Meta-Programming Revisited

Web Services and GUI Generation

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The KDE Project

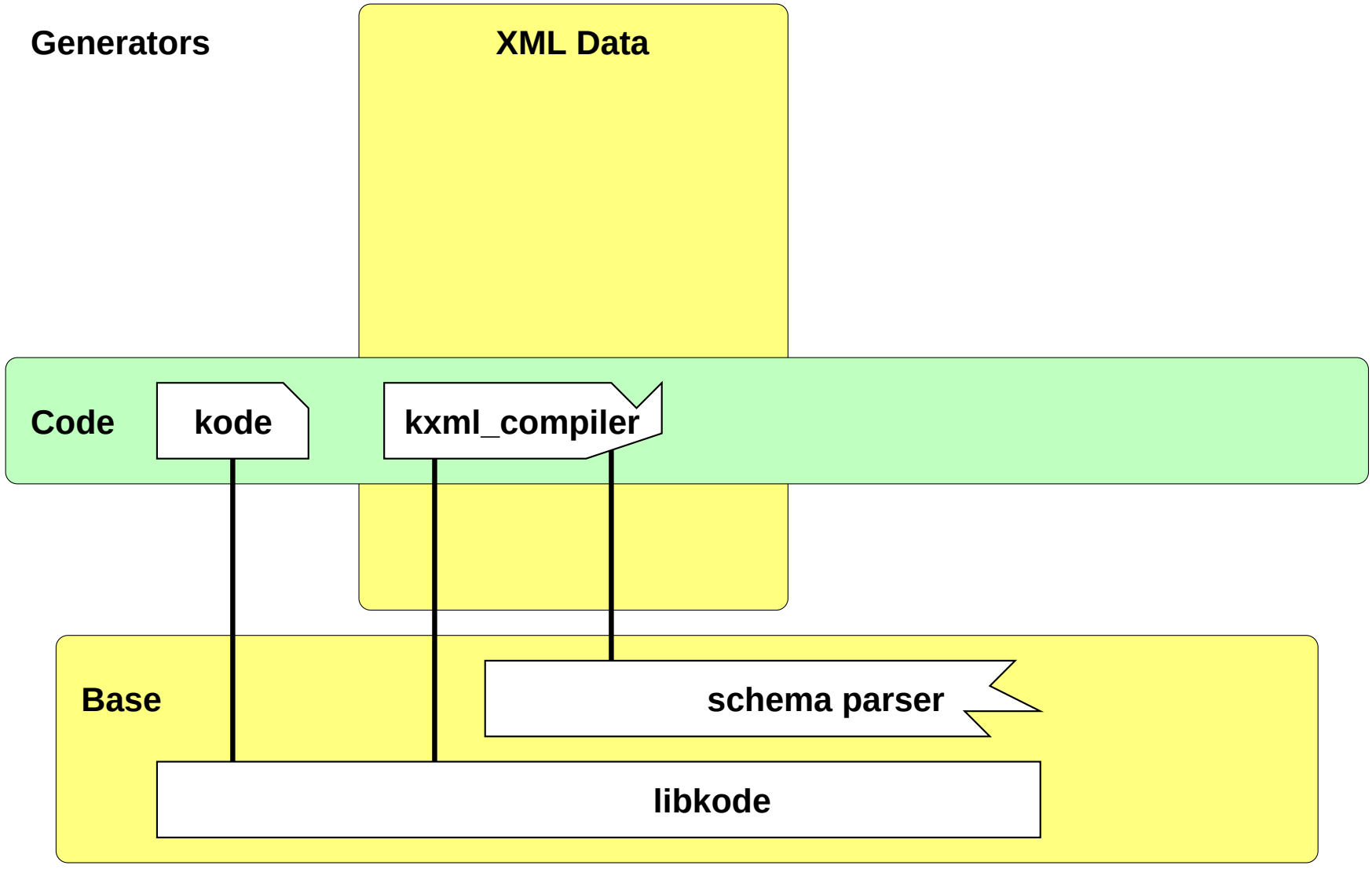
Overview

- What’s happened so far?
- The "kode" project
- kxml_compiler
- kwsdl_compiler
- GUI generation with Kung
- GUI generation with KXForms

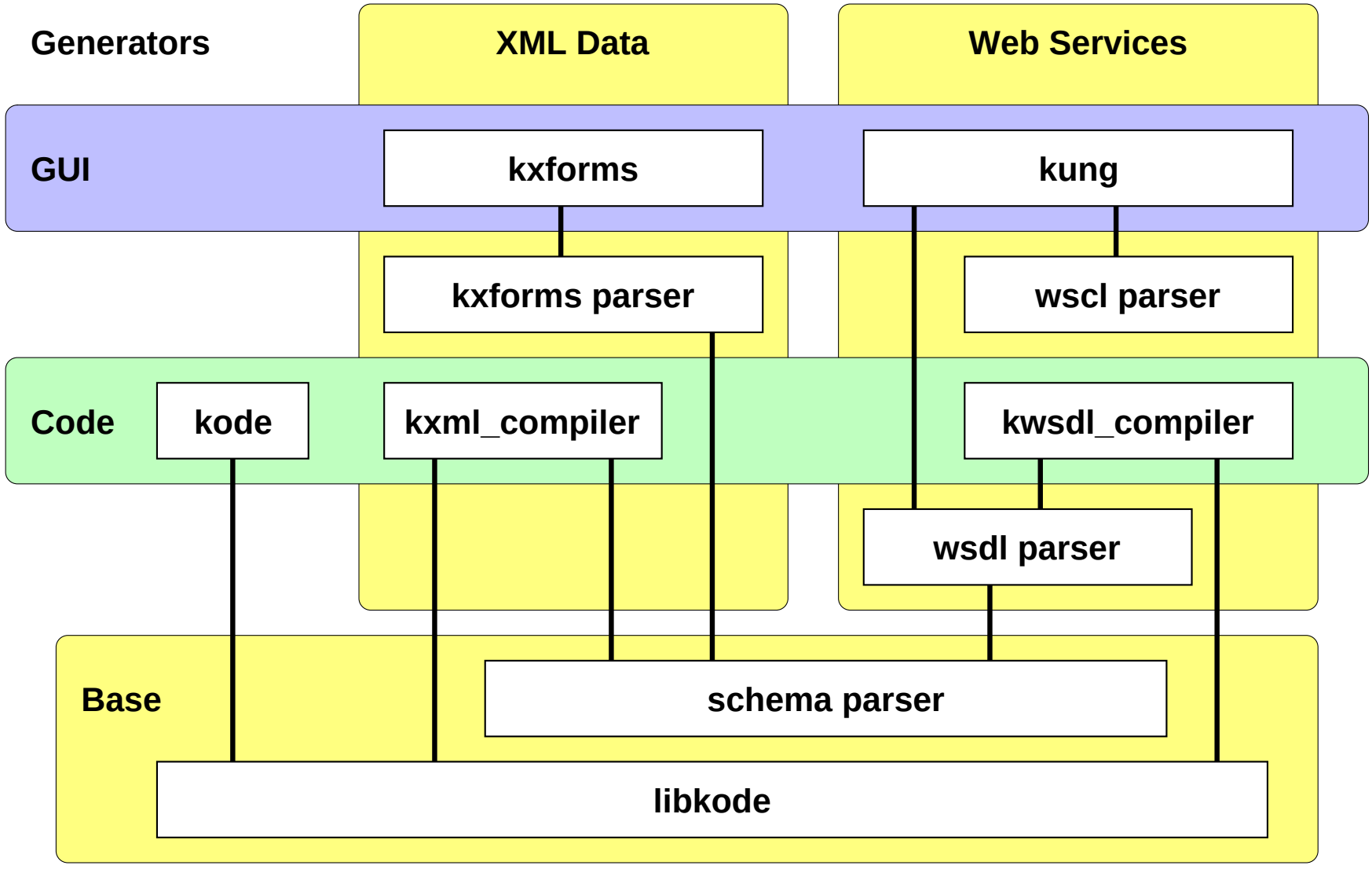
What's happened so far?

- aKademy 2004: Meta-Programming in KDE - The Technology behind KConfig XT and friends
  - Generating addressbook code in libkabc
  - Generating config code in KConfig XT
  - Generating XML handling code with kxml_compiler
  - Proof of concept: Read-only feature plan resource for KOrganizer

Kode Architecture 2004



Kode Architecture 2005



libkode

- Representing C++ code by C++ objects
- File, Class, Function, Variable, Code
- Special content: StateMachine, License, Automake file
- Classes generating output: Printer, Style
- Pragmatic solution for generating code

libkode Example

```
KODE::Function writer( "writeElement", "QString" );

KODE::Code code;

code += "QString xml;";

QString tag = "<" + element->name;

QValueList<Attribute *>::ConstIterator it3;
for( it3 = element->attributes.begin();
  it3 != element->attributes.end(); ++it3 ) {
  tag += " " + (*it3)->name + "=\\\"\" + " +
         (*it3)->name + "() + \"\\\"";
}

if ( element->isEmpty ) {
  tag += "/";
}

tag += ">\\n";

code += "xml += indent() + \"" + tag + "\";";
```

Kode Command Line Tool

- kode is a utility for code generation tasks

Templates

- Create class template (license, author information from KDE address book)
- Create dialog template
- Create kioslave template

Helpers

- Add property to class (inferior implementation, IDEs have much more powerful solutions)
- Codify

Kode Command Line Options

```
Usage: kode [Qt-options] [KDE-options] [options] [filename]

Options:
  -c, --create-class          Create class
  -d, --create-dialog         Create dialog
  --create-kioslave           Create kioslave
  --create-main               Create main function template
  -y, --codify                Create generator code for given source
  --add-property              Add property to class
  --inplace                   Change file in place
  --author-email <name>       Add author with given email address
  --project <name>            Name of project
  --gpl                       Use GPL as license
  --lgpl                      Use LGPL as license
  --classname <name>          Name of class
  --filename <name>           Name of file
  --namespace <name>          Namespace
  --warning                   Create warning about code generation
  --qt-exception              Add Qt exception to GPL
  --singleton                 Create a singleton class
  --protocol                  kioslave protocol

Arguments:
  filename                    Source code file name
```

kxml_compiler

- XML writer
- Second parser implementation, schema-optimized parser code.
- Still based on Relax NG, XML Schema is missing, but will come.
- Incomplete implementation, needs more love.
- Useful tool, but it’s still not good enough for mainstream adoption
- Writing XML doesn’t preserve formatting. (Is it a worthwile goal to fix that?)

XML Schema

- XML Schema is a W3C recommendation for formally describing XML document classes (`www.w3.org/XML/Schema`).

Alternatives:

- DTD (not very expressive, not XML)
- Relax NG (theoretically well-founded, not as commonly used as XML Schema)
- Schematron (based on finding tree patterns, not on grammars)
- Examplotron (lightweight, based on instance documents)

XML Schema Parser

- Parser based on an implementation in C++ from the wsdlpull project (`wsdlpull.sf.net`).
- Creates in-memory schema representation suitable for being used by C++ programs using Qt.
- Handles Simple Types, Complex Types, Namespaces, basic XML Schema data types.
- Complete enough for parsing the XML Schema commonly used in WSDL descriptions.
- Namespace handling needs improvement.
- Unions and groups are not supported yet.

WSDL

- WSDL: Web Services Description Language
- `www.w3.org/TR/wsdl`
- XML standard format for abstractly describing network services
- End points exchanging messages
- Bindings to concrete network protocols and message formats
- Bindings to SOAP, HTTP GET/POST and MIME

WSDL Parser

- libwsdl for parsing WSDL descriptions.
- Handles messages, ports, bindings, services.
- Makes use of XML Schema parser
- Parses the important publically available web services: Amazon, Google, eBay.
- Is intended to also parse Groupwise WSDL used in the Kontact Groupwise KResource
- Supports SOAP binding.
- Doesn’t support HTTP and MIME bindings yet.

kwsdl_compiler

- Creates code to parse and create SOAP messages from a WSDL description of the corresponding web service.
- Uses libwsdl to parse the WSDL descriptions.
- Uses libkode to create the generated code.

kwsdl_compiler Generated Objects

- C++ representations of the SOAP messages and their complex arguments.
- Customized Serializer for converting C++ objects to XML representations and back.
- Transport class to do asynchronous SOAP request using the HTTP kioslave (support for SSL, Proxies, etc. for free).
- Transport class could be exchanged with Qt-only transport class.
- Top-Level service access class for conveniently doing web service requests from native code in a type-safe way without having to care for any SOAP or XML details.

WSCL

- WSCL: Web Services Conversation Language
- `www.w3.org/TR/2002/NOTE-wscl10-20020314`
- XML standard format for describing business level conversations or public processes of web services
- Specifies conversations of a web service, which documents are exchanged in which order
- Can be associated with a WSDL description
- Parser supports complete specification.

Kung

- Creates a GUI on the fly for interacting with a web service from the WSDL description.
- Can use WSCL to specify flow of messages.
- Specific GUI representations for the types of data provided by the web service description.
- All XML handling, HTTP interaction, loading and saving from the GUI is automatically done in the background.

The Google Web Service

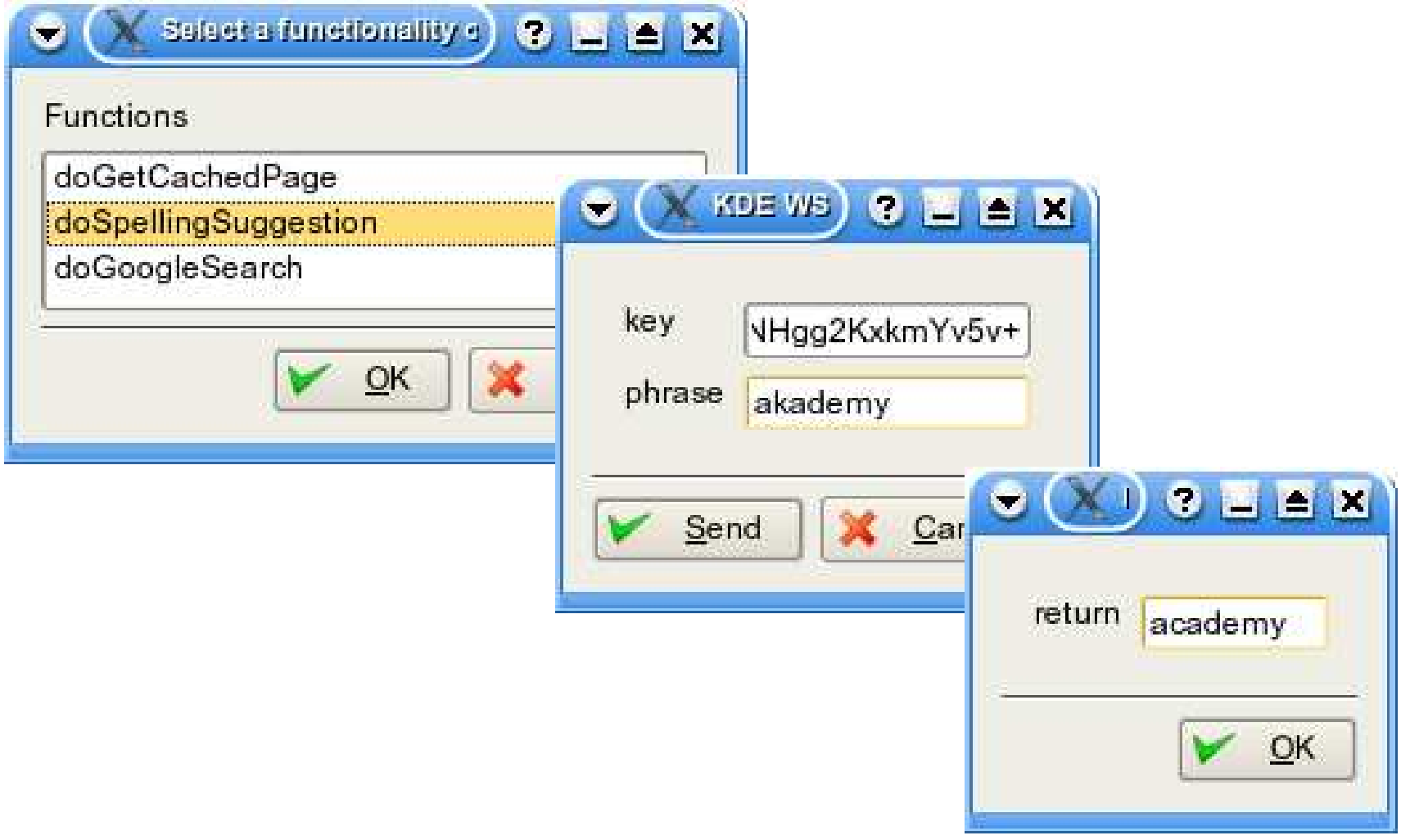
- Google search functionality provided as SOAP based web service
- Licence key required, available for free for personal, non-commercial use, 1000 requests a day

API:

- `doGetCachedPage`
- `doSpellingSuggestion`
- `doGoogleSearch`
- Objects for representing the search result

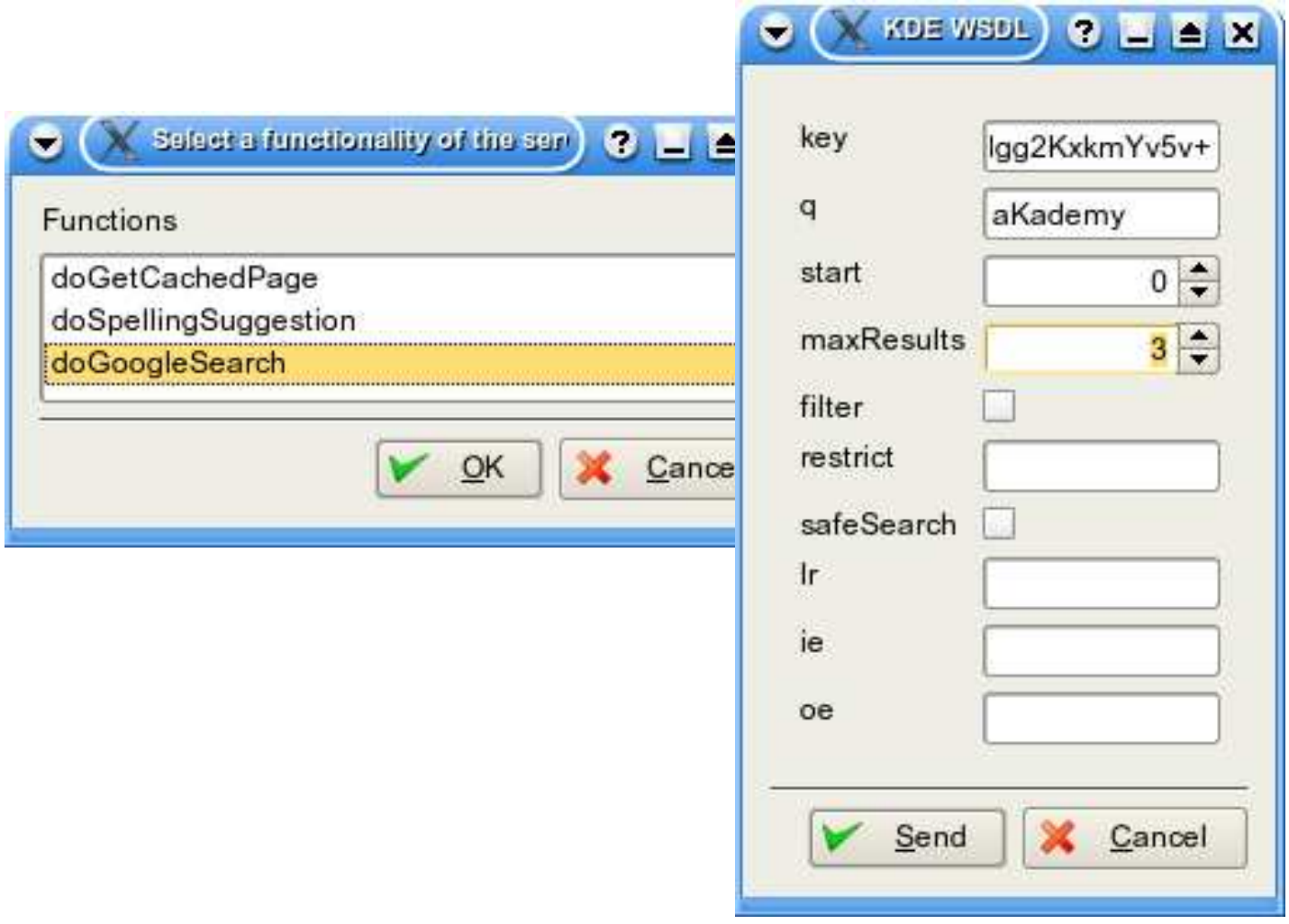
Kung Demo 1

```
>kung http://api.google.com/GoogleSearch.wsdl
```

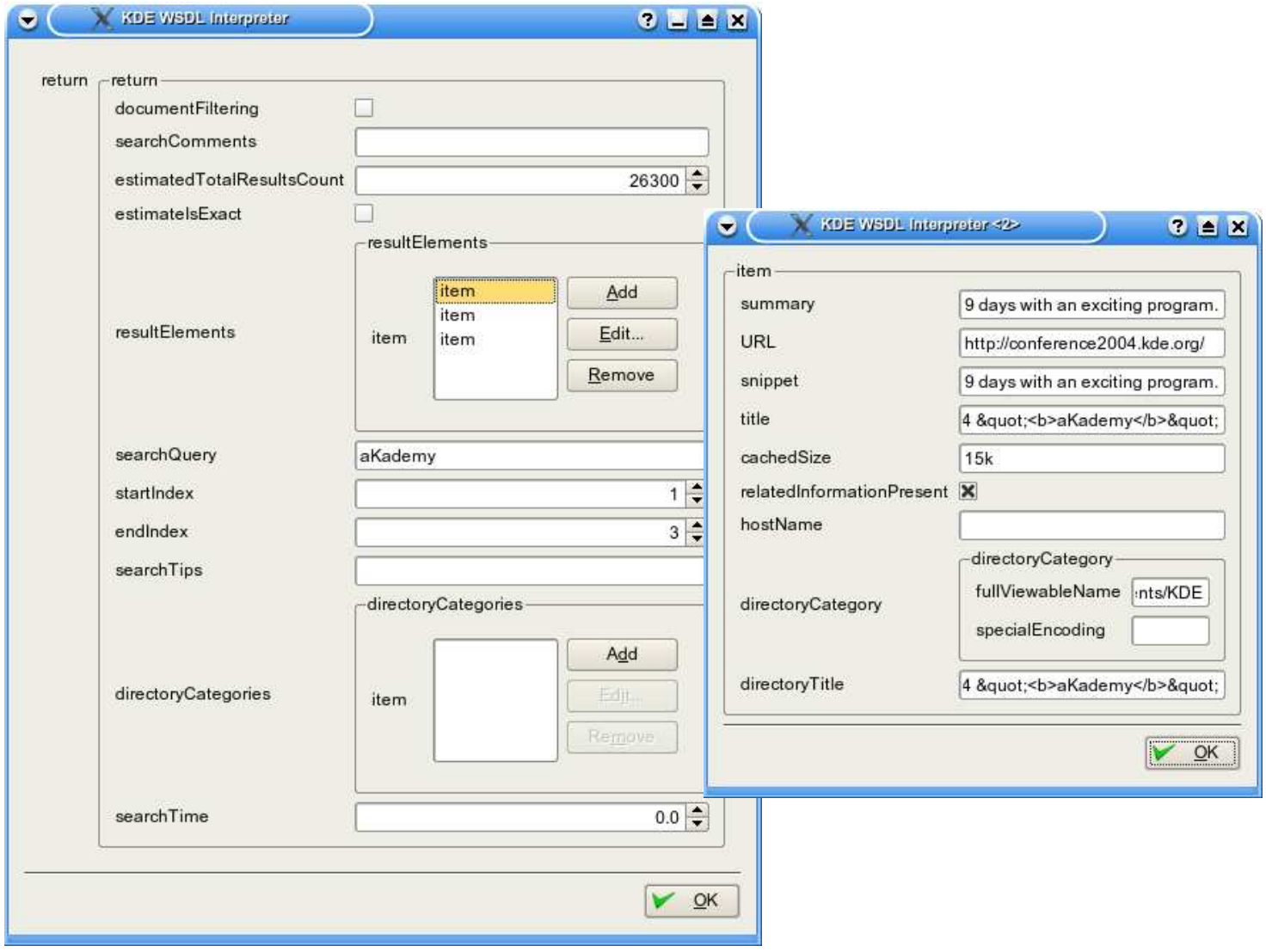


Kung Demo 2 - Request

```
>kung http://api.google.com/GoogleSearch.wsdl
```



Kung Demo 2 - Response



KXForms

- Approach: Use intermediate abstract GUI description to be able to automatically create GUIs
- Applications: Editor for XML data, configuration GUI based on KConfig XT descriptions, more
- Create intermediate description from descriptions of the data to be edited, e.g. XML Schema, KConfig XT

XForms

- XForms is the successor of HTML forms.
- W3C recommendation: `www.w3.org/TR/xforms/`
- XML based
- Standard GUI elements: input, secret, textarea, output, upload, range, trigger, submit, select, select1
- Grouping
- Interaction via XML, model, instance data, form element reference XML data elements.
- XPath for referencing data.
- Processing model, event specification
- Embeddable in host languages

KXForms Format

- Host language making use of XForms GUI elements and referencing scheme.
- KXForms as Pragmatic XForms
- Extension element `list` for heterogenous lists (including support for data driven item labels)

KXForms Example

- Description of GUI for editing KDE Feature Plan

```
<kxforms>

  <form ref="category">
    <xf:input ref="@name">
      <xf:label>Name</xf:label>
    </xf:input>
    <list>
      <xf:label>Item</xf:label>
      <itemclass ref="category">
        <itemlabel>Category <arg ref="@name"/></itemlabel>
      </itemclass>
      <itemclass ref="feature">
        <itemlabel>
          Feature <arg ref="summary" truncate="20"/>
        </itemlabel>
      </itemclass>
    </list>
  </form>

  (...)

</kxforms>
```

KXForms Engine

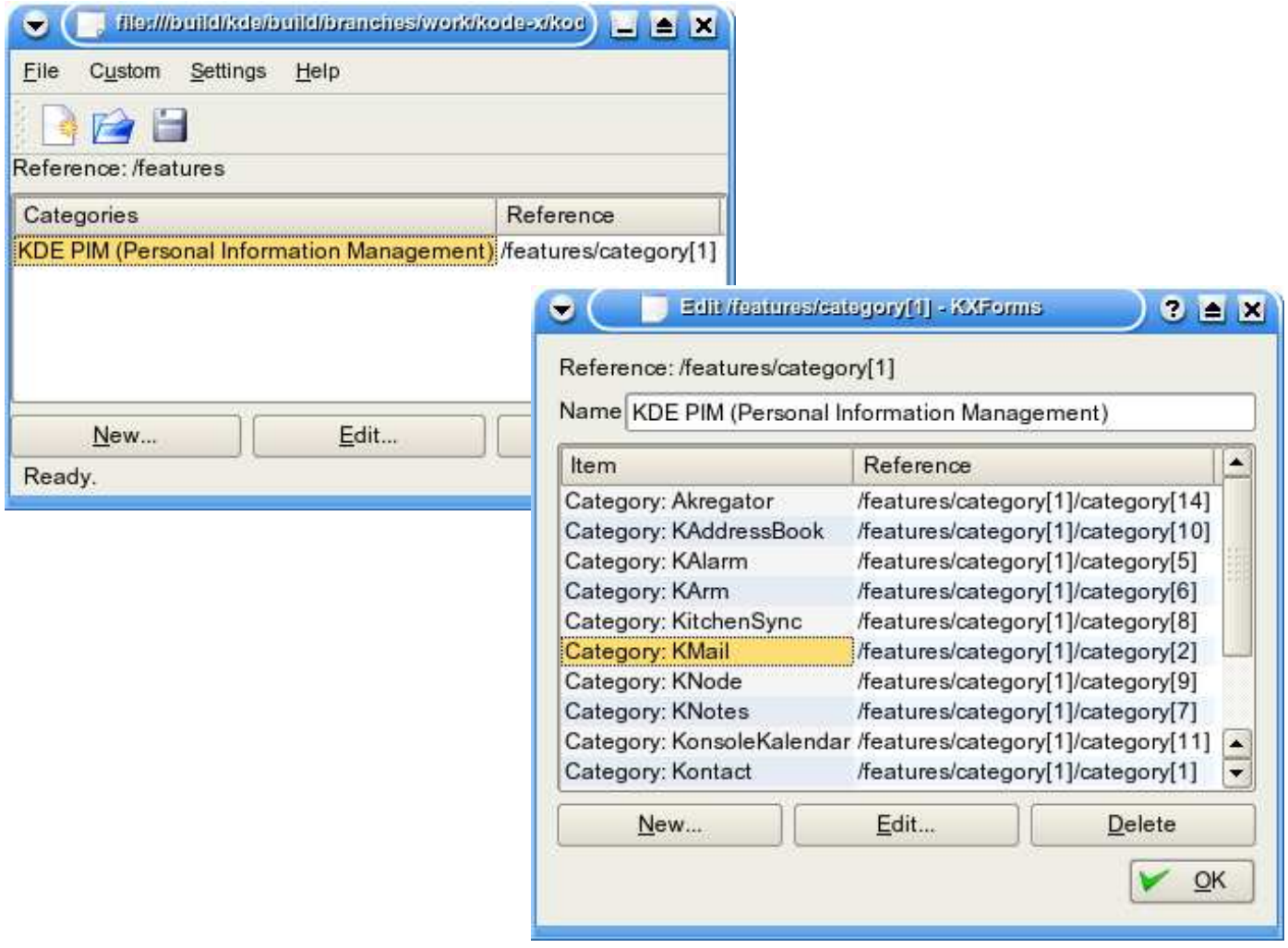
- Form representation
- Referencing XML data
- Common GUI creation and objects
- GuiHandler for handling GUI details, i.e. layout, nesting, widget layering, etc.

KXForms Demo - XML Data

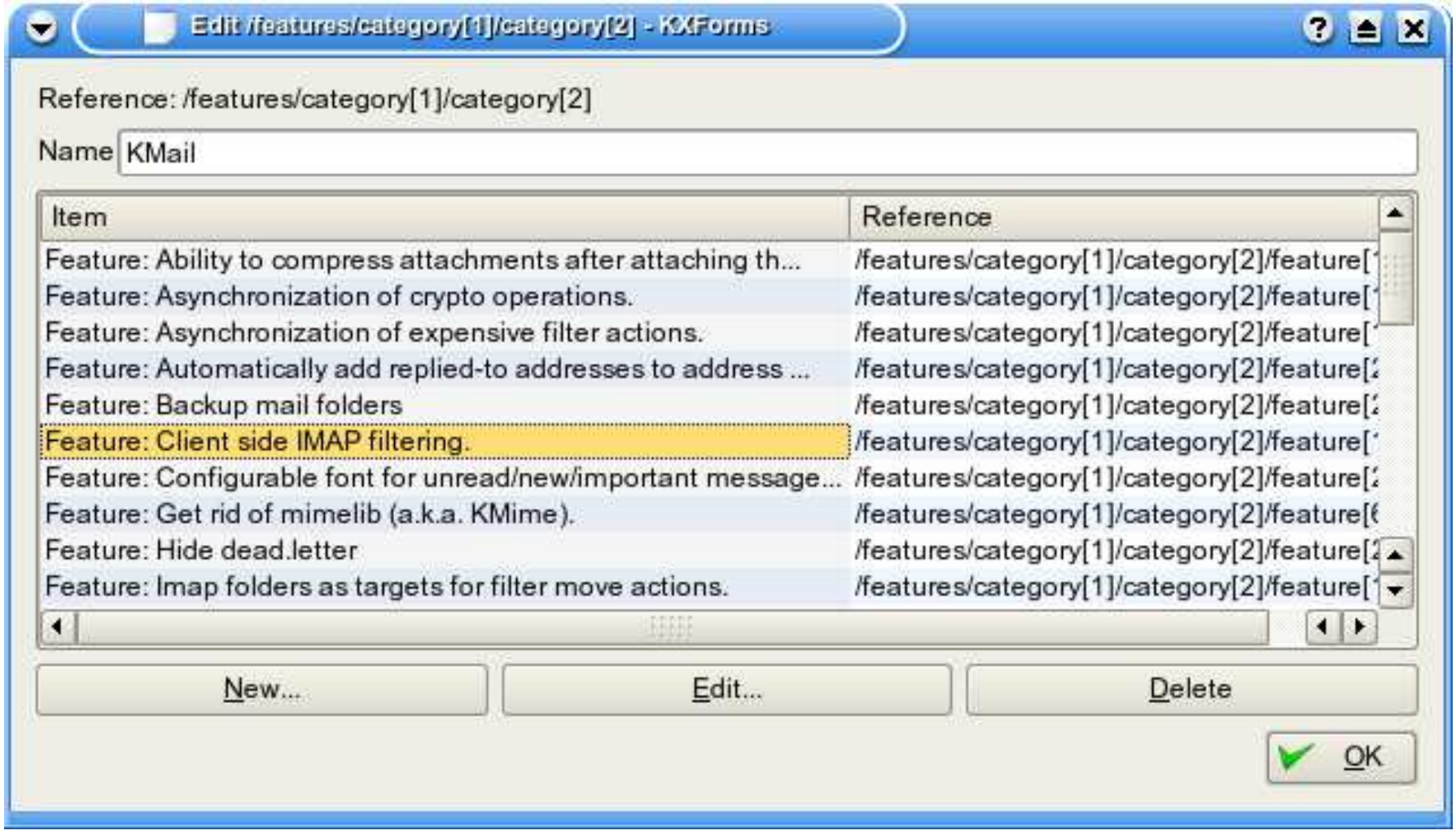
```
<features>

  <category name="KDE PIM (Personal Information Management)" >

    <category name="KMail" >

      <feature status="inprogress" target="3.5" >

        <summary>Client side IMAP filtering.</summary>

        <responsible email="adam@kde.org" name="Till Adam" />
        <responsible email="sanders@kde.org" name="Don Sanders" />

      </feature>

    </category>

  </category>

</features>
```

KXForms Demo 1

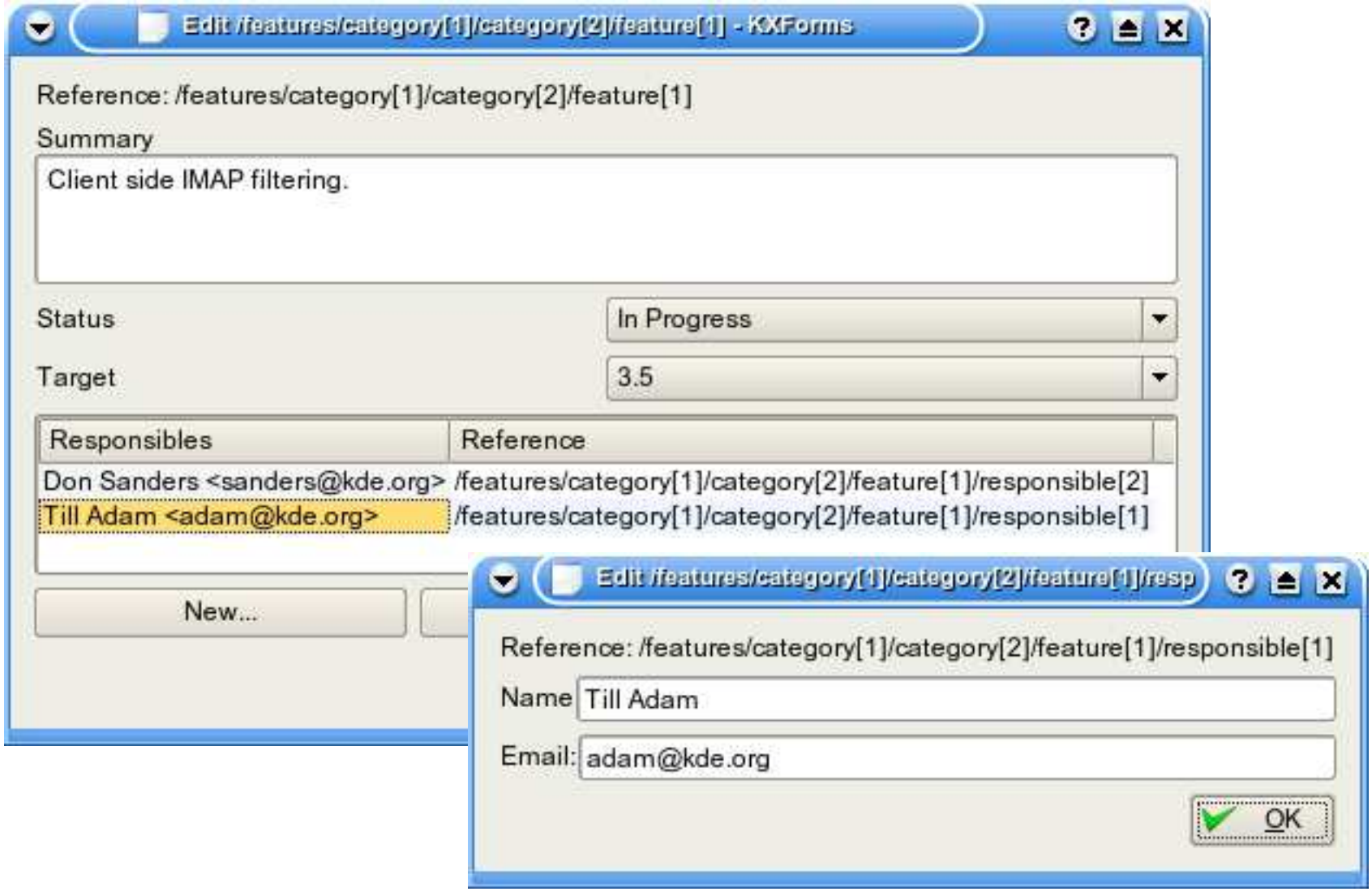
```
> kxforms --kxform gui.kxform features.xml
```



KXForms Demo 2



KXForms Demo 3



XML Schema and KXForms

- Transformation of XML Schema to KXForms
- Schema references in XML can automatically be resolved to create a GUI for editing XML data.
- Data on a server which is accessible by kioslaves can be edited without any more information or tools.
- GUIs needs to be customized.
- Label and hint texts.
- Layout and hierarchy hints.
- Annotating XML Schema, either inline or externally

Outlook KXForms

- Generate KXForms from KConfig XT descriptions to generate configuration dialogs.
- Make use of KXForms in Kung.
- More clever layouting logic.
- Problems can be addressed separately and generic.
- Lots of XML handling: Better integrate with other libraries, make use of existing frameworks, e.g. kdom.

Conclusion

- Kode project has grown
- Playground for some ideas
- Covers code generation, XML technologies, GUI generation
- Current code: `branches/work/kode-x/kode`