COOL performance

making collaboration slick & quick.

By Michael Meeks

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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

Outline

Basics of how COOL works

LibreOffice core Technology

- Wiggly lines

COOLWSD / Kit

- I/O and queueing

Javascript:

- Websocket
- String / Image handling & async
- DOM mutation
- JQuery / Select2

Profiling, tools & future

How Collabora Online (COOL) works:

Browser

- Thin Javascript.
- Overlays for cursor / selection etc.
- Pan / zoom interpolation / shape overlays for fluid movement

WSD

- Web Services Daemon – multiplexes all messages to/from the Kit

Kit

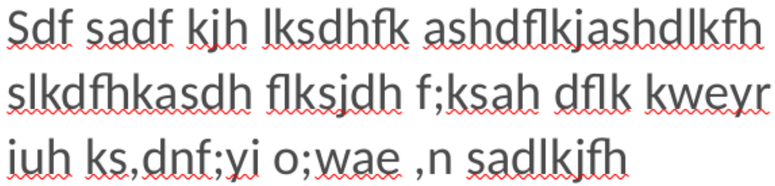
- A securely contained & isolated LibreOffice
- Streams 'tiles' to the client as PNG images
  - has view of whole document: unusually zoomed out.
  - Has multiple views – one per user.

User

- cognitive biases & perceptual fun.

LibreOffice core Tech.

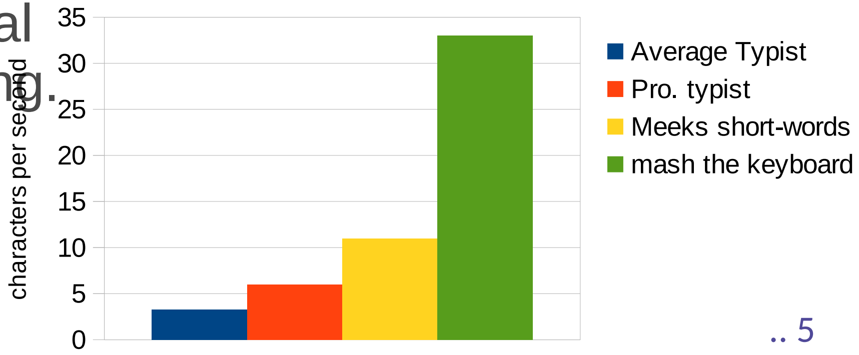
Performance Testing & typing ...

- Customer feedback: *“we tested it with eight people doing random typing”*
- Profiled this use-case; it is/was slow
  - The mis-spelling squiggly-line (cf. wrong language setting?) ...
    - an unfeasible amount of CPU ~90% of rendering time
    - A most beautiful sub-divided, AA b-spline but … ~2 pixels high mostly.
    - Fixed in 6.4.10
- Mashing the keyboard a pathological case: we’re still working on improving.
- 

  Sdf sadf kjh lksdhfk ashdflkjashdlkfh slkdfhkasdh flksjdh f;ksah dflk kweyr iuh ks,dnf;yi o;wae ,n sadlkjfh

Mashing the keyboard as a test

~10x as bad as reality



JSON generation

Lots of events generate JSON

- Particularly side-bar & dialog – description of widgets:
  - Looots of JSON: DumpAsPropertyTree
- Switch from:

```
-boost::property_tree::ptree DumpAsPropertyTree()
+void DumpAsPropertyTree(tools::JsonWriter& rJsonWriter)
```

- Instead of deep duplicating & returning ptree’s
- Implement a new JsonWriter
  - Ultimately a stream type interface anyway.
  - Disappears from the profile.
- *Thanks to Noel Grandin*

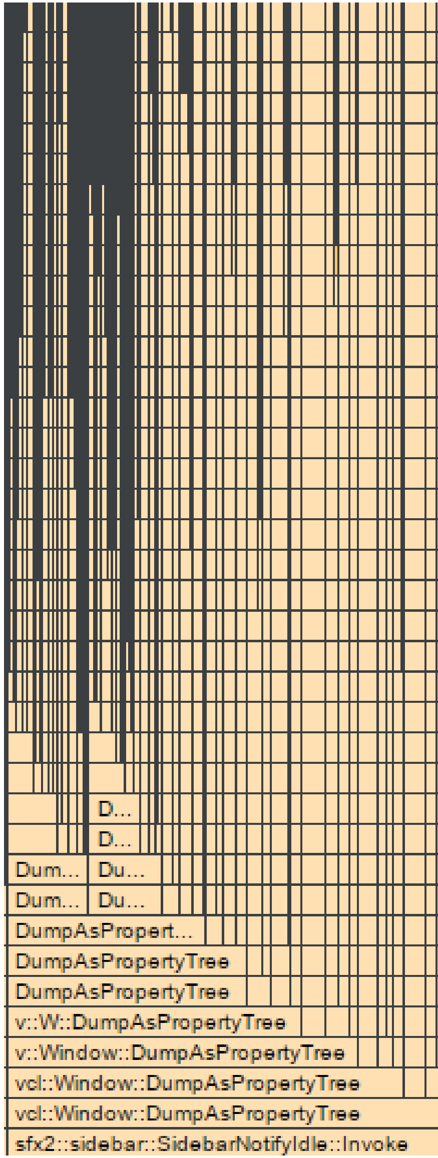


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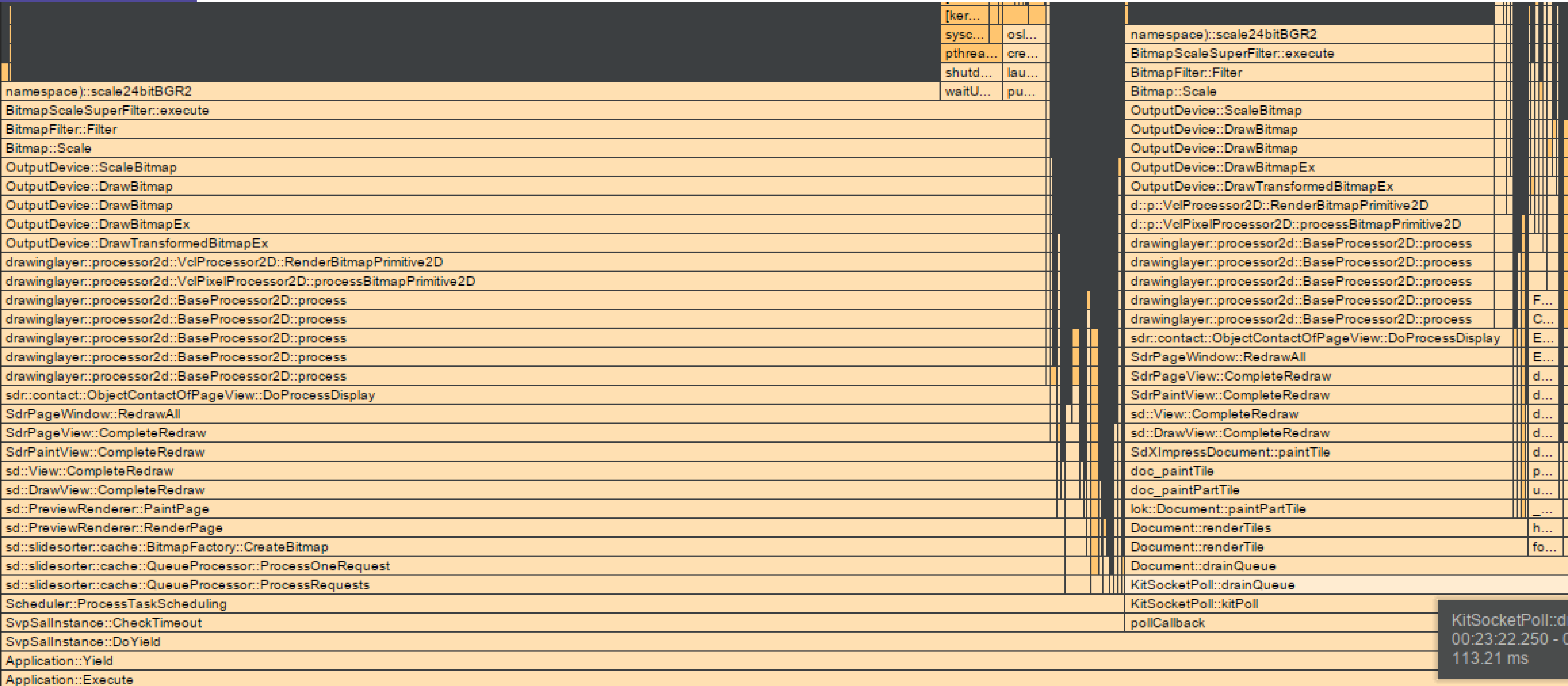
Image scaling & rendering



[ker…
sysc…
osl…
pthrea…
cre…
shutd…
lau…
waitU…
pu…
namespace)::scale24bitBGR2
BitmapScaleSuperFilter::execute
BitmapFilter::Filter
Bitmap::Scale
OutputDevice::ScaleBitmap
OutputDevice::DrawBitmap
OutputDevice::DrawBitmap
OutputDevice::DrawBitmapEx
OutputDevice::DrawTransformedBitmapEx
drawinglayer::processor2d::VclProcessor2D::RenderBitmapPrimitive2D
drawinglayer::processor2d::VclPixelProcessor2D::processBitmapPrimitive2D
drawinglayer::processor2d::BaseProcessor2D::process
drawinglayer::processor2d::BaseProcessor2D::process
drawinglayer::processor2d::BaseProcessor2D::process
drawinglayer::processor2d::BaseProcessor2D::process
drawinglayer::processor2d::BaseProcessor2D::process
sdr::contact::ObjectContactOfPageView::DoProcessDisplay
SdrPageWindow::RedrawAll
SdrPageView::CompleteRedraw
SdrPaintView::CompleteRedraw
sd::View::CompleteRedraw
sd::DrawView::CompleteRedraw
sd::PreviewRenderer::PaintPage
sd::PreviewRenderer::RenderPage
sd::slidesorter::cache::BitmapFactory::CreateBitmap
sd::slidesorter::cache::QueueProcessor::ProcessOneRequest
sd::slidesorter::cache::QueueProcessor::ProcessRequests
Scheduler::ProcessTaskScheduling
SvpSalInstance::CheckTimeout
SvpSalInstance::DoYield
Application::Yield
Application::Execute
namespace)::scale24bitBGR2
BitmapScaleSuperFilter::execute
BitmapFilter::Filter
Bitmap::Scale
OutputDevice::ScaleBitmap
OutputDevice::DrawBitmap
OutputDevice::DrawBitmap
OutputDevice::DrawBitmapEx
OutputDevice::DrawTransformedBitmapEx
d::p::VclProcessor2D::RenderBitmapPrimitive2D
d::p::VclPixelProcessor2D::processBitmapPrimitive2D
drawinglayer::processor2d::BaseProcessor2D::process
drawinglayer::processor2d::BaseProcessor2D::process
drawinglayer::processor2d::BaseProcessor2D::process
drawinglayer::processor2d::BaseProcessor2D::process
drawinglayer::processor2d::BaseProcessor2D::process
sdr::contact::ObjectContactOfPageView::DoProcessDisplay
SdrPageWindow::RedrawAll
SdrPageView::CompleteRedraw
SdrPaintView::CompleteRedraw
sd::View::CompleteRedraw
sd::DrawView::CompleteRedraw
SdXImpressDocument::paintTile
doc_paintTile
doc_paintPartTile
lok::Document::paintPartTile
Document::renderTiles
Document::renderTile
Document::drainQueue
KitSocketPoll::drainQueue
KitSocketPoll::kitPoll
pollCallback
F…
C…
E…
E…
d…
d…
d…
d…
d…
p…
u…
_…
h…
fo…
KitSocketPoll::d
00:23:22.250 - 0
113.21 ms

Continual re-scaling of bitmaps

We had a nice image scaling cache:

- Problem: only caches one size per image
- For (random) reasons: not working nicely on Android.
- Now we have a multi-resolution scaled image cache:
  - Hugely faster, particularly for large zoom-out

Online

- Now we scale the cache size based on the number of open views
- Great for multiple users at different zooms
- *Thanks to Lubos Lunak*

Pointless ~O(n^3) in SwRegionRects

SwRegionRects::Compress()

- Notionally saves effort & space by compressing invalidated rectangles together.
- Particularly problematic with COOL – since the document is always visible in a gigantic pseudo-view.

Now only ~O(n^2) in number of regions

- https://gerrit.libreoffice.org/c/core/+/122121

Thanks to Lubos Lunak

Should accelerate all large writer documents with complex invalidations.

Calc: ScDocument::GetPrintArea

Called surprisingly often

- Switching views, when re-rendering a region etc.

Pixel area dependent on zoom

- Row heights vary in real height based on zoom level
    - But all look the same height.

So – scan from the beginning ...

Cost is all in:

- ScTable::GetRowForHeight(sal_uLong nHeight)

Now massively faster

- Walks both ‘hidden’ and ‘height’ span-trees concurrently – in jumps.
- Instead of iterating row by row.

And much more in core ...

Noel Grandin's work

- Endless profiling & improvement:

Lots of misc other pieces

- Faster file opening
- Better font caching to accelerate text rendering
- Quicker scrolling
- Quicker spreadsheet filtering
- Faster large chart insertion/setup

Don't paint to windows

- In LOK mode we used to often calculate & paint to an invisible 1x1 pixel window
- Avoid repeated writer layout calls too.

Detail overload ...

Web Service Daemon / Kit

Shuffling vectors …

Buffering outgoing socket data: std::vector<char>

- Transmit from the beginning and then erase(begin(), begin() + sentBytes)
- Unfortunately: SSL: 16k max writable chunks
- 20Mb images / document downloads common
- Shuffling ~10Mb average - 1200x times down a vector – not fast.

Buffer class

- Wrap a std::vector<char>
- Don’t erase – have an offset: send 1Mb at a time before shuffling
  - bingo – 64x faster.

STL / Android amazement

STL on Android is abysmal

- Thankfully we no longer have to binary-patch it at run-time; but …

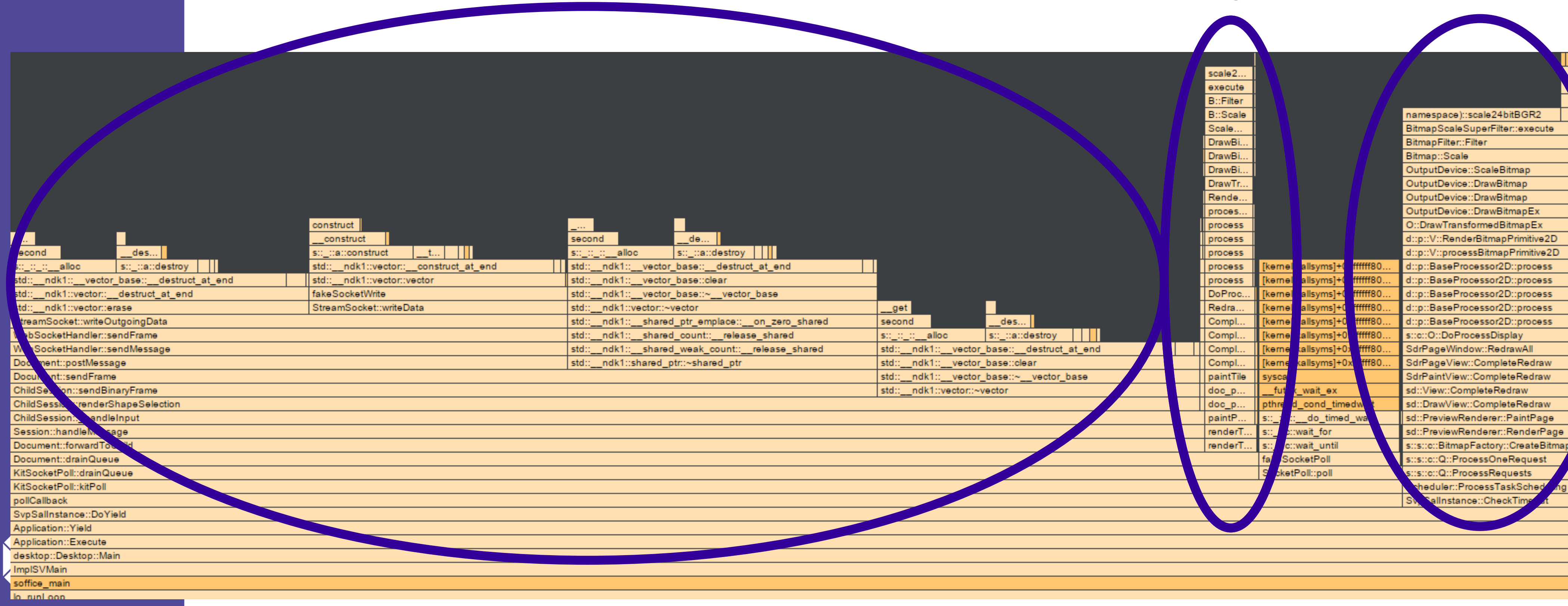
vector::~vector<char>

- Very high on the profile – doing some ‘0’ assignment in a loop while destroying ?
- allocation – understandably slow – but freeing [!] …
- More time spent allocating, wiping & freeing std::vector<char>
- Than rendering document content: huh !
- calloc buffer to render into instead.

And here it is:

Android std::vector <char> folly:

Scaling bitmaps,
rendering tiles etc.



Merge key-events

Under heavy-load

- Can’t process key-events in the time they come in:

Input event compression:

- Kill un-necessary keyup events, then:

```
child-foo textinput id=0 text=f
child-foo textinput id=0 text=o
child-foo textinput id=0 text=o  → Turn it into:
child-foo textinput id=0 text=foo
```

- So we can catch-up … (also for removetextcontext (backspace/delete) events)
- *Thanks to Tor Lillqvist.*

Asynchronous save ...

Previously

- Paused all document editing during save + up-load

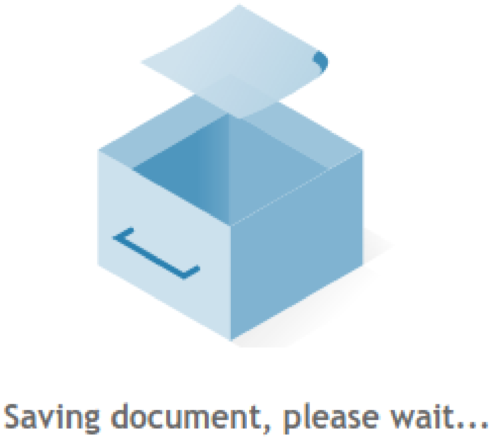
Up-load

- Thought to be fast: data-center ↔ data-center internal network link & storage.
- But ... some backends: several seconds
- So re-worked to continue editing while we up-load.
- *Thanks to Ashod Nakasian*

Solves autosave 'stalls' while typing

Even so some things sync still:

- Rename for example
- So be pretty there:



Saving document, please wait...

Javascript

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End to end profiling

Catching badness across the board

- Found that we had been optimizing the wrong piece.
- So implemented a new end-to-end profiler.

Core: ProfileZone

- Passing data back from Kit → WSD

JS: TraceEvent logging

- Passing data back from browser → WSD

WSD:

- ProfileZone code too.

To enable:

- Tripple-click in Help→About
- [x] Performance Tracing
- Needs: trace_event[@enable] config option in loolwsd.xml.

Visualize:

- Load trace in chrome://tracing

Thanks to Tor Lillqvist

Profiling: Javascript – the surprise

We thought JS in the browser is fast

- We obsessed about network latency & server-side performance.
  - We were mostly wrong.
  - (though lots of sillies on the server-side too ...)

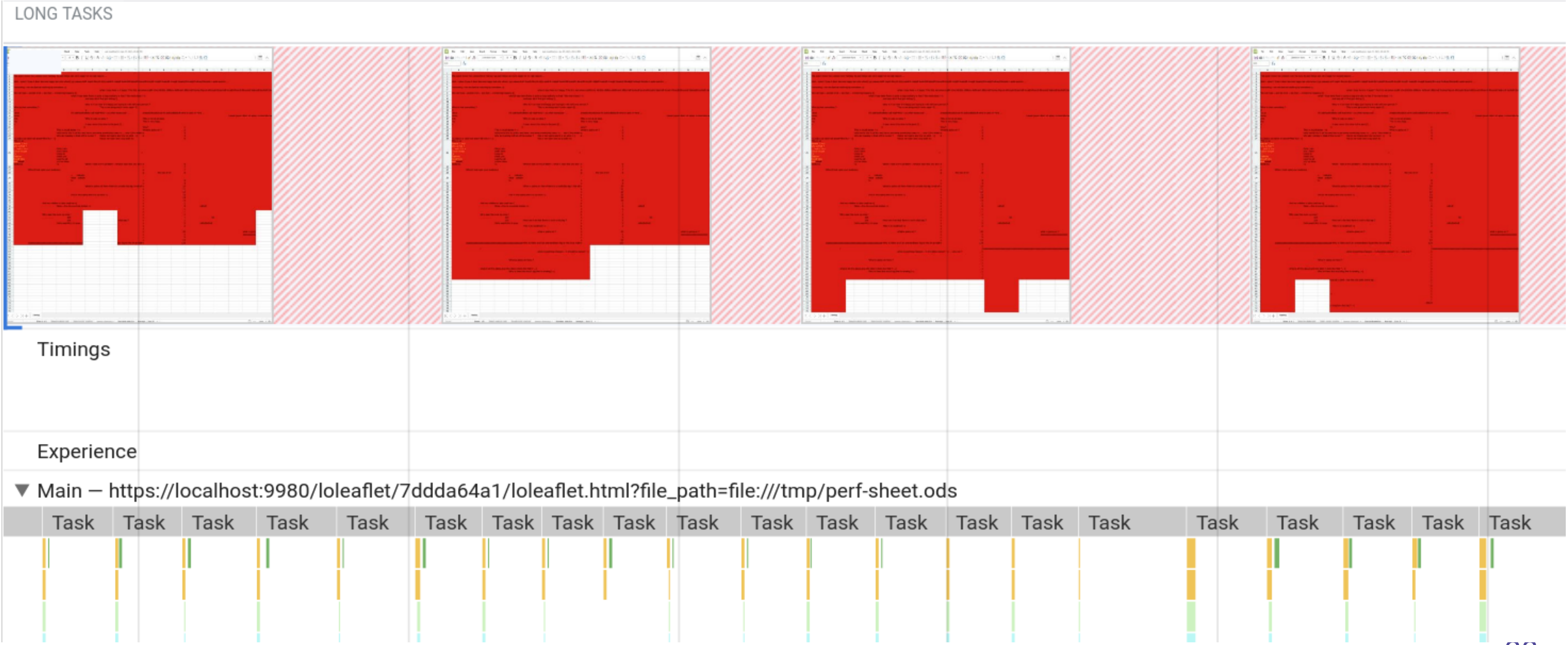
Please be careful with your JS

- DOM mutation, Canvas re-rendering, ‘elegant’ code using unusual libraries.

Watch each tile render: (spreadsheet with red background)

Websocket messages processed one by one at idle …

do a re-render → we see an animation of each tile rendering



Simple solution: (worth avoiding Promises too?)

```
// The problem: if we process one websocket message at a time, the
// browser -loves- to trigger a re-render as we hit the main-loop,
// this takes ~200ms on a large screen, and worse we get
// producer/consumer issues that can fill a multi-second long
// buffer of web-socket messages in the client that we can't
// process so - slurp and the emit at idle - its faster to delay!
_slurpMessage: function(e) {
    var that = this;
    if (!this._slurpQueue || !this._slurpQueue.length) {
        this._queueSlurpEventEmission(); // process in 1ms timer
        that._slurpQueue = [];
    }
    this._extractTextImg(e);
    that._slurpQueue.push(e);
},
```

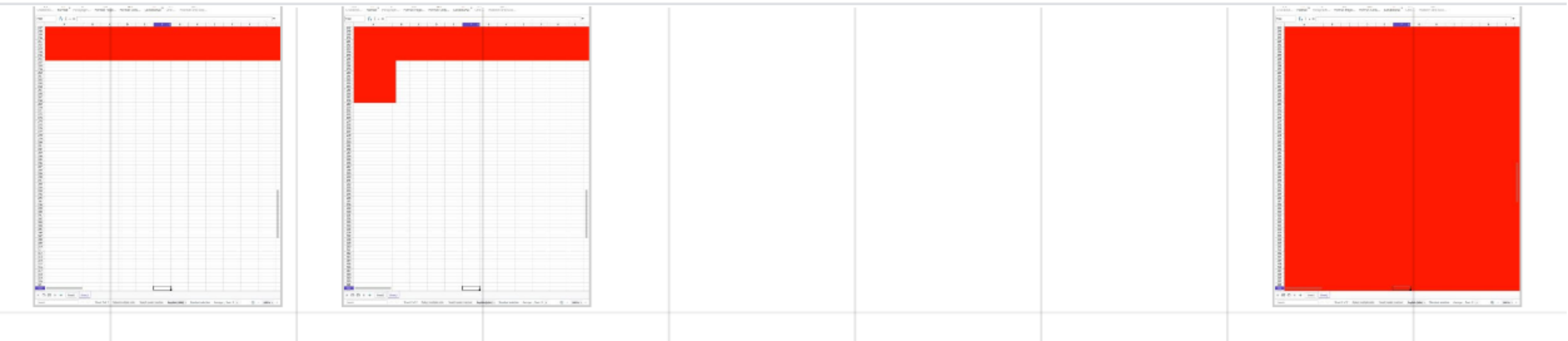
Same problem with async image load from .src=<base64 URL>

Event emission:

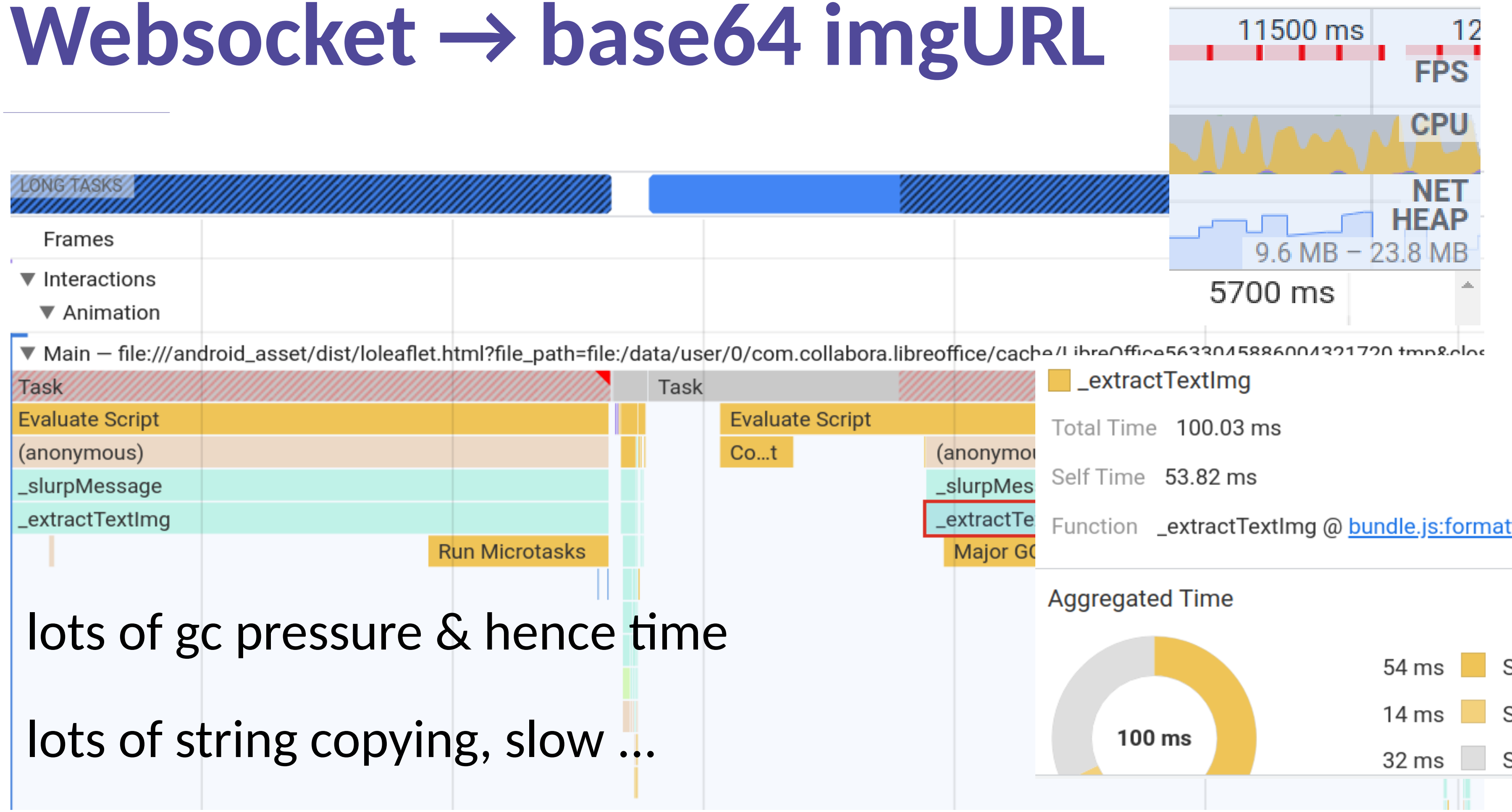
```
_emitSlurpedEvents: function() {
    this._map._docLayer.pauseDrawing();

    try {
        for (var i = 0; i < queueLen; ++i) {
            var evt = this._slurpQueue[i];

            if (evt.isComplete()) {
                try {
                    // it is - are you ?
                    this._onMessage(evt);
                }
```



Websocket → base64 imgURL



▼ Main — file:///android_asset/dist/loleaflet.html?file_path=file:/data/user/0/com.collabora.libreoffice/cache/LibreOffice5633045886004321720.tmp&clos

_extractTextImg

Total Time 100.03 ms

Self Time 53.82 ms

Function _extractTextImg @ bundle.js:format

Aggregated Time

lots of gc pressure & hence time

lots of string copying, slow …

Before code:

```
// read the tile data
var strBytes = '';
for (var i = 0; i < data.length; i++) {
    strBytes += String.fromCharCode(data[i]);
}
img = 'data:image/png;base64,' + window.btoa(strBytes);
```

After code:

```
// convert to string of bytes without blowing the stack if data is large.
_strFromUint8: function(data) {
    var i, chunk = 4096;
    var strBytes = '';
    for (i = 0; i < data.length; i += chunk)
        strBytes += String.fromCharCode.apply(null, data.slice(i, i + chunk));
    strBytes += String.fromCharCode.apply(null, data.slice(i));
    return strBytes;
},
…
img = 'data:image/png;base64,' + window.btoa(this._strFromUint8(data));
```

Invisibly repeating the same work.

Now we: delay all the cursor related onScrollTo work / etc. until we have processed our whole incoming queue

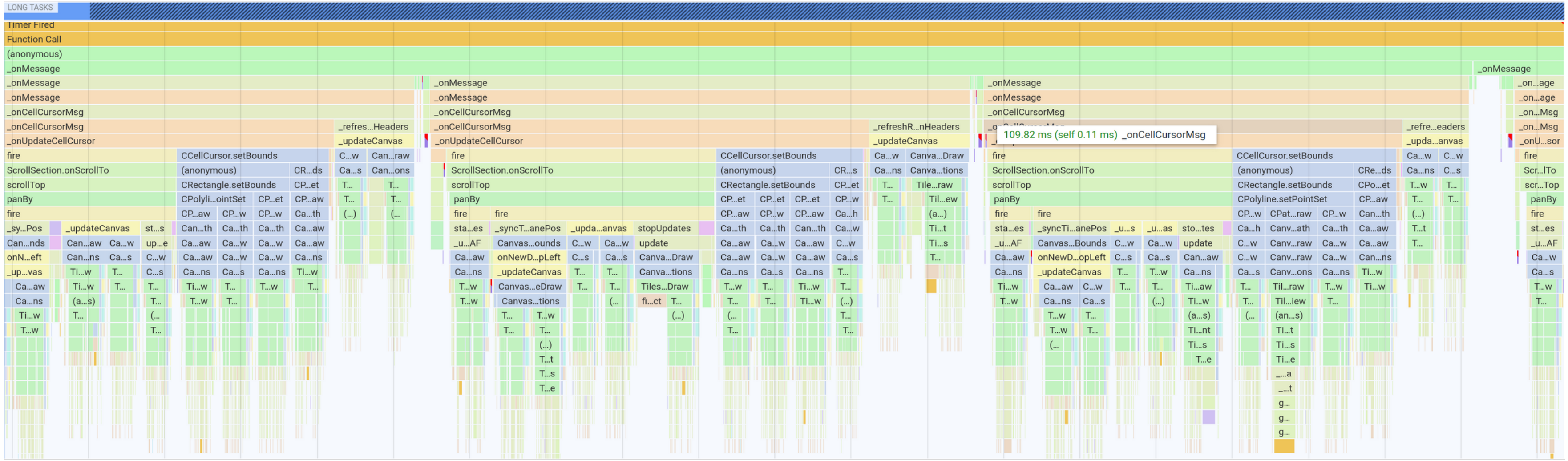
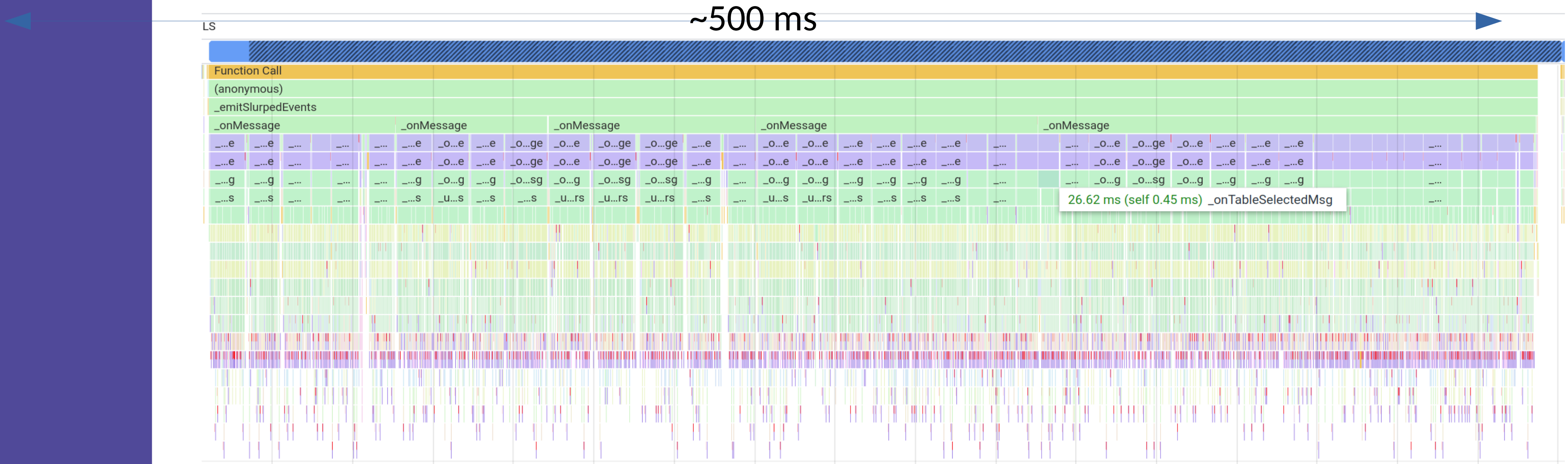
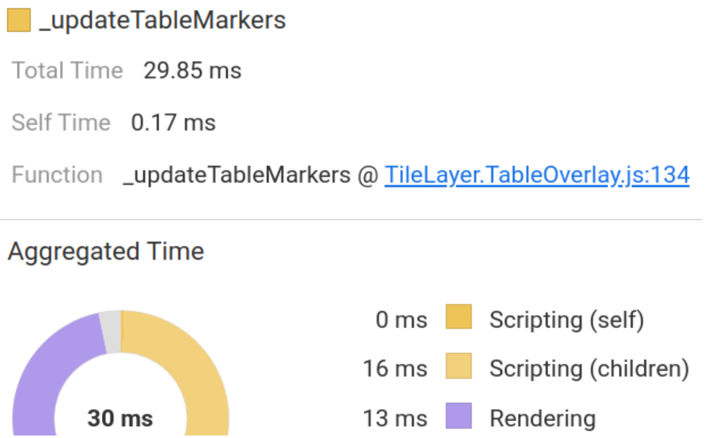


Table handle DOM mutation



We were continually re-creating & destroying table handles for multiple redundant tableselected messages:

15x faster do it just once.



🟨 _updateTableMarkers

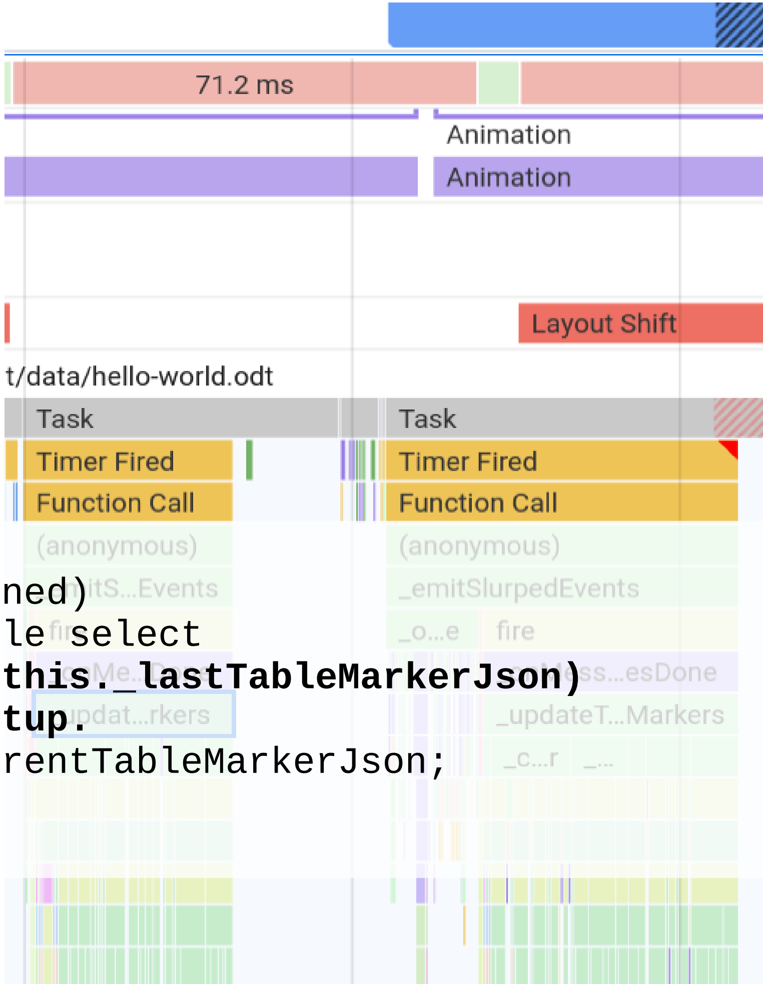
Total Time 29.85 ms

Self Time 0.17 ms

Function _updateTableMarkers @ TileLayer.TableOverlay.js:134

Aggregated Time

0 ms	🟨	Scripting (self)
16 ms	🟨	Scripting (children)
13 ms	🟪	Rendering



```
_updateTableMarkers: function() {
        if (this._currentTableData === undefined)
                return; // not writer, no table select
        if (this._currentTableMarkerJson === this._lastTableMarkerJson)
                return; // identical table setup.
        this._lastTableMarkerJson = this._currentTableMarkerJson;
```

avoid destroying & re-creating identical table handles

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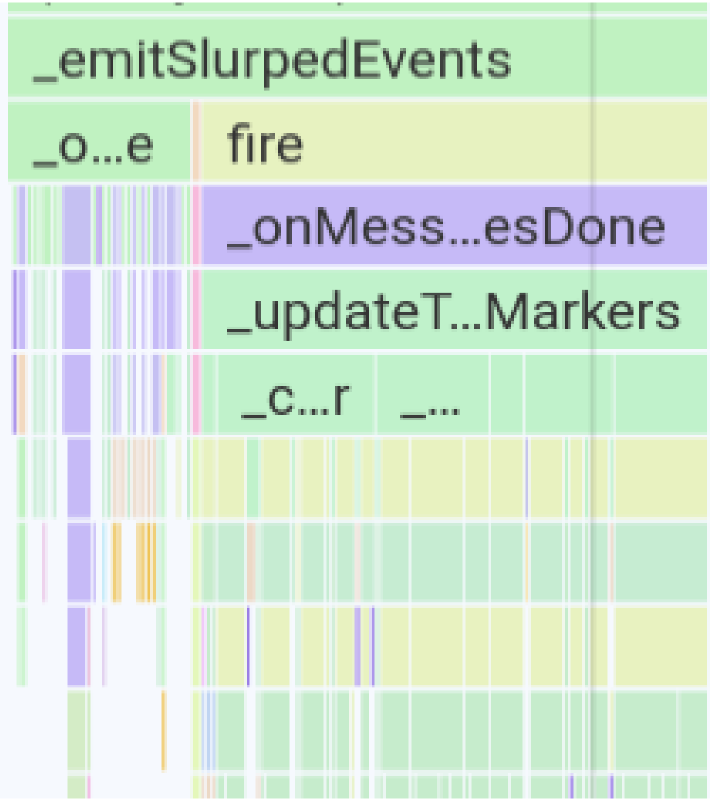
‘messagesdone’ to do it right easily:

New ‘messagesdone’ event

- fired when we have emitted all complete slurped messages
- If you’re updating view-state, re-render once at the end …



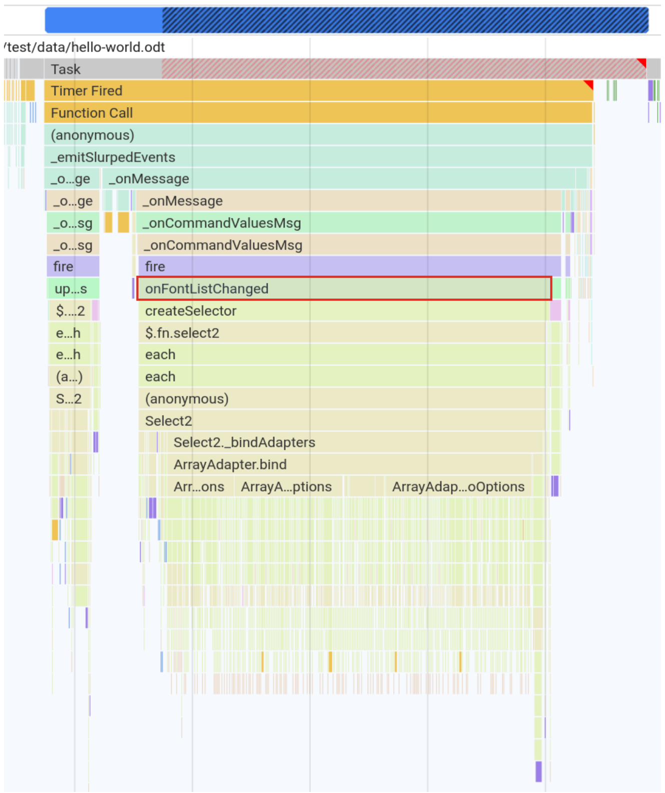
JQuery plugin thrash:

Select2 → argh !

- That 31337 new JQuery plugin
- **800ms** on startup of thrash
- Saw this with jsdom → noticed it … ~5s+ of CPU time

Thanks to Mert for fixing it

- Using native JS now



Calc: client side rendering ...

Spreadsheets

- Header / row column sizing
  - Replicate the rounding nightmare in the client to avoid sending it later

Render grid-lines on the client

- Instant <ctrl>-<down-arrow>
- Possible to do some cursor movement locally too in future.
- Potentially render ‘cell’ tiles.

Ongoing Work ...

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Deltas ...

private/mmeeks/deltas

- Monotonic tile-id updates
- Diff tiles to previous versions & send a binary patch → Time compression.
  - Deflate too
  - Inflate in JS
  - big B/W reduction.

CanvasSections:

- dirtying – to avoid re-paint

Better JS usage

- Async loading of images:
  - Horribly slow
  - Can't be controlled / sequenced by JS
- Seems better to unpack pixels & send to Canvas manually
  - (amazingly)

Cursor / tile delta synchronization

Work ongoing – not yet merged.

Other in-progress wins

Reduce protocol thrash

- Avoid redundant notifications:
- eg. per key-stroke:

```
statechanged: .uno:LanguageStatus=English (USA);en-US
statechanged: .uno:InsertPageHeader={}
statechanged: .uno:InsertPageFooter={}
statechanged: .uno:Undo=enabled
statechanged: .uno:Orientation=IsPortrait
statechanged: .uno:TrackedChangeIndex=
tabstoplistupdate: {    "tabstops": ""}
```

Each change:

- Forces a spin of the browser main-loop to read from the websocket.
- On a ‘busy’ browser – adds lots of latency.

Others happen too fast:

- `statechanged: .uno:StateWordCount=3 words, 13 characters`

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Testing tools …

Perf-test

```
cd browser ; make perf-test
```

- Built on sample customer writer odt
- Plenty of complex tables, layout, text
- Runs Javascript as-is
  - jsdom, jscanvas
- Six concurrent users
  - Jump to a bookmark
  - Do random typing

Coolstress

```
./coolstress wss://localhost:9980
test/data/hello-world.odt
test/traces/writer-hello-shape.txt
```

- Loads a document, and replays a trace
  - cf. test/traces for sample editing sessions
- Approximates responses of JS client
- Very scalable – easy to run 300 simulated clients at once & measure latency / metrics.

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Conclusions: much faster

Much improved performance work for Collabora Online

- Lots of this in LibreOffice 7.2, more coming in 7.3
- Much of it shipping in COOL 6.4.11, more just arrived in COOL 21.11

More work to do here

- more stress testing & profiling is underway
- We’re not even half way done yet.

Make Open Source ROCK

Thanks & Questions

By Michael Meeks

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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