Migration from MFC to Qt

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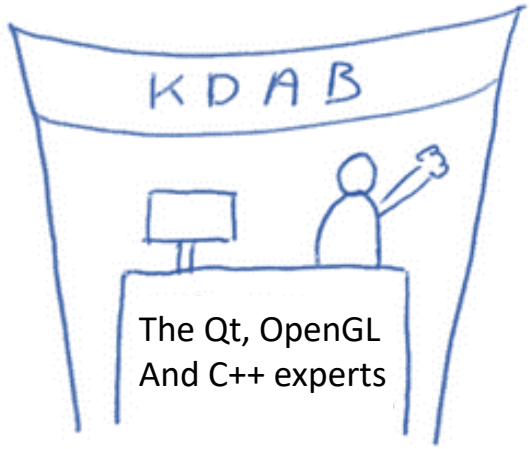
The Qt, OpenGL and C++ experts

About me

- Senior Software Engineer, KDAB
- C++/Qt developer since ~2002
- Living in Limoges, France



Who doesn't mind working on Windows?

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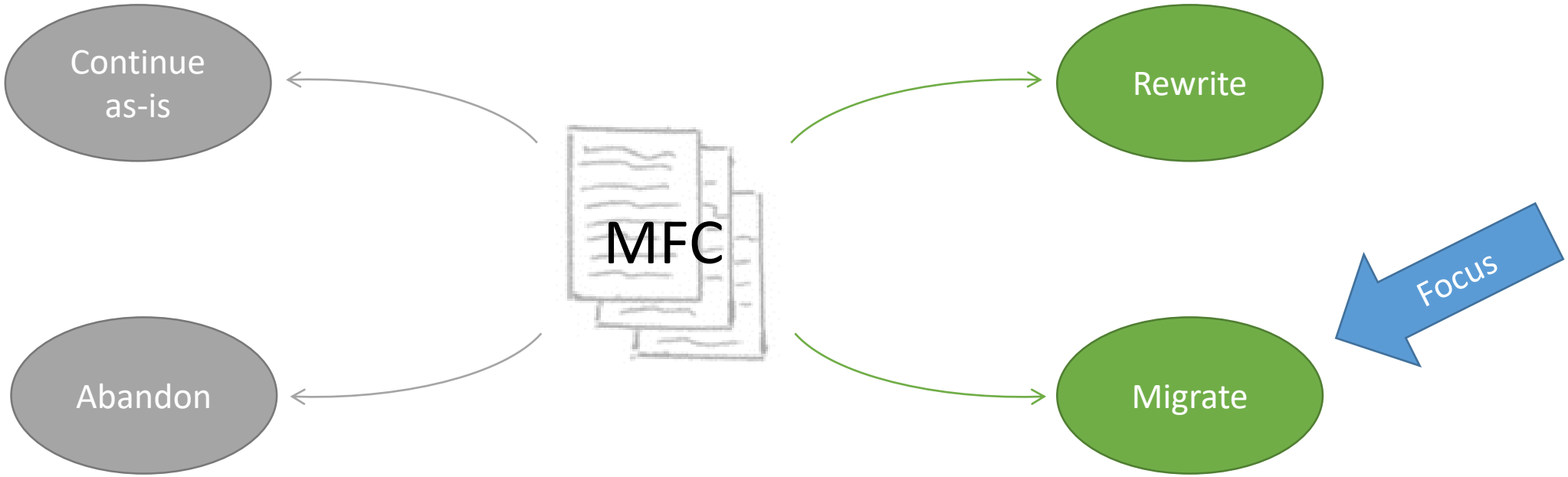
Modernizing legacy MFC code

You got a big pile of MFC code...

... and now what?



Reasons to move to Qt

- The MFC framework is on life support
  - Qt is supported, is improving, and has a lively community
- The UI feels very out-dated
- The application needs to run on multiple platform
- The application needs to follow new UI paradims (touch-screens…)
- It's getting harder to add new features, fix bugs (technical debt)
- It's getting harder to find good MFC developers
- …

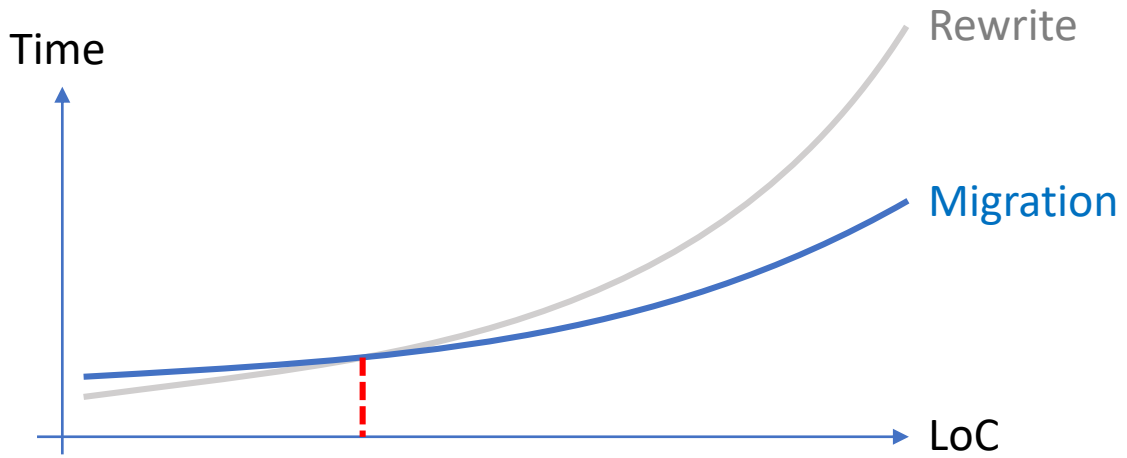
"It's never the right time to move off MFC."
Make it happen!

Rewrite vs Migration

+ Start from clean state
+ Not bound by technical decisions made decades ago
+ Revisit and clean up requirements
- Long time to market
- Lost years of knowledge, corner-cases

+ Keep the good, replace the bad
+ Migration can be done incrementally
+ Smaller time to market
- Developers must **know both MFC and Qt**
- Developers must **know migration techniques**

Focus



Refactoring

- **Avoid mixing migration and refactoring**:
  - Increase development time
  - Prevent comparing old / new code
  - Make it harder to find bugs

- Advices for refactoring:
  - Refactor once the migration is done (or once the module is migrated)
  - Rewrite if the module is isolated from the rest of the code (partial rewrite)

What to migrate?

- **User interface**
  - Moving dialogs and UI elements to Qt equivalents.
- **Build system**
  - Moving from Microsoft-specific builds to a platform-independent build system
- **Non-UX code**
  - Moving the core MFC classes (like strings, files, containers…) to pure C++ or C++ with Qt as desired
- **Windows APIs**
  - Removing any Windows-specific APIs and replacing them with OS-generic equivalents

MFC Migration Techniques

Clean up your codebase

- Clean up warnings
- Document and simplify development setup
  - Make sure to have a reproducible setup
  - Make sure 3rd-party libraries are available
- Clean up warnings
- Remove dead-code
  - Use static analysis tools
- Clean up warnings
- (Optional) Beautify your code, update coding style
  - Automate the work with uncrustify, clang-format…
- Clean up warnings

There is a subliminal message hidden.
Can you find it?

Integrate Qt into the build system

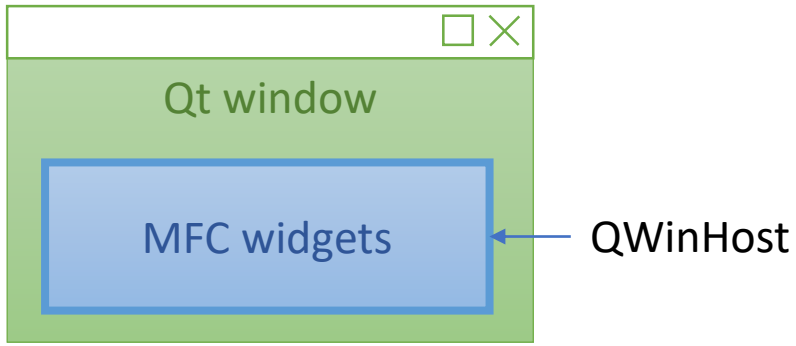
- Download and install Qt Visual add-in
  - https://download.qt.io/archive/vsaddin/
- Add support of Qt add-in in your project
  - Edit *project.vcxproj*
  - Add *QtVS_v301* keyword
  - Add *qt_defaults* property sheet
  - Add *qt.props* property sheet
  - Add *qt.targets*
  - Add *QtSettings*
- Decide how to handle PCH
  - **moc** supports adding an include
  - **rcc does not!**

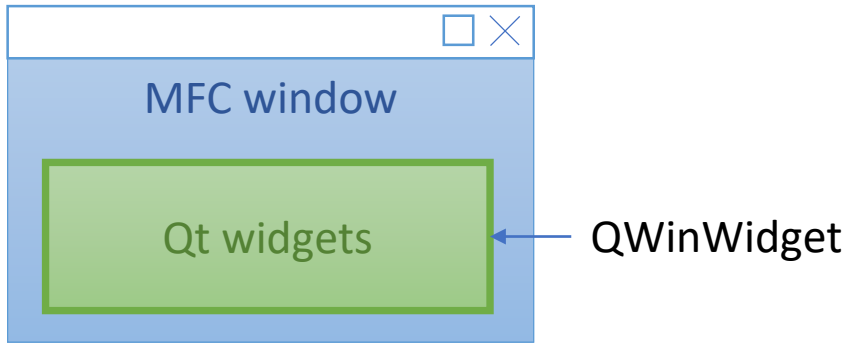
```
diff --git a/MFC_UpdateGUI.vcxproj b/MFC_UpdateGUI.vcxproj
index 7eee3fa..48b3c67 100644
--- a/MFC_UpdateGUI.vcxproj
+++ b/MFC_UpdateGUI.vcxproj
@@ -14,6 +14,7 @@
     <ProjectGuid>{78446EED-3469-467F-999B-AC5C2E7BD249}</ProjectGuid>
     <RootNamespace>MFC_UpdateGUI</RootNamespace>
     <Keyword>MFCProj</Keyword>
+    <Keyword>QtVS_v301</Keyword>
     <WindowsTargetPlatformVersion>10.0.17763.0</WindowsTargetPlatformVersion>
   </PropertyGroup>
   <Import Project="$(VCTargetsPath)\Microsoft.Cpp.Default.props" />
@@ -30,6 +31,10 @@
     <PlatformToolset>v141</PlatformToolset>
   </PropertyGroup>
   <Import Project="$(VCTargetsPath)\Microsoft.Cpp.props" />
+  <PropertyGroup Condition="'$(QtMsBuild)'=='' or !Exists('$(QtMsBuild)\qt.targets')">
+    <QtMsBuild>$(MSBuildProjectDirectory)\QtMsBuild</QtMsBuild>
+  </PropertyGroup>
+  <Import Project="$(VCTargetsPath)\Microsoft.Cpp.props" />
   <ImportGroup Label="ExtensionSettings">
   </ImportGroup>
   <ImportGroup Condition="'$(Configuration)|$(Platform)
@@ -41,6 +46,20 @@
     <Import Project="$(VCTarg
   </ImportGroup>
   <Prope
+  <Import
+    <Impo
+  </Impor
+  <Propert
+    <QtIns
+    <QtMod                                  gui;widgets</QtModules>
+  </PropertyGroup>
+  <PropertyGroup Label="QtSettings" Condition="'$(Configuration)|$(Platform)'=='Release|x64'">
+    <QtInstall>5.12.5</QtInstall>
+    <QtModules>core;gui;widgets</QtModules>
+  </PropertyGroup>
+  <ImportGroup Condition="Exists('$(QtMsBuild)\qt.props')">
+    <Import Project="$(QtMsBuild)\qt.props" />
+  </ImportGroup>
   <PropertyGroup>
     <_ProjectFileVersion>10.0.30319.1</_ProjectFileVersion>
     <LinkIncremental Condition="'$(Configuration)|$(Platform)'=='Debug|x64'">true</LinkIncremental>
@@ -117,6 +136,9 @@
     <ResourceCompile Include="MFC_UpdateGUI.rc" />
   </ItemGroup>
   <Import Project="$(VCTargetsPath)\Microsoft.Cpp.targets" />
+  <ImportGroup Condition="Exists('$(QtMsBuild)\qt.targets')">
+    <Import Project="$(QtMsBuild)\qt.targets" />
+  </ImportGroup>
   <ImportGroup Label="ExtensionTargets">
   </ImportGroup>
 </Project>
\ No newline at end of file
```

- Create an empty Qt project
- Copy all XML tags related to Qt

Add QtWinMigrate to your project

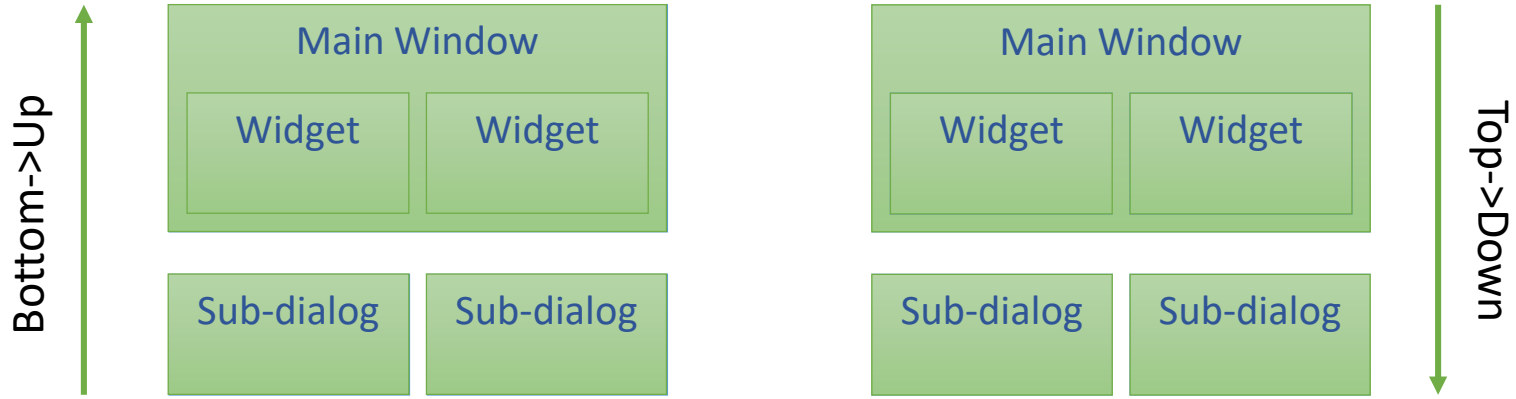
- Qt/MFC migration framework
  - https://github.com/qtproject/qt-solutions/tree/master/qtwinmigrate
  - BSD license
- Contains 3 classes
  - **QMfcApp** – merge the Qt and MFC event loops
  - **QWinHost** – integrate native Win32 widgets/windows into Qt ones
  - **QWinWidget** – integrate Qt widgets into native Win32 widgets





Note on mixed MFC/Qt application

- QtWinMigrate allows to create mixed MFC/Qt application
  - The application is almost 100% feature complete during the port
  - Two issues with mixed MFC/Qt application:
    - Drag'n'drop from MFC to Qt (or vice-versa)
    - Focus handling
- 2 different approaches to migration

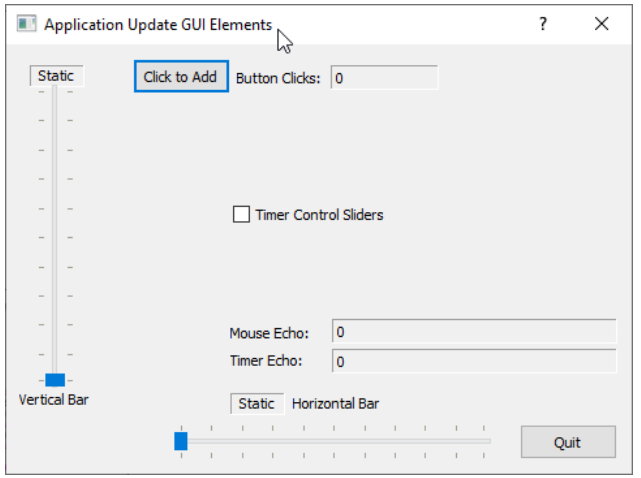


Avoid nesting too many levels of *QWinHost* / *QWinWidget*

Migrate dialogs

- UI descriptions are in the resource file (.rc)
  - Declarative description
  - “Easy” to parse
  - Different sections for:
    - Dialogs
    - Assets
    - Strings
    - Menus
    - Toolbars
    - …

```
IDD_UPDATEGUI_DIALOG DIALOGEX 0, 0, 320, 200
STYLE DS_SETFONT | DS_MODALFRAME | DS_FIXEDSYS | WS_POPUP | WS_VISIBLE |
    WS_CAPTION
EXSTYLE WS_EX_APPWINDOW
CAPTION "Application Update GUI Elements"
FONT 8, "MS Shell Dlg", 0, 0, 0x1
BEGIN
    DEFPUSHBUTTON   "Click to Add",ID_BTN_ADD,65,7,50,16
    PUSHBUTTON      "Quit",IDCANCEL,263,177,50,16
    LTEXT           "Button Clicks:",IDC_STATIC,118,11,50,8
    LTEXT           "0",IDC_ECHO_AREA,166,10,55,11,0,WS_EX_CLIENTEDGE
    CONTROL         "",IDC_V_SLIDER_BAR,"msctls_trackbar32",TBS_VERT |
                    TBS_BOTH | TBS_NOTICKS | WS_TABSTOP,17,19,17,141
    CONTROL         "",IDC_H_SLIDER_BAR,"msctls_trackbar32",TBS_BOTH |
                    TBS_NOTICKS | WS_TABSTOP,86,178,162,15
    LTEXT           "Vertical Bar",IDC_STATIC,7,161,39,8
    LTEXT           "Horizontal Bar",IDC_STATIC,147,163,47,8
    CTEXT           "Static",IDC_V_SLIDER_ECHO,12,10,28,10,0,
                    WS_EX_CLIENTEDGE
    CTEXT           "Static",IDC_H_SLIDER_ECHO,115,163,28,10,0,
                    WS_EX_CLIENTEDGE
    LTEXT           "0",IDC_TIMERECHO,167,142,146,11,0,WS_EX_CLIENTEDGE
    LTEXT           "0",IDC_MOUSEECHO,167,128,146,11,0,WS_EX_CLIENTEDGE
    LTEXT           "Timer Echo:",IDC_STATIC,115,143,45,8
    LTEXT           "Mouse Echo:",IDC_STATIC,115,130,45,8
    CONTROL         "Timer Control Sliders",IDC_TIMER_CONTROL_SLIDERS,"Button",
                    BS_AUTOCHECKBOX | WS_TABSTOP,116,74,86,10
END
```



Automate ui files creation

Migrate dialogs – cont.

- Migrate the MFC message map into Qt paradigms
  - Qt event handlers
  - Qt slots (or normal functions)

```
BEGIN_MESSAGE_MAP(CTutorialDlg, CDialog)
  ON_WM_PAINT()
  ON_WM_TIMER()
  ON_WM_LBUTTONDOWN()
  ON_WM_MOUSEMOVE()
  ON_WM_RBUTTONDOWN()
  ON_WM_HSCROLL()
  ON_WM_VSCROLL()
  ON_BN_CLICKED(ID_BTN_ADD, OnBnClickedBtnAdd)
  ON_BN_CLICKED(IDC_TIMER_CONTROL_SLIDERS, ...)
END_MESSAGE_MAP()
```

Qt event handlers

```
void paintEvent(QPaintEvent *event);
void timerEvent(QTimerEvent *event);
void mousePressEvent(QMouseEvent *event);
void mouseMoveEvent(QMouseEvent *event);
```

Qt slots

```
void OnHScroll(int value);
void OnVScroll(int value);
void OnBnClickedBtnAdd();
void ...();
```

Automate message map migration

Migrate dialogs – cont.

- MFC dialog data exchange mechanism

Dialog Object

Class members

```
CString m_EchoText;
CString m_HSliderEcho;
CString m_VSliderEcho;

CSliderCtrl m_VSliderBar;
CSliderCtrl m_HSliderBar;

CString m_MouseEcho;
CString m_TimerEcho;
```

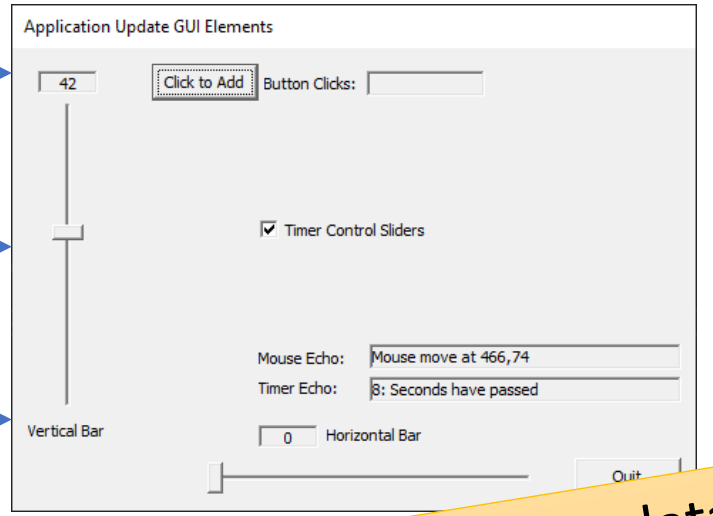
Link objects in *DoDataExchange*

Initialize controls in *OnInitDialog*

Exchange data *UpdateData*

Dialog on the screen

Controls



- Qt does not need this complex mechanism
  - Use the widget pointers for the ui directly
  - Use Qt API for widget calls
  - Defer initialization using *showEvent*

Automate data exchange migration and API migration

Migrate other resources

- The resource files (.rc) contain:
  - Menus definitions
  - Toolbars definitions
  - Shortcuts (accelerators) definitions
  - Assets list
  - Strings translations
  - Languages, versions…
- During the migration, it's important:
  - To automate the migration of resources
  - To be able to refactor the migrated code

Automate any resource migration

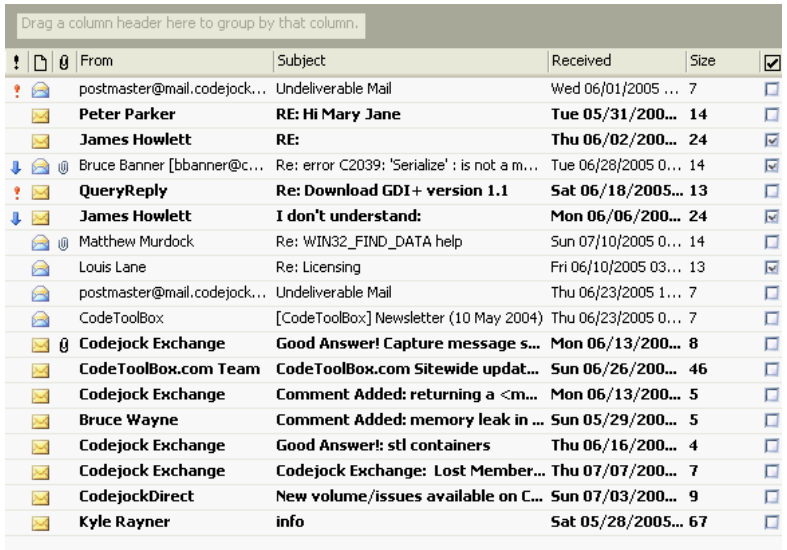
Migrate controls

- Simple controls (checkbox, buttons...):
  - Use simple Qt widgets directly
  - Avoid any behavior changes (even if done in MFC)

- Complex controls (property grid, dock system...):
  - Usually from existing MFC libraries (ex: Toolkit Pro)
  - Create a new Qt widget with:
    - Same behaviour as MFC controls
    - Same (or close) API as MFC controls
  - **Minimize changes in code during migration**

- Use existing Qt libraries:
  - Advancing docking system: KDDockWidgets

Image from CodeJock website



Find the right level of abstraction

Automate migration of project-specific controls

DEMO

We have barely scratched the surface

- Document / View architecture
  - CDocument, CView…
  - SDI, MDI…
- Printing and print previewing
- Threads
  - CWinThread…
- Component Object Model
  - COM, OLE, ActiveX

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Conclusion

To sum up

- **Choose** your migration strategy wisely
  - Be prepared to defend it internally
  - Don’t mix migration and refactoring
- **Clean up** the code before anything
- **Use** the Qt/MFC migration framework
  - Don’t lose sight of the big picture: removal of MFC
- **Find** the right level of abstraction
  - Use existing libraries if they exist
- **Automate** all things:
  - resource migration
  - MFC code migration
  - project-specific code migration
- **Limit** code differences

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Thanks!

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