Cross-platform C++ development using Qt®

Fall 2005

QT Presentation By Gabe Rudy

Overview

- About Trolltech®/QT
- Qt Features and Benefits
- Examples and Code
- Demos and more Code!
- Questions

About Trolltech/QT

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Trolltech

Eirik Chambe-Eng

Haavard Nord

- Founded in 1994
- Offices:
  - Oslo, Norway (HQ)
  - Santa Clara, California
  - Brisbane, Australia
- Ownership:
  - Majority by employees
  - 24% VC
- Main products: Qt and Qtopia®

Products

- Qt: a complete C++ application development framework
- Qtopia: a comprehensive application platform and user interface for Linux-based consumer electronics
- QSA: Qt Script for Applications
- Teambuilder: distributed compilation solution Linux®/Unix

Other Products First

- Any Linux based PDQ will be running QTopia, which is based on QT-embedded.
- If you know QT, you could easily write for this platform.

Qt in a nutshell

- Qt is a complete C++ application development framework, including
  - A comprehensive C++ class library
  - RAD GUI development tool (Qt Designer)
  - Internationalization tool (Qt Linguist)
  - Help browser (Qt Assistant)
  - Source code and comprehensive documentation

Qt is comprehensive

- Qt supplies 80-90% of commonly needed functionality for rich client developers
  - 400+ fully documented classes
  - Core libs: GUI, Utility, Events, File, Print, Network, Plugins, Threads, Date and Time, Image processing, Styles, Standard dialogs
  - Modules: Canvas, Iconview, Network, OpenGL®, SQL, Table, Workspace, XML
  - Tools: Designer, Assistant, Linguist
  - Extensions: ActiveQt, Motif migration, MFC migration
- Qt Solutions for platform-specific customer requests
- Easy to add/extend/customize

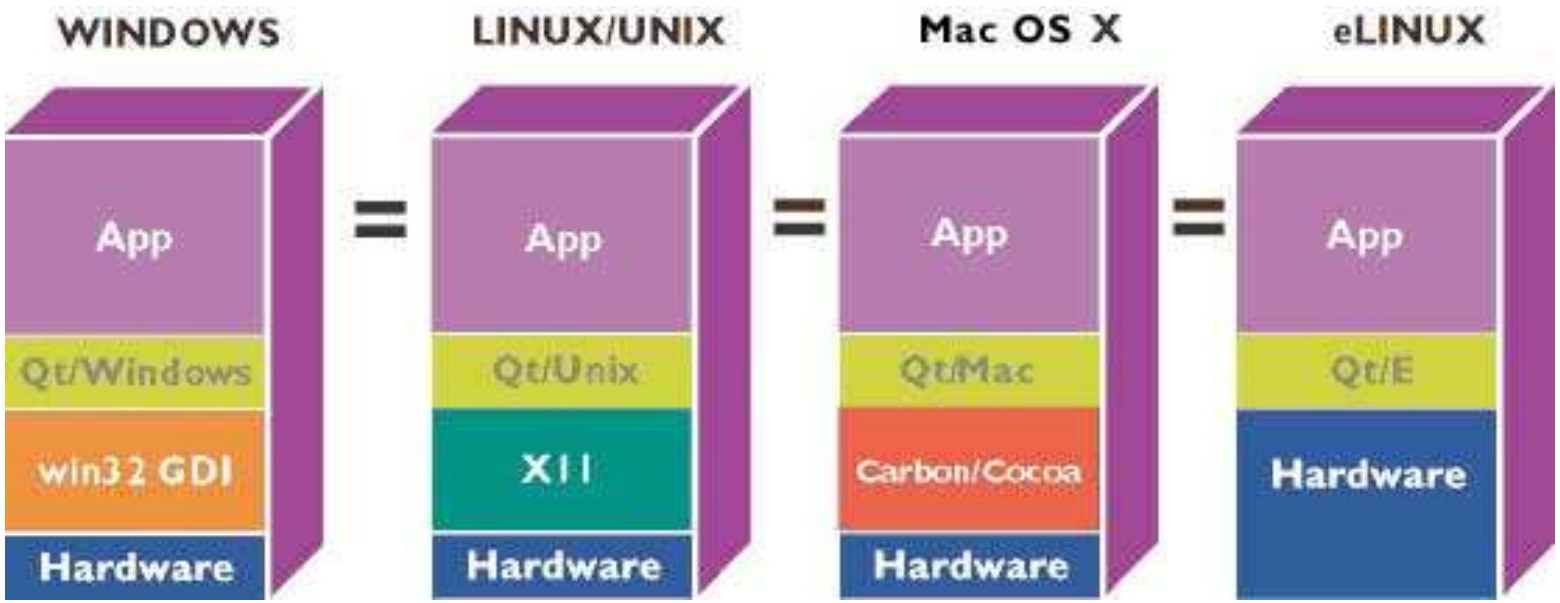
Qt is cross-platform

- The Qt API and tools are consistent across all supported platforms
  - Qt runs on mobile phones to Cray supercomputers
- Consequence for users and customers
  - Freedom of choice in terms of development and deployment platform
  - Protection against changing platform fashions

A few platforms it runs on:

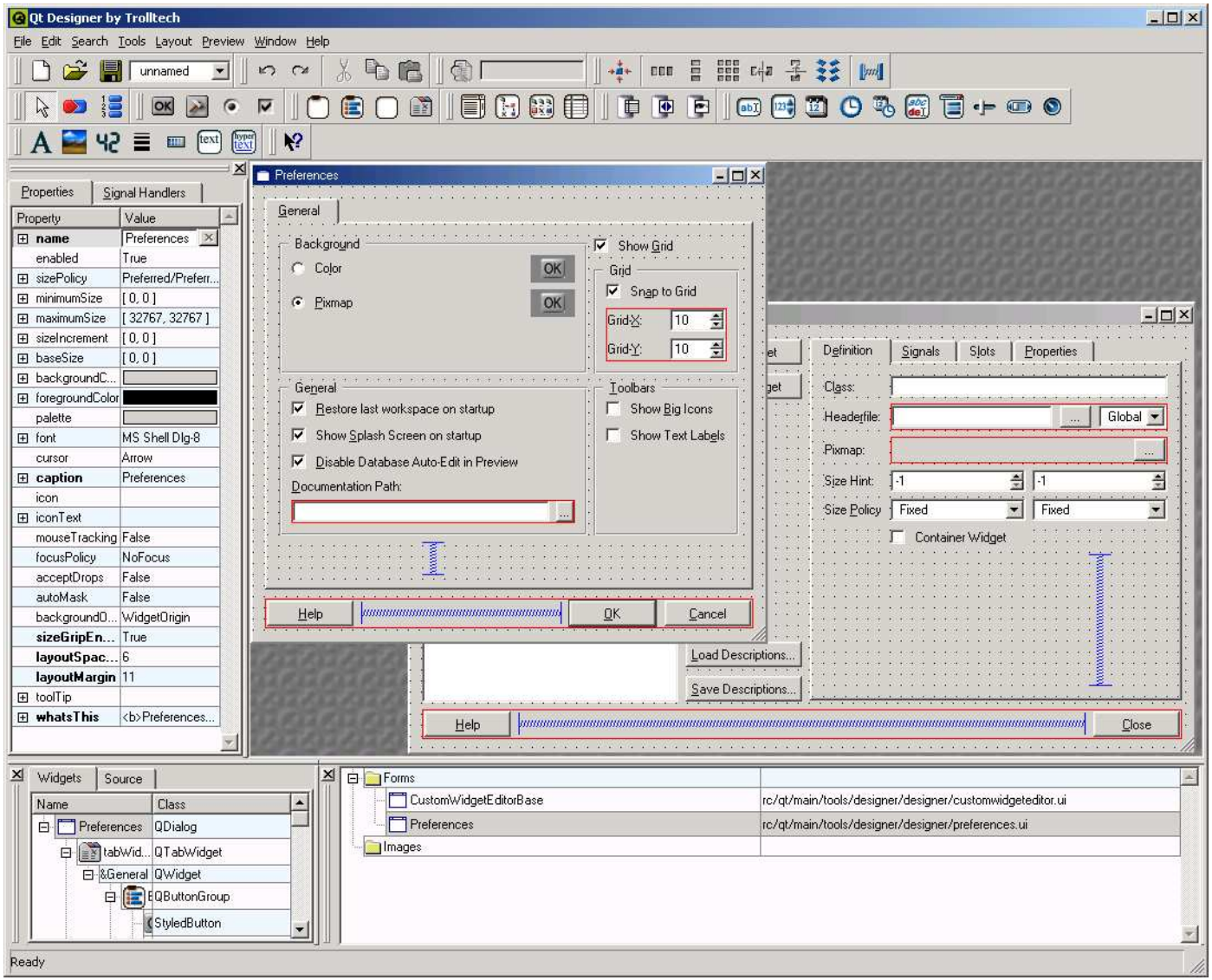
- Windows® 95 through Server 2003
- Mac OS® X
- Linux and embedded Linux
- AIX, BSD/OS, FreeBSD, HP-UX, IRIX, NetBSD, OpenBSD, Solaris, Tru64 UNIX
- And more

Qt is native

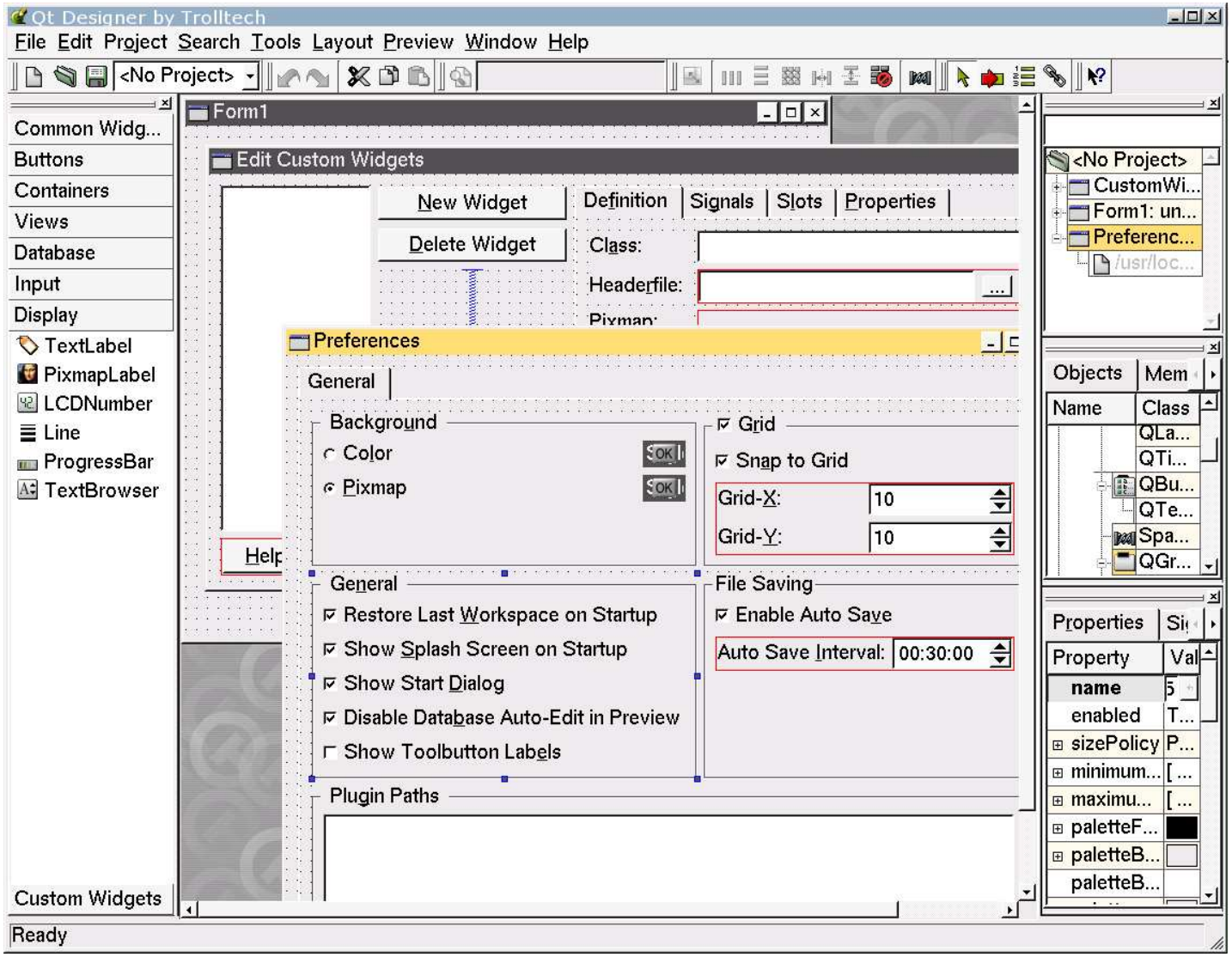


- Qt builds on the native graphics layer
- Qt applications run at compiled speed

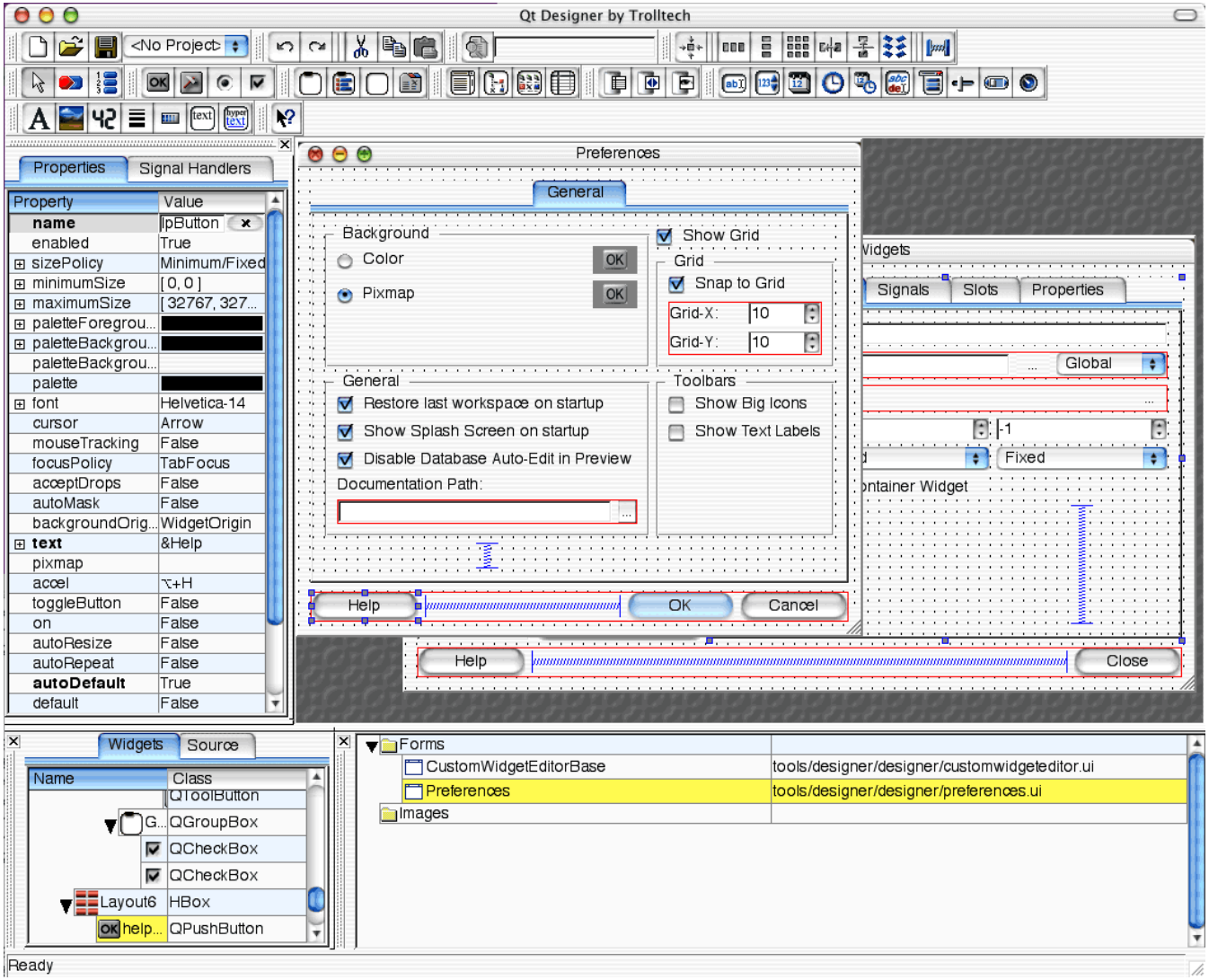
Native look on Windows



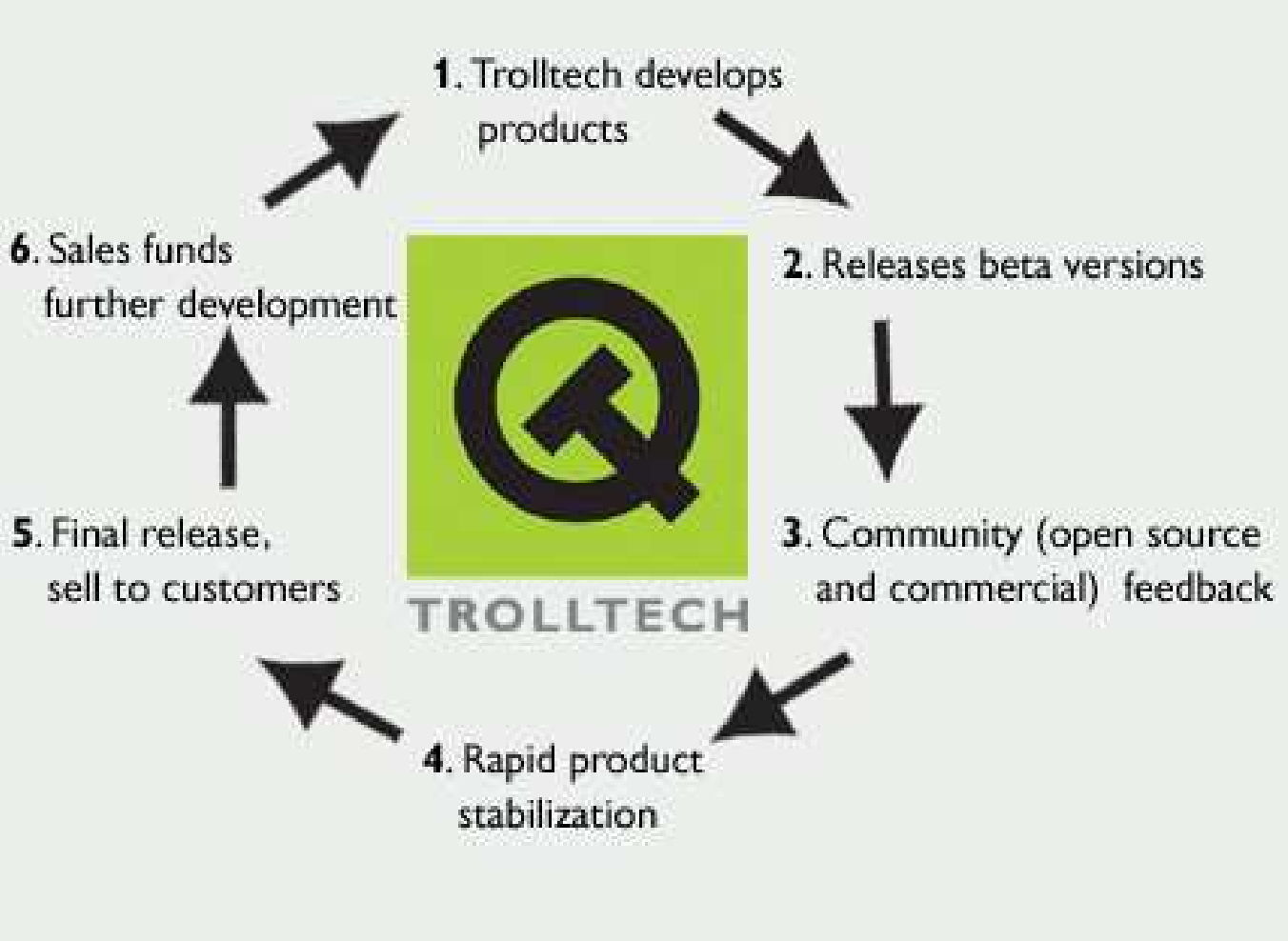
Native look on Linux



Native look on Mac OS X



Qt is open source, but…



QT is also Commercial

- QT requires a commercial license if you plan to sell your product written in QT.
- Per developer licensing
- License cost based on edition and number of platforms
- Windows does not have GPL version of QT
- NO runtime fees/roalties etc.

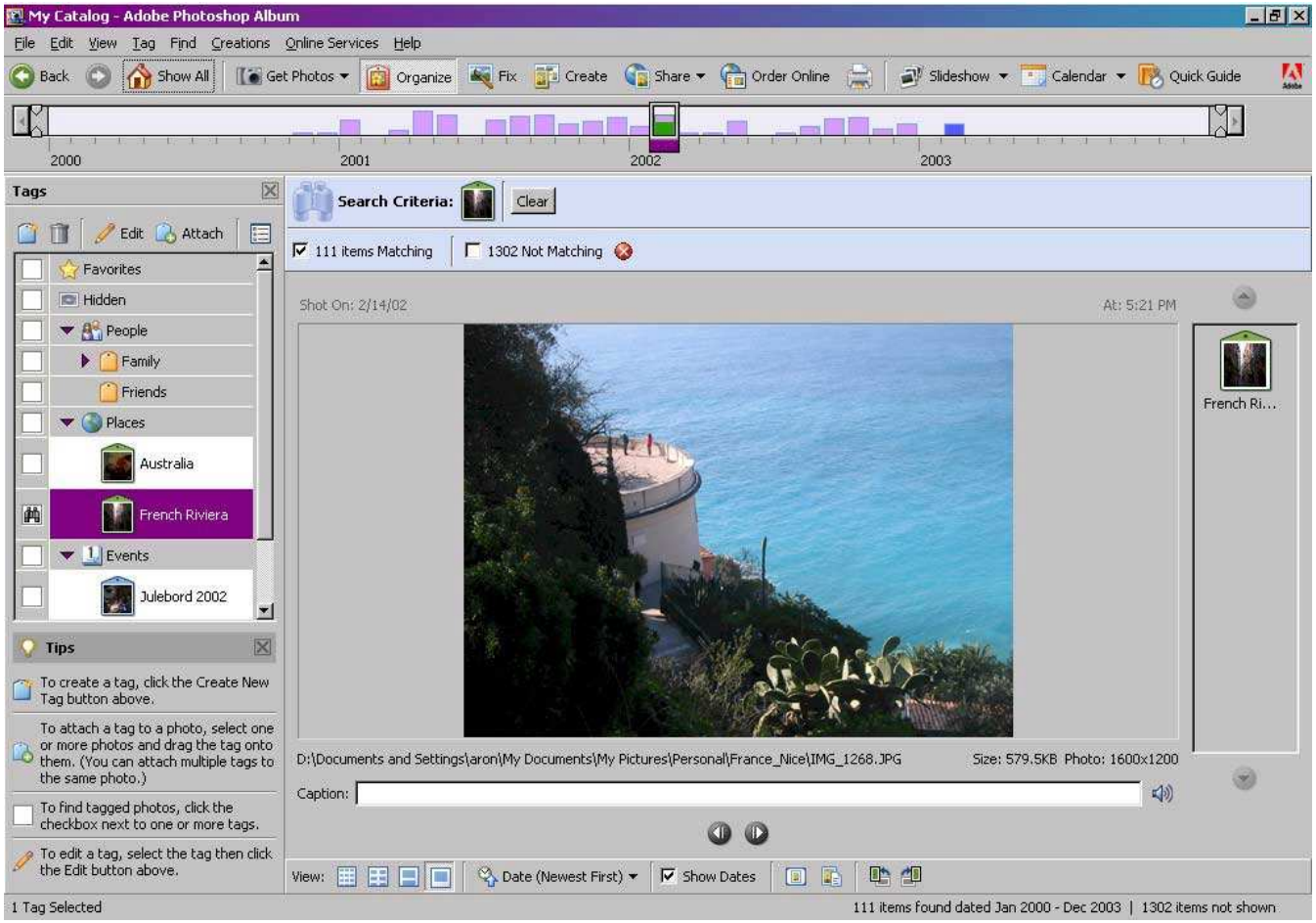
Qt is rock solid

- Qt is used as the basis of the Linux KDE (K Desktop Environment)
  - Millions of lines of code, strong reliability requirements, industry strength stability
- Widely used by Linux community
  - thousands of developers
  - millions of end-users
- Used commercially in a wide variety of demanding applications
  - Medical devices
  - Air traffic guidance

Qt customers

- Adobe, Agilent, ARM, Boeing, Bosch, Cadence, Canon, CEA Technologies, ChevronTexaco, DaimlerChrysler, Deutsche Telekom, Earth Decision Sciences, ESA, Fraunhofer, HP, IBM, Intel, i-penta JD Edwards, Lockheed Martin, LogicaCMG, Mentor Graphics, NASA, NEC, NTT, PGS, Pioneer, Rohde & Schwarz, Scania, Schlumberger, Sharp, Shell, Siemens, Sony, STN-Atlas, Stryker Leibinger, Synopsys, Thales...
- Qt is used for a wide variety of applications: mass-market and custom software, internal apps, research, modeling, visualization, etc..

Sample application: Abobe Photoshop Album



Qt Features and Benefits

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Qt Features

- Unique features in Qt
  - Cross-platform, consistent, compiled API
  - Signals and slots
- Class library overview
- Qt tools overview
- Documentation
- Third-party integration

Cross-platform, consistent API

- Use the standard native tools to build Qt apps (IDE, debugger etc.)
- Qt provides a *platform-independent encapsulation* of the local window system and operating system
- The Qt API is identical on every platform, applications are compiled to native executables
- *Result: Write once, compile everywhere*

Signals & Slots

- Unique inter-object communication mechanism, provides
  - Type-safe callback between objects
  - Facilitates loose coupling / encapsulation
    - Sender and receiver does not ”know about” each other
  - 1-to-many, many-to-1 communication between objects
- Fully Object-oriented

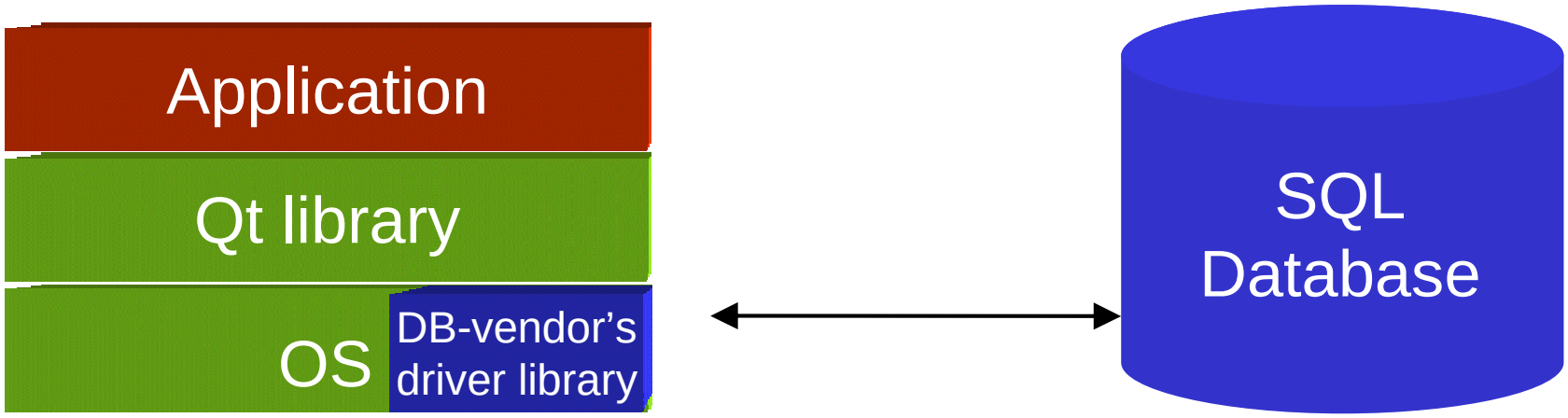
Class Library Overview

- Full set of GUI classes
  - Widget set and GUI toolkit
- Operating system encapsulation classes
  - OO, C++ class interface to C system calls
- SQL database access classes
  - Data storing and retrieval
- Utility classes
  - Commonly useful classes
- Integration & Migration classes
  - Using Qt with other libraries and legacy code

OS encapsulation classes

- File & directory handling
- Date & time
- Registry / preferences
- Networking
  - URL, socket, TCP, DNS, FTP, HTTP
- Process handling
  - exec, terminate, kill, stdin/stdout/stderr I/O
- Threading
  - start, terminate, semaphore, mutex, wait
- Dynamic library loading

SQL Database classes



- Store, retrieve, query, traverse & modify DB data
- Database-independent API
  - Oracle, Sybase/MS SQL Server, MySQL, PostgreSQL, DB/2, Interbase, ODBC
- DB-aware widgets
  - Editable forms and tableviews

Utility classes

- String and regular expressions
  - Unicode
- Text and binary I/O
  - codecs
- Collections
  - Optional alternatives to STL collections
- XML I/O
  - Parser with SAX2 interface
  - DOM level 2 implementation

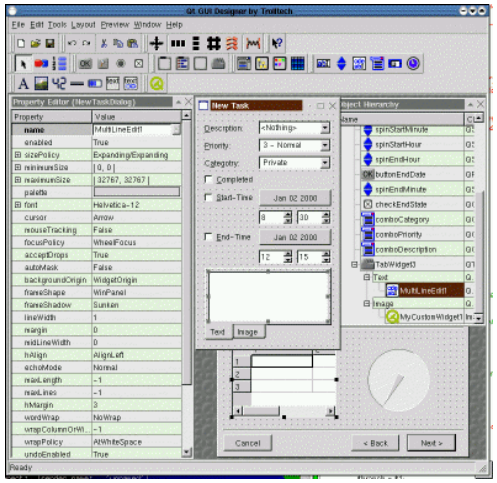
Integration & Migration classes

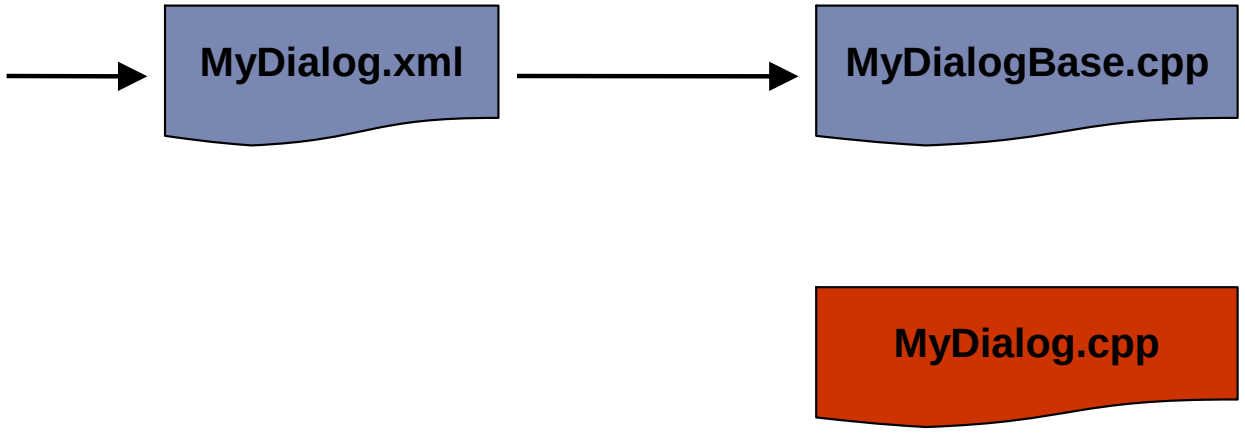
- OpenGL
  - 3D graphics rendering in a Qt widget
- ActiveX
  - Host ActiveX controls in a Qt app
  - Use Qt to create ActiveX controls
- Motif
  - co-exist with legacy Motif code; stepwise migration
- Netscape Plugins
  - Create Netscape/Mozilla/Opera LiveConnect plugins with Qt

Development Tools Overview

- Qt Designer
  - Visual GUI builder
- Qt Linguist
  - Language translators' tool
- Qt Assistant
  - Help browser
- qmake
  - Makefile generator, eases cross-platform builds

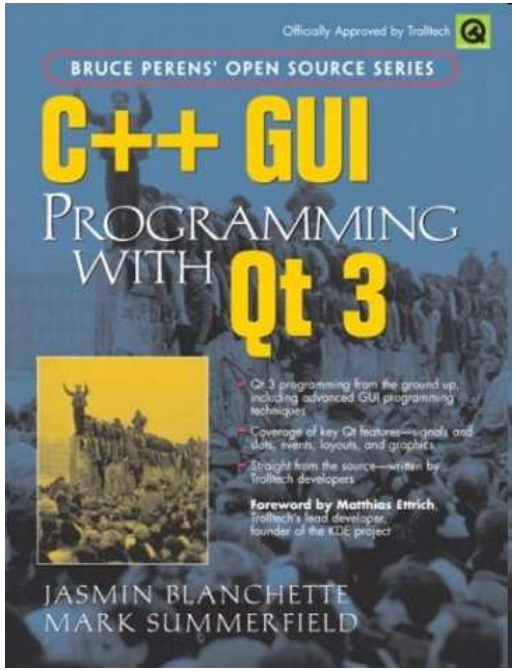
Qt Designer





- WYSIWYG, drag & drop GUI builder
- Supports the Qt auto-layout system
- Designs stored in open, documented XML format
- Does not interfere with user's source code

Documentation



- Reference Manual
  - HTML
  - generated from the source code
  - Fully cross-referenced
  - Browsable from Qt Assistant
  - or normal web browser: doc.trolltech.com
- Tutorials
- Examples
- Qt programming books

Examples and Code

The fun stuff.

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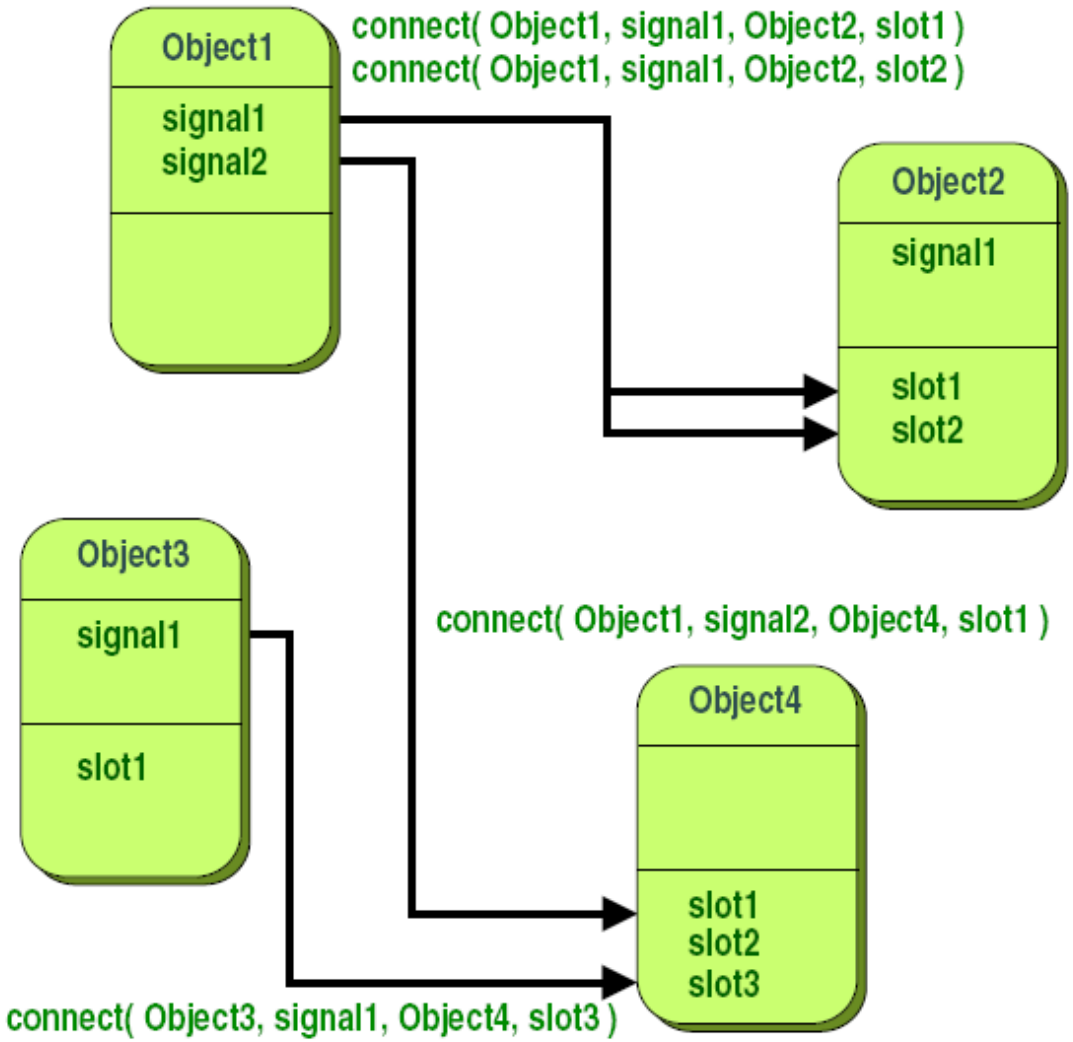
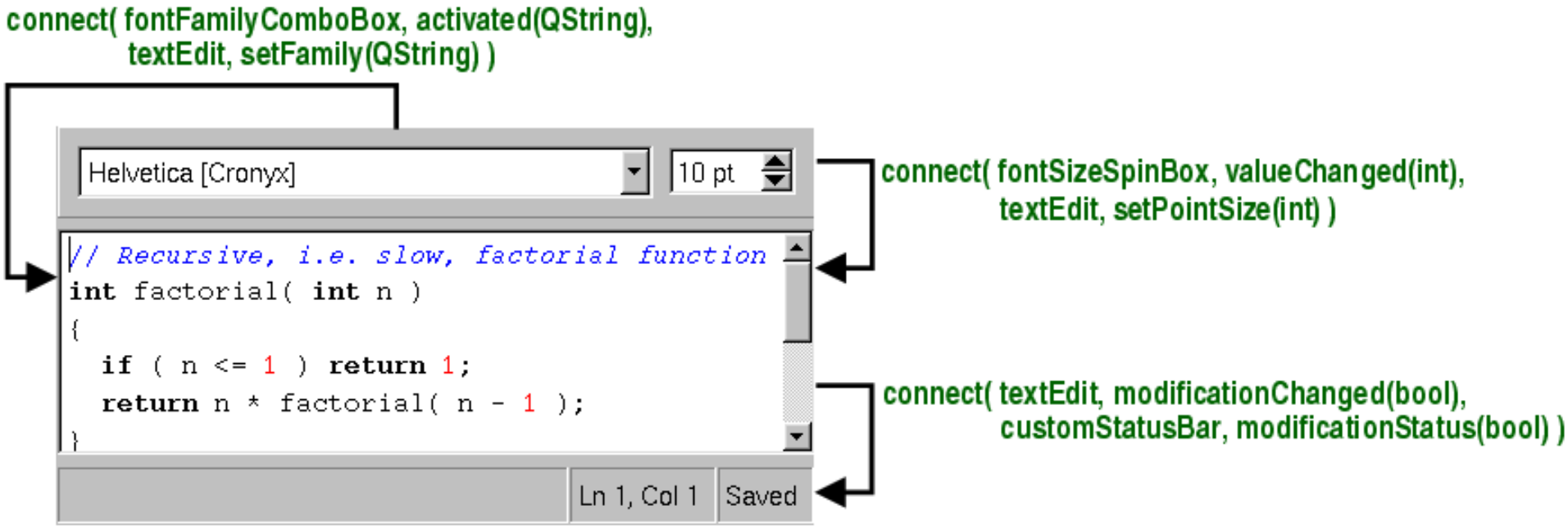
Hello World(ish)

```
#include <qapplication.h>
#include <qlabel.h>

int main(int argc, char* argv[]) {
  QApplication myapp(argc, argv);

  QLabel* mylabel = new QLabel("Hello MSU“,0);
  mylabel->resize(80,30);

  myapp.setMainWidget(mylabel);
  mylabel->show();
  return myapp.exec();
}
```

Signals and Slots (in-depth)



Signals and Slots – example



Defining Signals and Slots

- New C++ Syntax for defining Signals/Slots

```
class myClass : public QObject {
Q_OBJECT          //required macro, no semicolon
…
signals:
  void somethingHappened();
…
public slots:
  void slotDoSomething();
…
private slots:
  void slotDoSomethingInternal();
…
};
```

Gory Details

- Signals: emit events
  - declare as signals, otherwise normal member functions
  - You don't implement them. Rather, you send them with the keyword **emit**
  - E.g. emit sliderChanged(5)
- Slots: receive and handle events
  - Normal member functions declared as slots
- Connect: must connect signals to slots
  - QObject::connect(mymenu, SIGNAL(activated(int)), myobject, SLOT(slotDoMenuFunction(int)));
- moc: meta object compiler (preprocessor) converts these new keywords to real C++

Hello World Proper

```
int main(int argc, char* argv[]) {
    QApplication myApp(argc, argv);
    QWidget* myWidget = new QWidget();
    myWidget->setGeometry(400, 300, 120, 90);

    QLabel *myLabel = new QLabel("Hello MSU!",myWidget);
    myLabel->setGeometry(10, 10, 80, 30);

    QPushButton* myQuitButton = new QPushButton("Quit", myWidget);
    myQuitButton->setGeometry(10, 50, 100, 30);
    QObject::connect(myQuitButton, SIGNAL(clicked()), &myApp,
      SLOT(quit());

    myapp.setMainWidget( myWidget );
    myWidget->show();
    return myApp.exec();
}
```

Hello with QT Designer

- Create a widget/dialog/wizard etc in Designer
- Use the code generated at compile time in the program.

```
#include "helloui.h" //Generated at compile time
int main(int argc, char* argv[]) {
    QApplication myApp(argc, argv);
    HelloUI* hello = new HelloUI(0);
    myApp.setMainWidget( hello );
    hello->show();
    return myApp.exec();
}
```

Look at Designer .ui and Demo

- Designer generates clean xml code
- Demo shows off QT well.

Thank you!

Additional information resources:

- **http://www.trolltech.com/**
- **http://kde.org**
- **Gabe**

Questions?