`  
  - Registered

Create new key: `/some/path`

DONE

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Available Packages

➢ Thanks to the maintainers!

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Users and Targets

✓ **Embedded Systems**

- Broadcom
- Toshiba
- Cameras
- Universities
- Weighting scales

✓ **shared configuration in FLOSS (Desktop)**

- Opyranóς
- Oyranos Color Management
- (in progress)

✓ **Administrators (Servers)**

- Puppet
- Libelektra.org, Universities, Insurances, ...

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Who is working on Elektra?

➢ Armin Wurzinger: Type Interference
➢ Bernhard Denner: Puppet Module
➢ Daniel Bugl: WebUI
➢ Dominik Hofer: the high-level API
➢ Kurt Micheli: Order Preserving Minimal Hash Map
➢ Markus Raab: Maintainer
➢ Michael Zehender: Quality Improvements
➢ Mihael Pranjić: mmap plugin
➢ Peter Nirschl: crypto plugin
➢ René Schwaiger: YAML plugin
➢ Sebastian Bachmann: Shell Completion
➢ Thomas Waht: Notification
➢ Thomas Waser: Validation and Transformations of Configuration
➢ Vanessa Kos: Misconfiguration Bug Database
➢ You: Fun Parts?
Who is working on Elektra?

- Armin Wurzinger: type system
- Bernhard Denner: Puppet
- Daniel Bugl: WebUI
- Dominik Hofer: high-level API
- Kurt Micheli: order preserving minimal perfect hash map
- Marvin Mall: website
- Mihael Pranjić: mmap plugin
- Peter Nirschl: fcrypt+crypto plugin
- Raffael Pancheri: Qt GUI
- René Schwaiger: parsing techniques
- Thomas Wahringer: notification
- Thomas Waser: validation and transformations of configuration
- Ulrike Schaefer: shell completion
- Vanessa Kos: misconfiguration bug database

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Future Work

misconfiguration database
fail-safe user interface
extend type system
optimizations
elektrify
Conclusion

➢ **out-of-the-box experience**
   better defaults
   dependences in plugins

➢ **share configuration**
   using other's configuration
   across applications

➢ **support tooling**
   introspection
   make system administration sane

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Resources

Thank you for your attention!
Drop us an email or open a issue!
Questions?

➢ Homepage: https://www.libelektra.org/
➢ Open Data: https://rawdata.libelektra.org/
➢ Build Server: https://build.libelektra.org/
➢ Book: https://book.libelektra.org/

see you tomorrow 12:30
Config Management DevRoom
UA2.114 (Baudoux)

Markus Raab <elektra@markus-raab.org>

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