A year in the Visual Class Libraries (VCL)

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"Stand at the crossroads and look; ask for the ancient paths, ask where the good way is, and walk in it, and you will find rest for your souls..." - Jeremiah 6:16

Overview

- New & interesting stuff in VCL
  - Main-loop / Idle
  - Not much RenderContext (Kendy did it)
  - OpenGL
    - challenges & fun.
  - VclPtr
    - why, what, how, debugging ...
- TODO: Where next ?
  - RGBA vs. RGB + A
  - Cleanups …

New: Main-loop / idle

How it used to work ...

- VCL had (and still has) a single timer
  - This is a system-timer
  - Abstracted in SalTimer
  - We set the duration to the shortest timeout we have.
  - Wait for timeout, and emit any expired timeouts.
  - Start again ...

How it used to work #2

- So – to order events eg.
  - resize & layout window (50ms)
  - re-render window: Paint timer (30ms)
- A zoo of different length timeouts
  - 250+ timers of various sorts.
- Now fixed:
  - Timeouts (as before) & 'Idle' handlers.
  - Idle → “when nothing else is going on do it”
    - Prioritized to get sensible ordering ...

Now -much- better & cleaner.

- Can now get rapidly to the right idle handler
  - 'Invalidate' a widget → it will be re-rendered soon; not 30ms later …
  - High resolution timers on Windows (Kendy)
    - Windows 'rounds-up' your timers to 10ms – unless another app on the system asked for high-resolution timers.
- Thanks to: Munich guys ...
    - jennifer.liebel@muenchen.de, tobias.madl@muenchen.de florian.haftmann@informatik.tu-muenchen.de
- https://wiki.documentfoundation.org/Development/LHM_LiMux/Main_Loop

Problem type

- Some code used to loop all the time
  - re-render something every 30ms – why not ?
  - Writer / deferring spell/grammer checking for 'a bit' hoping for the next keystroke
    - Type “misspelledthin” (and don't press space) …
  - Beyond-lame 'Timer' to collect state and stash it into a struct – so it'll be ready on an event emission.
- Now we see this dumb-ness as a 100% CPU burning hot loop … <fix it>
  - For now: hacked a bit – low prio. idles throttled to 5ms: we should kill that on master ...

Problem type:

- Starvation by high-prio Idle handler
  - This guy will always get the callback.
  - lower-prio. Idle handlers : no look in
- Effect:
  - If prio. higher than render: 100% CPU – and no re-rendering: but … otherwise usable app.
- Arguably better
  - previously priority / ordering not obvious – based on timeouts.
  - Races: Unix - configure_event vs. paint timer https://gerrit.libreoffice.org/#/c/16273/ - thanks Caolan.

VclPtr

VclPtr change ...

- Intended to be -minimal- not a complete fix, but getting the simple, basics in-place,
  avoid touching the tar-baby too hard etc.
  - (its the way you tell them)
- Initial branch merge:
  - 276 commits thanks to: Noel Grandin & Myself.
  - 2635 files changed, 24679 insertions(+), 41344 deletions(-)
  - 'make check' passing (2x days before)
  - new unit tests written …
- But: VclPtr tracker bug (zero open)
  - As of today: 61 regression bugs tracked (~65 'vclptr' commits)
    - Great work from the QA team.
    - Left paranoid assertions on – no longer needed.
  - 5 bugs 'escaped'
    - 5.0.1 → 3 fixed. 5.0.2 → 2 fixed.

What was the change ?

- Previously:
  - Window / OutputDevice classes had unusual lifecycles:
    - members, stack allocated, heap allocated.
  - Normal to have a heap allocated parent, with a ton of stack allocated children.
    - delete pParent → implicitly delete's memberChildren.
- Unfortunately:
  - Lifecycle reasonably impenetrable.

Impenetrable ?

- Window's could have ref-counted UNO / toolkit peers:

  WorkWindow aWin;

  Reference< awt::XWindowPeer > xWin = aWin.GetComponentInterface();

- Window's also got wrapped in boost
  - shared_ptr<WorkWindow> aWin(new WorkWindow());
- Destruction semantics very unclear.
  - Impress a particularly good example.
  - shared_ptr + UNO / framework + destruction ordering → extreme fragility.

Destruction ordering ...

- Window extremely paranoid wrt. children being destroyed before parents.
  - We left this dbgutil assert / check in to help find dodgy places; no real need for it.
    - This was the majority of the regressions.
- A child could easily be a member
  - We need to avoid FMR's at all costs

    => assert if child not destroyed.

[In]Correct coding ...

- Lots of code not robust vs. unexpected window destruction.
  - What you should (have) done:

```
ImplDelData aDelData;
ImplAddDel( &aDelData );
    ... call some user / virtual callback ...
if ( aDelData.IsDead() )
    return;
... otherwise safe to use 'this' again ...
```

- ie. '**this**' would disappear under you.
  - Not-expected.
  - Dozens of code-paths unsafe in this regard.
  - Others use: Window::doLazyDelete ...

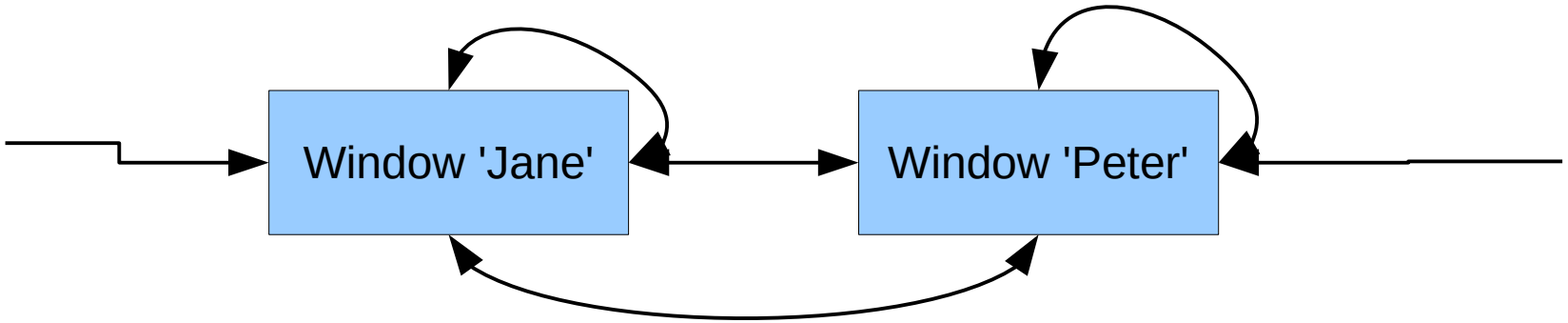
New world:

- *Thanks for the update, refcounting Windows always seemed like a good idea* - Philipp Lohman
  - The man with the previous VCL plan ...

- All children are VclPtr's
  - A VclPtr is either NULL, points to valid memory (perhaps a disposed object)

New world:

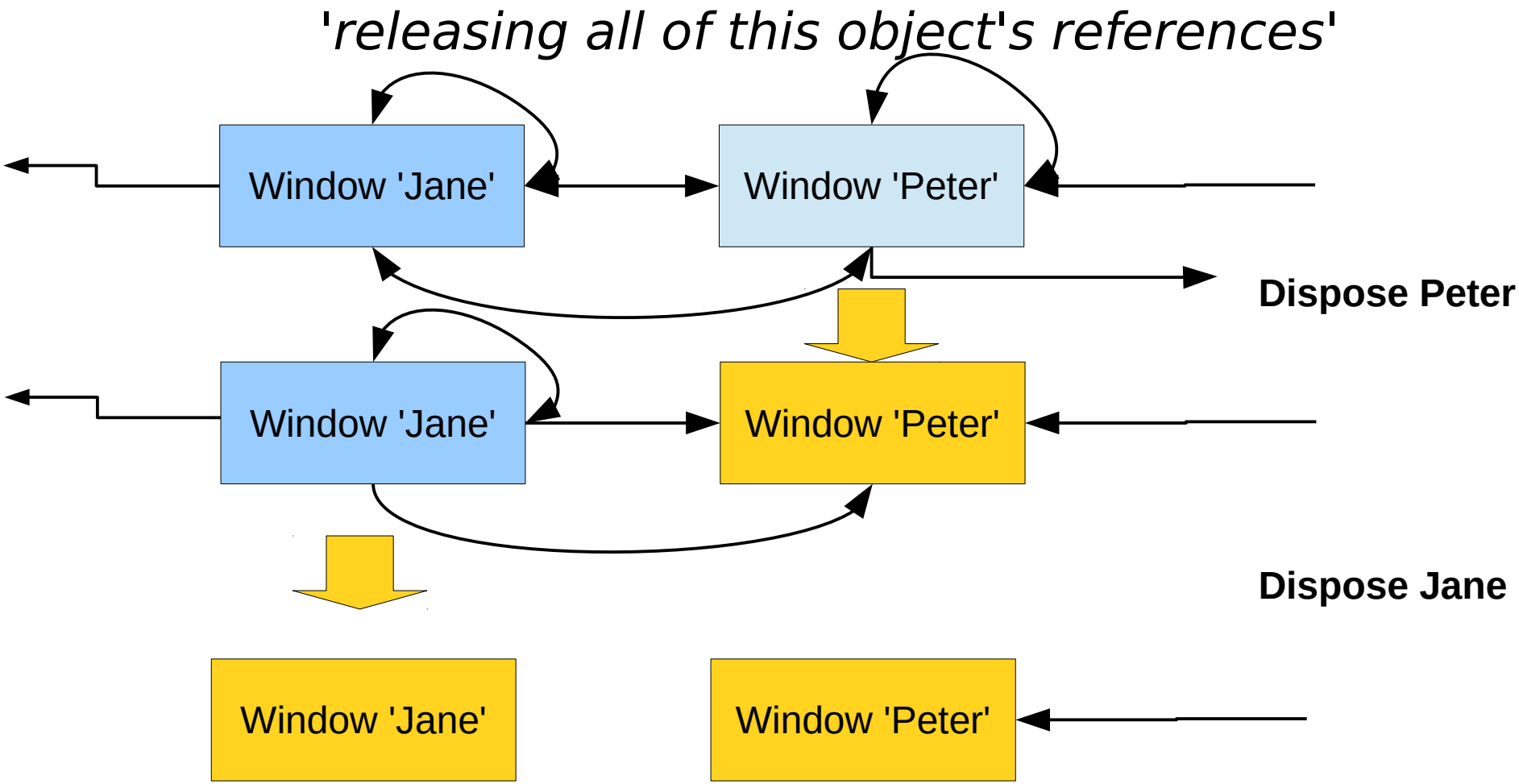
- Reference cycles are implicit:
  - Window has VclPtr's to parents, children, next windows (sometimes itself) etc.



No weak references. All strong.

- So how do we free anything ?

Disposing ...


'releasing all of this object's references'
Window 'Jane'
Window 'Peter'
Dispose Peter
Window 'Jane'
Window 'Peter'
Dispose Jane
Window 'Jane'
Window 'Peter'

New world:

- Dispose:
  - Frees backend resources – leaving a very small 'empty' placeholder.
  - Happens only once:
    - 'disposeOnce' makes this fly.
  - *Ideally* – methods called on a disposed object don't SEGV ...
    - We have belt & braces protected many dozens of methods.
  - So no need for dog-tag type code; we'll get some sane default behavior.

Problem type: destructors

- Moved all Window sub-class destructor code into ::dispose
  - ~Foo::Foo → ~Foo::dispose
  - ~Foo::Foo() { disposeOnce(); }
    - Clang plugin to check.
- Problem is:
  - There can be other members of Foo that are not Window sub-classes
    - They assume destruction ordering

      → need to add 'dispose' and call from ::dispose

Problem type: vtables ...

- As you destroy your C++ object:
  - The vtable is mapped to sub-classes

```
class Base {
    virtual void doFoo() { print (“hello world”); }
    ~Base() { doFoo(); }
}
class Inherit : public Base {
    virtual void doFoo() { print (“whatever”); }
}
```

- As we destroy ~Inherit → “hello world”
- BUT → if we move all destructors to:
  - virtual dispose() methods – this is not so.
  - Nasty re-ordering issues ... fixed a large number of these.

Other benefits

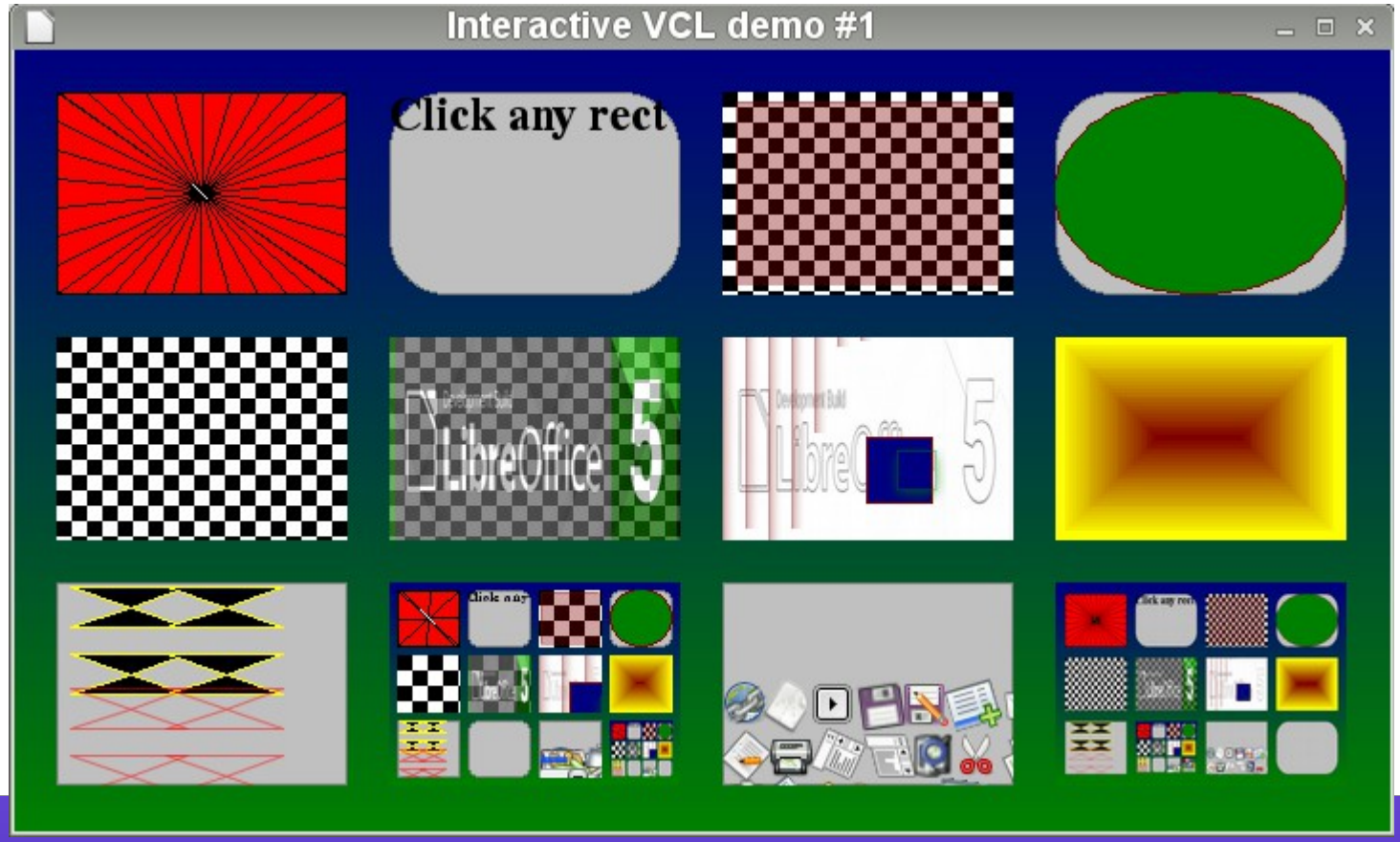
- Can implement UNO interfaces directly in a Window
  - No helpful templates yet, but – shouldn't need a separate proxy object
    → de-bloat accessibility peers.
- Ultimately more stable, reliable & defensive code.
  - Multiple disposeAndClear's are fine.
  - found & fixed a good number of leaks while porting.
- Everything is now my fault ...
  - Previously it was Caolan's (wrt. layout work)
  - cf. VclPtr regression from ~LibreOffice 4.2 ...

VclDemo

Had no good, small test-app

$ bin/run vcldemo

- Built as part of the OpenGL work …



OpenGL rendering ...

Lots of work here ...

- 2.1 man years in the last year from Collabora
- Where is the code ?
  - vcl/source/opengl
    - OpenGLContext – management ...
  - vcl/opengl/*
    - Implements VCL / GDI backend etc.
  - vcl/opengl/win/ or unx/
    - Windows / Unix specific platform / GL backends
- Why so long ?

OpenGL's API is appalling ...

- Global (varible) state …
  - Is a complete nightmare.
  - Encourages the most horrible programming
  - Hides the most vicious bugs.
- Getting performance is 'fun'.
- Heavily using framebuffers to avoid GL context switching.
- Thanks so much to:
  - *Louis-Francis Ratté-Boulianne, Markus Mohrhard, Tomaž Vajngerl, Luboš Luňák, Jan Holesovsky, Tor Lillqvist, Marco Cecchetti, Miklos Vajna, Lubosz Sarnecki and others ...*

Using modern OpenGL

- Shaders
  - Mini C-like programs → run on a very odd processor per-pixel.
  - Arbitrary Alpha blending algorithms eg.
  - Almost 'free' work ...
- Texture atlas (Tomaz)
  - Managing a single large texture for our icons – handing out patches of pixels.

Using modern OpenGL

- Shaders – clever hacks for Anti-aliased lines:
  - Thanks to Chris Tsang:
  - http://artgrammer.blogspot.com/2011/05/drawing-nearly-perfect-2d-line-segments.htm
    http://www.codeproject.com/KB/openGL/gllinedraw.aspx
- Essentially rendering gradients along the edge of lines.
- And Lubos Lunak for implementing this.

Reducing texture up-loads

- Font rendering … (Tor)
  - Splitting UniScribe font rendering into:
    - Render (runs of) glyphs to bitmaps
    - Compose these into a single OpenGL texture.
  - Rendering text is:
    - foreach-glyph:
      - “alpha-blend <x,y,w,h> → there”
- Improves performance nicely.
  - Creates space for Glyphy
    - → glyph rendering mostly on the GPU, on-demand.

GPU for CRC calculation

- To de-duplicate images internally
  - We use(d) a CRC32 → not ideal collision-wise
  - Switched to CRC64T (ish)

	CPU	GPU
1Mpix	4.8ms	2.8ms
6Mpix	37ms	10ms

Consider a document with 100x images:
37ms → 3.7s

  - Leaves image data on the GPU until the last minute.
  - 2x pass successive 16x reduction → CPU.
  - CRC unit tests added
  - Thanks to Marco Cecchetti

Gtk3 ...

(Caolan's talk tomorrow)

VCL: the future …

at least my (un-funded) ideas …

Cleanups

- Killing split alpha:
  - RGB + (1bit ? 8bit A) → RGBA everywhere
    - Avoid hitting all these odd driver paths.
    - Drastically simplify & improve performance of code.
  - Code-wise; a big change:
    - audit all BitmapEx usage
    - remove BitmapEx vs. Bitmap.
  - Kill 1bit pixel formats …
- Kill under-window store / restore ...

Wider Cleanups

- Push classes down into VCL
  - Lame VCL widget → less lame svx widget
  - no-one else uses VCL → we should avoid pointless inheritance for specialization
- Slideshow re-work
  - Lots of horrible hacks-around old VCL problems
  - Now we have high-resolution timers

    → bin the custom thread & main-loop there.
  - De-UNO-ise some of the fluff in here ...

More changes

- Continued Idle re-work
  - Unifying sources & timeouts/idle with priorities
  - Currently main-loop special-cases some input / event posting means.
  - Moving more things to low prio. Idle from timeouts. eg. sfx2 / toolbar updates.
- LibreOfficeKit / CloudSuite
  - Pre-initializing → glyph caching / pre-render etc.
- Stubbing font / layout → unit testing ...

OpenGL work ...

- VirtualDevice – construction: always a 1x1
  - Reducing texture up-loads
- Glyphy → Markus has great plans …
  - Beautiful SDF text rendering with transforms.
- Keeping geometry on the GPU
  - Currently re-tesselate & re-up-load constantly.
- Move 'image insensitization' to GPU ...
- Double buffering → get it on.
- Reduce duplicate working left & right ….
- glFlush optimization ...

Conclusions

- VCL:
  - A huge amount of work in the last year.
    - please be patient as it beds down ...
  - Major performance wins & long-term swamp draining
  - Fitting us for the deep cross-platform future.
- All executed alongside the community
  - Without you, it couldn't be done & it wouldn't be fun.
- Interested in helping out
  - Mail me / grab me on IRC ...

Oh, that my words were recorded, that they were written on a scroll, that they were inscribed with an iron tool on lead, or engraved in rock for ever! I know that my Redeemer lives, and that in the end he will stand upon the earth. And though this body has been destroyed yet in my flesh I will see God, I myself will see him, with my own eyes - I and not another. How my heart yearns within me. - Job 19: 23-27