EFL

Enlightenment Foundation Libraries

http://www.enlightenment.org

Architecture & Usage

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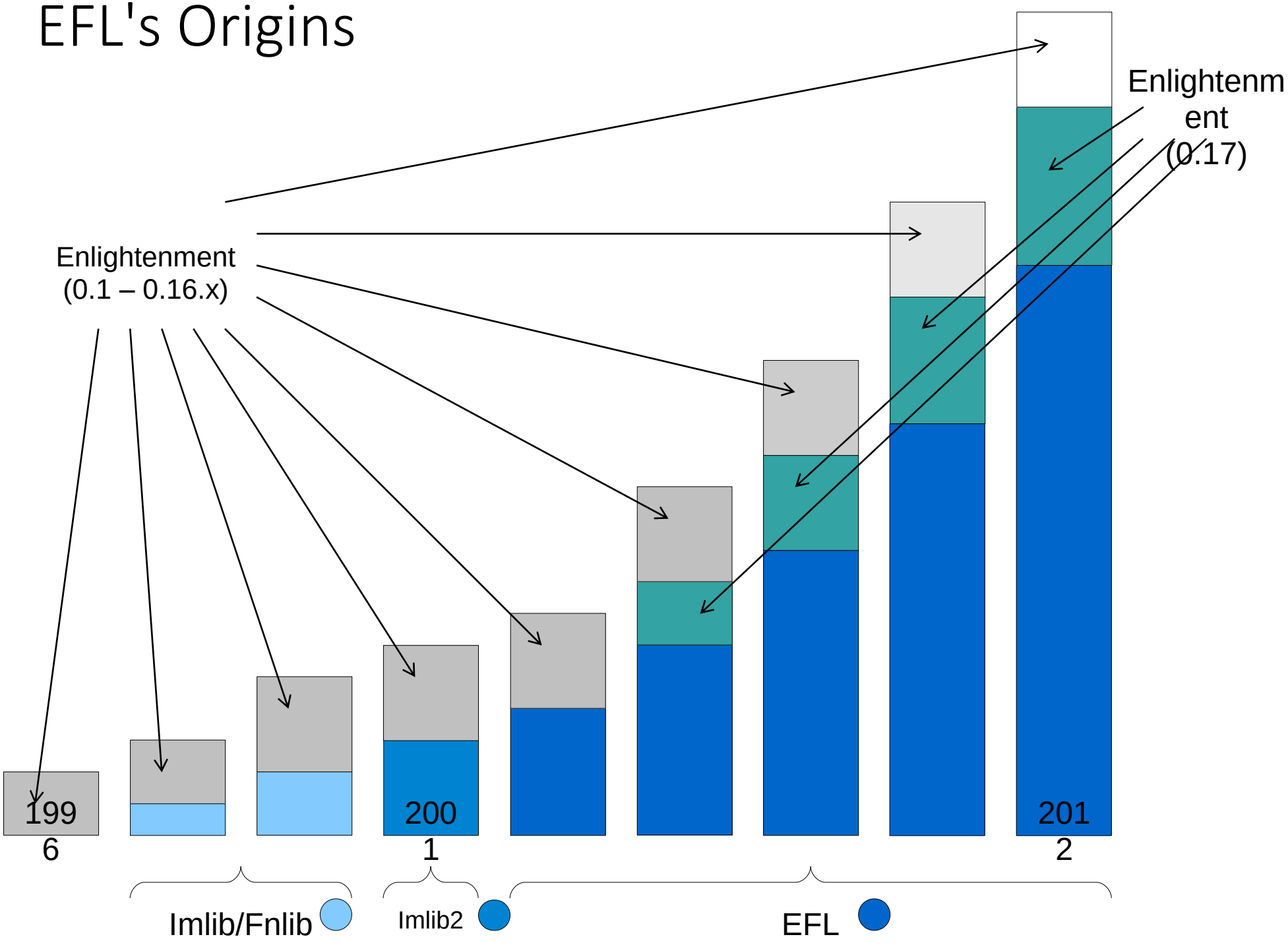
What is EFL?

- A collection of libraries
- Built by the same team working on Enlightenment
- Built for the purpose of making E17 (Enlightenment 0.17)
- Always focused on staying lean and still providing fanciness
- Almost all development focus sunk into EFL vs E17
- Cover a wide range of functionality due to broad needs
- 26% of code for E17 is E, rest is EFL.
- E17+EFL make up only 50% of code in SVN though

EFL's Origins



Historical Details

- 1996 – Enlightenment development started
- 1997 – Imaging layer split off into Imlib and Fnlib
- 1997 – Imlib adds GTK+/GDK support
- 1999 – Imlib2 combines images, fonts, alpha channels etc.
- 2001 – Evas (using Imlib2 and OpenGL) first appears
- And then EFL really began as more libs were added:
- Ecore, Ebits (later replaced by Edje), Edb (deprecated in favor of Eet), Eina, Embryo, Efreet, EDbus, Ethumb, Emotion, Elementary, Epdf, Eeze.

What's inside

- Canvas scene-graph (Evas)
- OpenGL, OpenGL-ES2.0, Software renderer and more
- Core mainloop, connection, input and glue libraries (Ecore)
- Data codec and storage (Eet)
- Bytecode VM (Embryo)
- Pre-made data objects with scripting, animation etc. (Edje)
- Freedesktop.org standards support (Efreet)

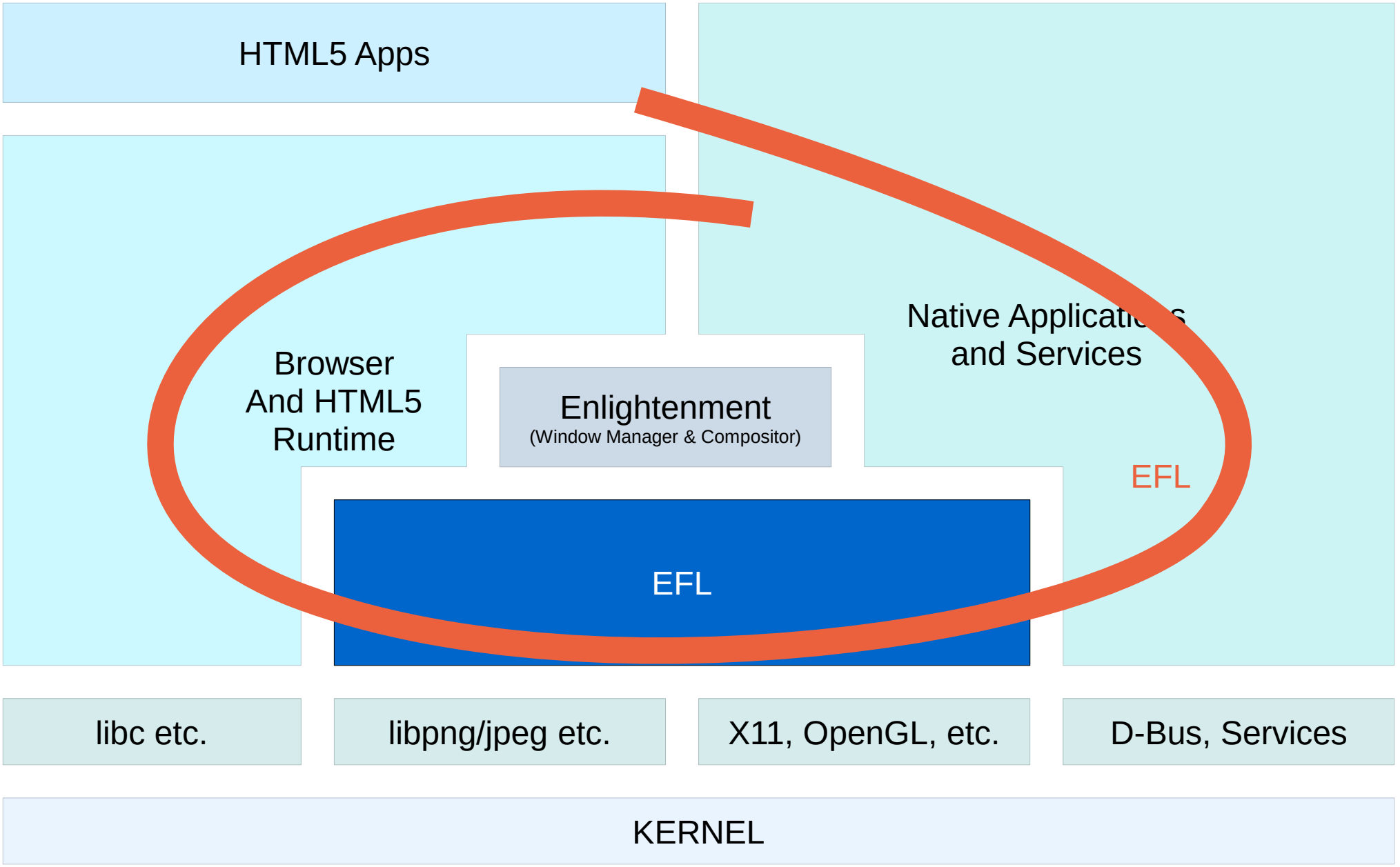
What's inside

- Data structure, modules and base (Eina)
- Dbus integration and wrapping (Edbus)
- Asynchronous I/O (Eio)
- Video playback glue (Emotion)
- Udev hardware detection (Eeze)
- Thumbnailer & cacher (Ethumb)
- Widgets & convenience (Elementary)

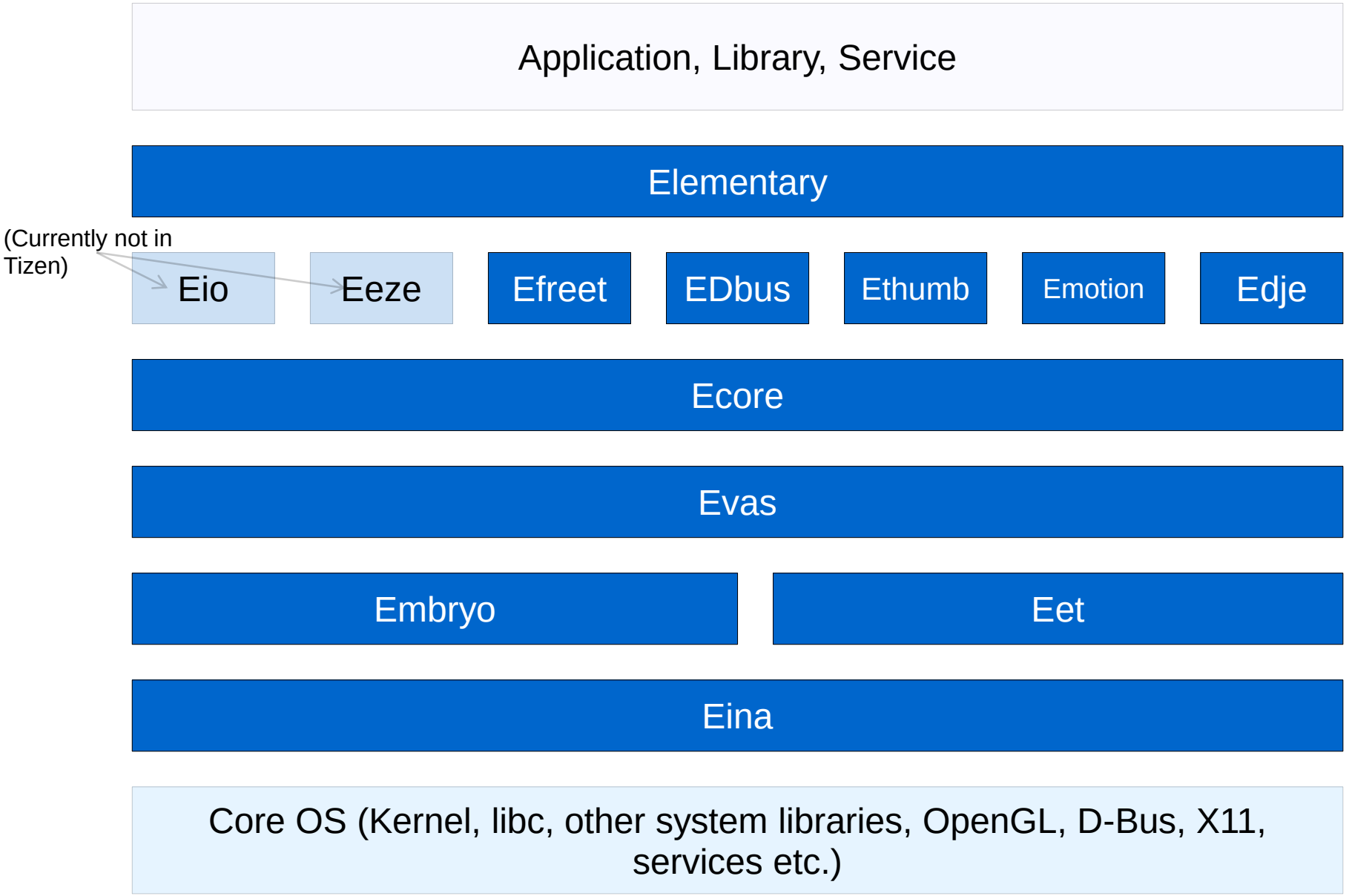
So why does this matter?

- EFL is the core toolkit being used in Tizen
- EFL is built for performance and low footprint
  - Still heavy focus on customization and power
- Native apps can use EFL as opposed to shipping their own toolkits
- Smaller footprint for shipping devices
- Continued support
- It's an open source project
- API's all in C, thus easily usable from both C and C++
  - Support for language bindings coming soon.

Where does it lurk?



Building Blocks



Why EFL?

- Why is EFL being used as opposed to GTK+ or Qt or something else?
- Speed
  - Samsung used GTK+, X11 and DirectFB (in combinations) and once EFL was tried, it soundly beat these hands-down in performance
  - Very fast software rendering (for all occasions)
  - Solid Accelerated OpenGL and OpenGL-ES2.0 support for many years
  - 60fps+ on common smartphones equaling android with higher quality

Why EFL?

- Why is EFL being used as opposed to
  - GTK+ or Qt or something else?
- Benchmarking based on failsafe X11 session (2011)
  - Unity – 168Mb
  - Enlightenment 0.17 – 65Mb
- Roughly similar features and setup
  - Compositor (OpenGL),
  - fullscreen wallpaper,
  - launcher, icons, filemanager, etc.

How is this relevant?

- Mobile devices ship with limited memory
- These devices almost never use swap
- Flash has limited writes, so swap can hurt device lifespan
- Lower end devices may not have GPU's
- Require decent software rendering to make up for it

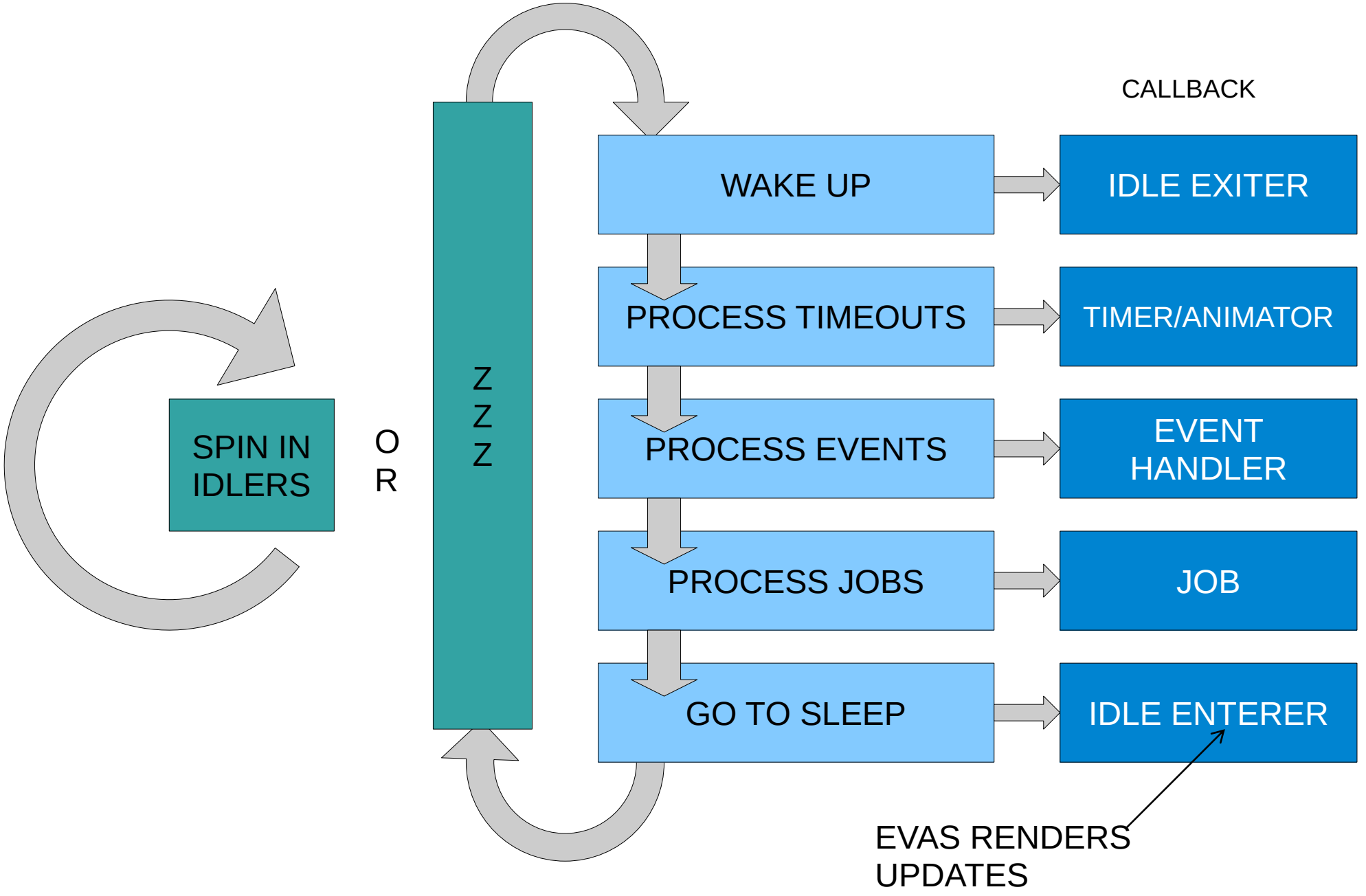
Samsung Z1
768 MB RAM
480 x 800 pixels (~233 ppi pixel density)

ECORE

Core concepts

- Event driven mainloop
- Rendering (UI)
- Application state management
- Small miscellaneous tasks (non-blocking)
- Support for threaded work
- Added thread models with mainloop begin/end blocks and mainloop call dispatch (from threads).
- More on threading
  - http://docs.enlightenment.org/auto/elementary/threading.html

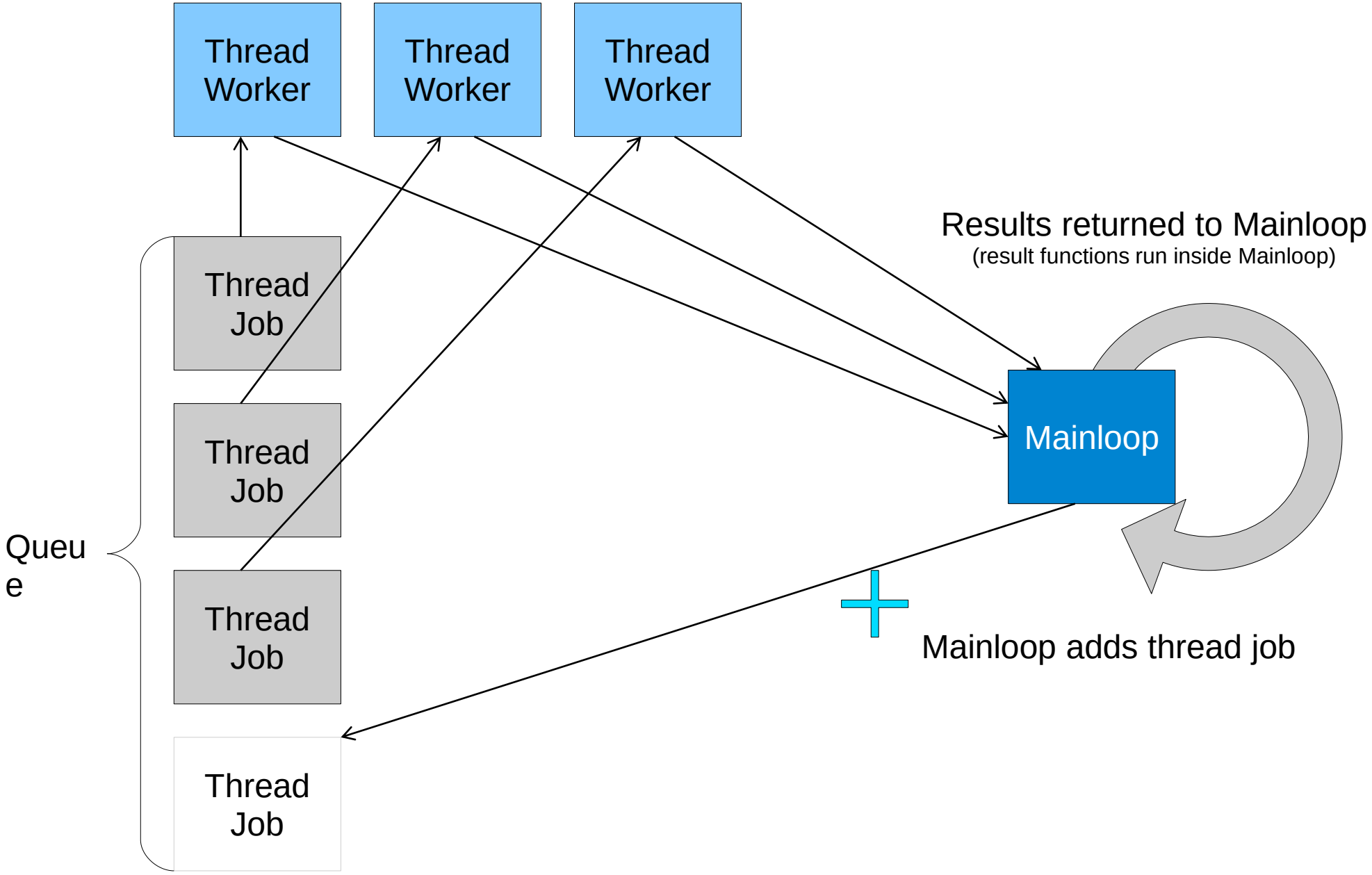
The Mainloop (Ecore)



To keep a smooth UI

- Put I/O work or heavy computation into threads
- Use the constructs provided to make this easy
- Keep state in Mainloop consistent
- Only deliver changes as a whole (UI tracks state)
  - automatic within mainloop
- Use Animators, not Timers for animation
- Remember that mainloop is for keeping application state
- Blocking it blocks state (and UI) updates

Threading the Mainloop (Ecore Thread)



Hello EFL

(in C)

```
#include <Elementary.h>
static void on_win_del(void *data, Evas_Object *obj, void *event_info) {
   elm_exit();
}
static void on_ok(void *data, Evas_Object *obj, void *event_info) {
   elm_exit();
}
int elm_main(int argc, char **argv) {
   Evas_Object *win, *box, *label, *button;
   win = elm_win_util_standard_add("main", "Hello");
   evas_object_smart_callback_add(win, "delete,request", on_win_del, NULL);
   box = elm_box_add(win);
   label = elm_label_add(win);
   elm_object_text_set(label, "Hello out there world");
   elm_box_pack_end(box, label);
   evas_object_show(label);
   button = elm_button_add(win);
   elm_object_text_set(button, "OK");
   elm_box_pack_end(box, button);
   evas_object_show(button);
   evas_object_smart_callback_add(button, "clicked", on_ok, NULL);
   elm_win_resize_object_add(win, box);
   evas_object_show(box);
   evas_object_show(win);
   elm_run();
}
ELM_MAIN();
```

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   evas_object_show(win);
   elm_run();
}
ELM_MAIN();
```

Hello EFL

(in C)

- `$ gcc hello.c -o hello `pkg-config --cflags --libs elementary``
- `$ ./hello`

EVAS

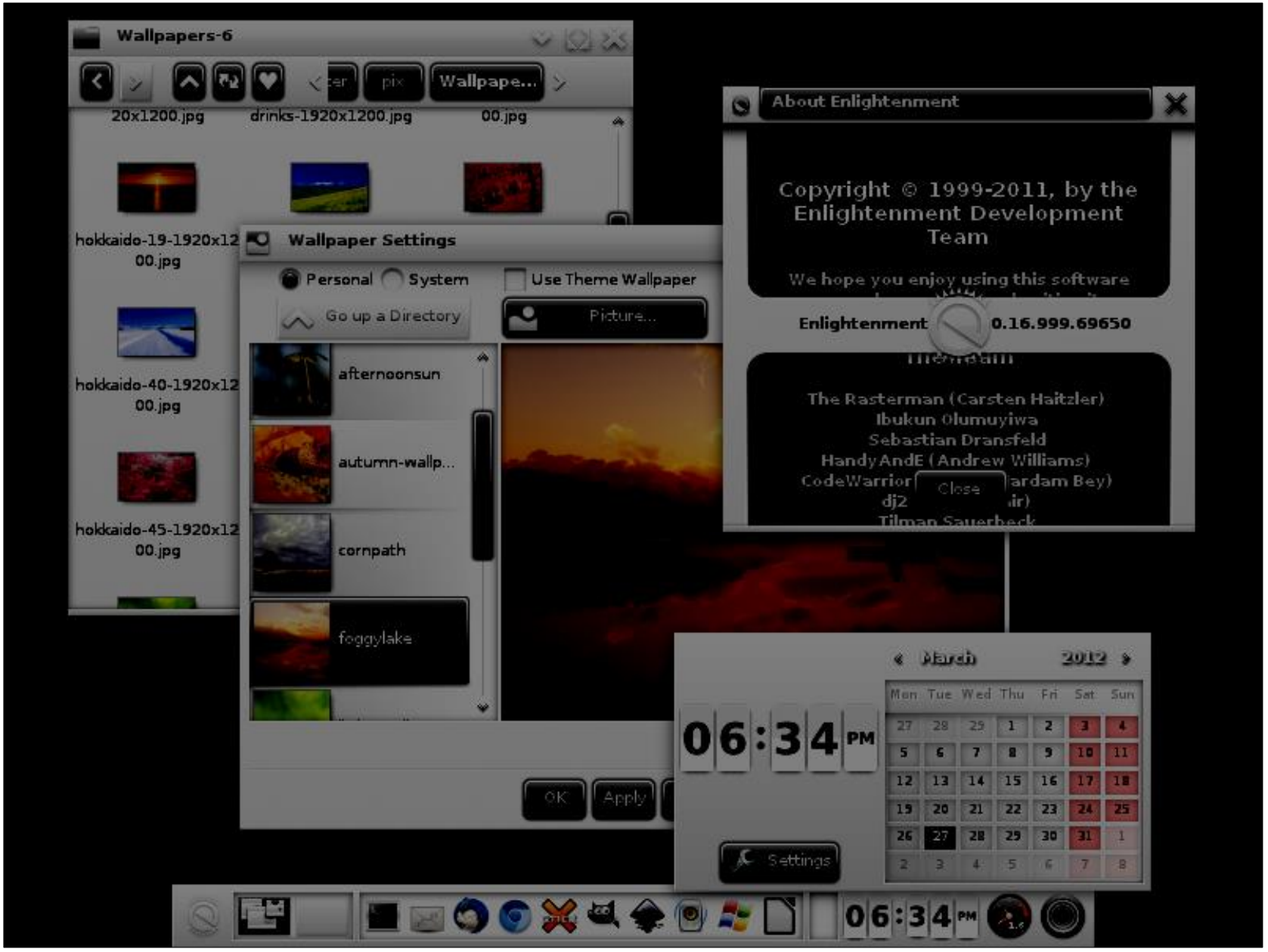
What is a scene graph? (Evas)

- Tracks state of all display objects
  - Position, size, visibility, color, properties etc.
- Handles rendering of each object
  - Loading fonts, images, rendering glyphs, scaling, fading etc.
- Handles minimizing of rendering
  - Only update areas changed
- If changes obscured, reduce to a NOP
  - Optimize rendering
- Abstract to OpenGL, software, or anything else

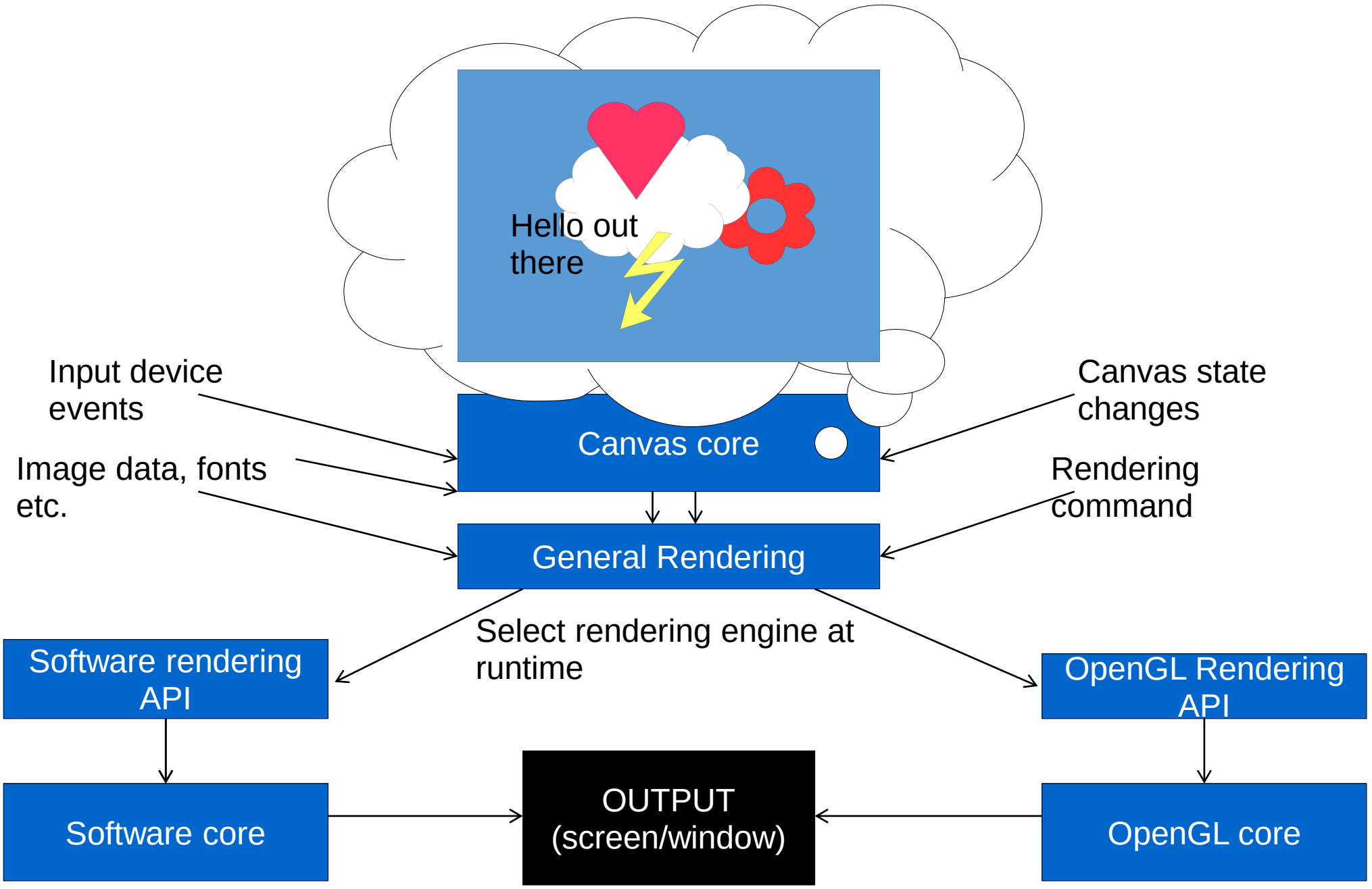
What is a scene graph? (Evas)

- Allows you to build your own composite objects
  - Creates parent/child relationship
- Is used throughout EFL to build widgets etc.
- Handles input direction and event callbacks
- Text formatting & layout

Putting together objects

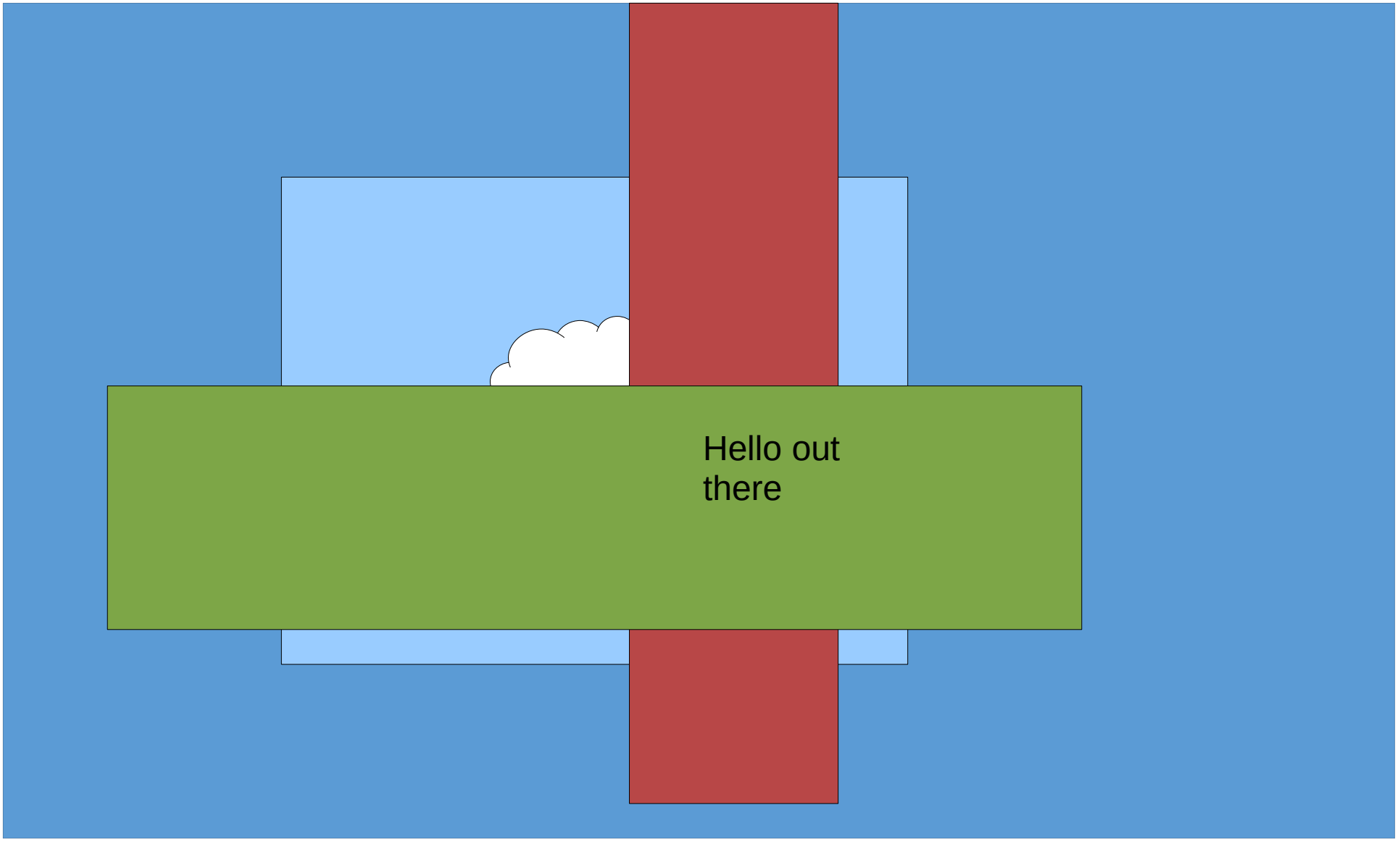


Abstracting rendering



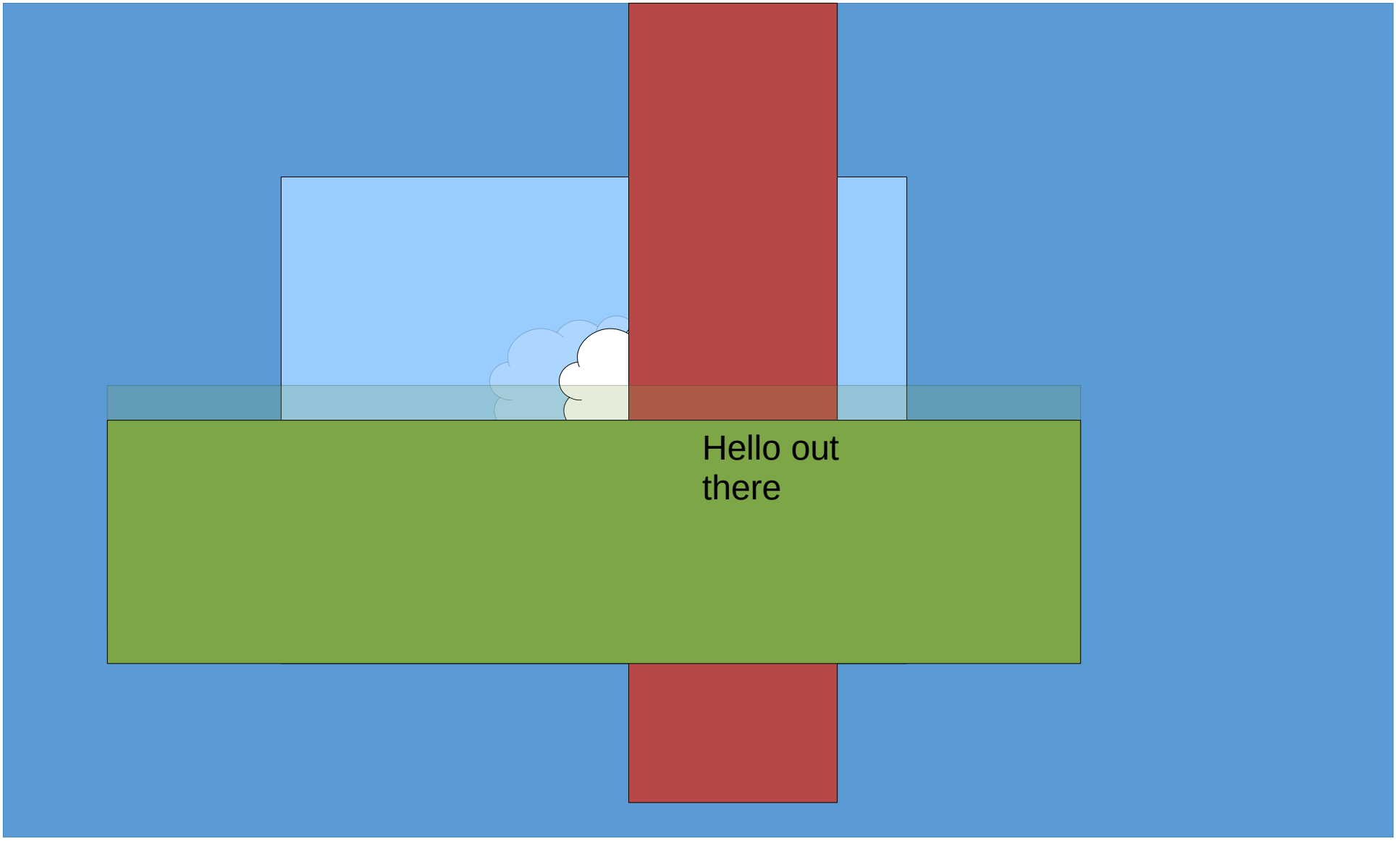
Automated update handling

Start here



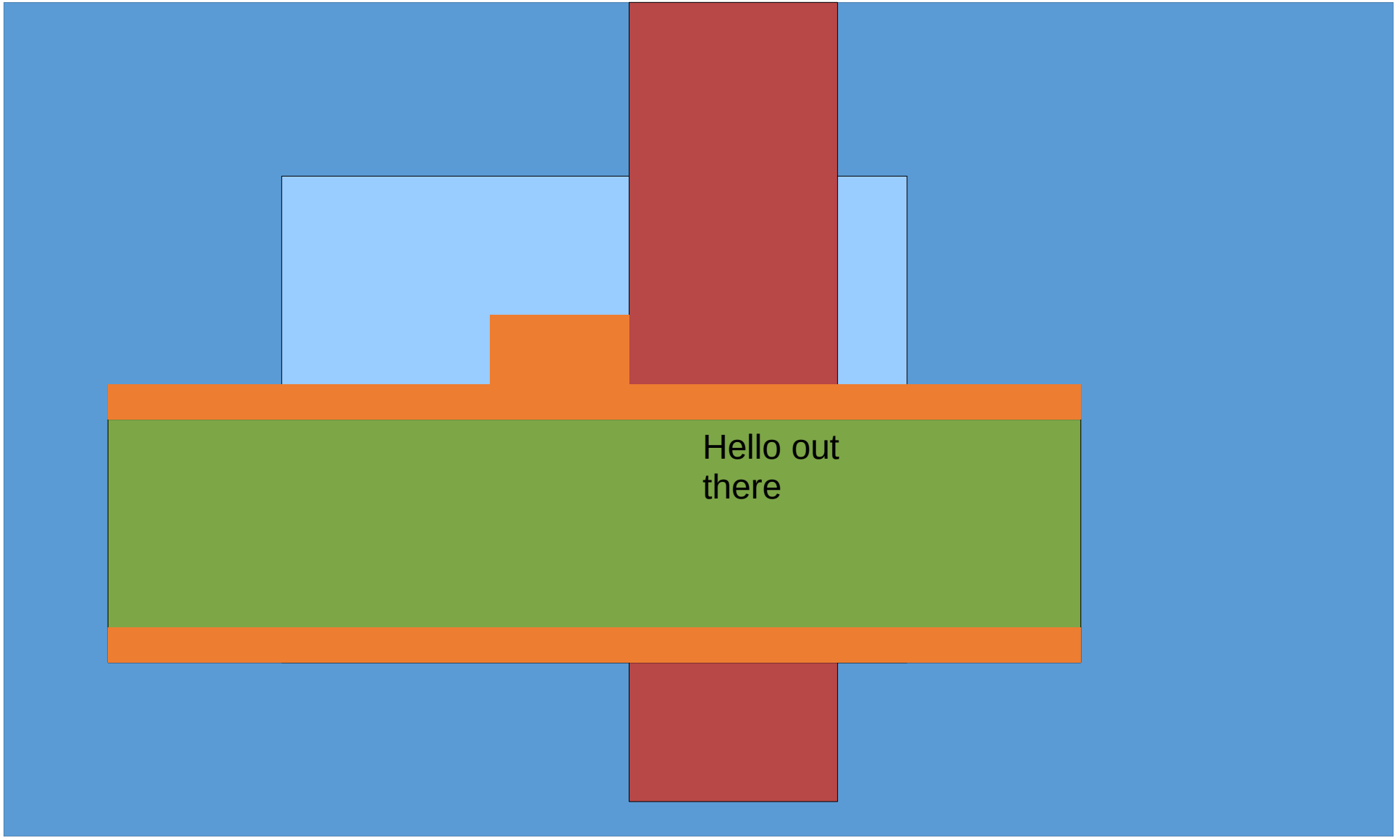
Automated update handling

Next frame is here



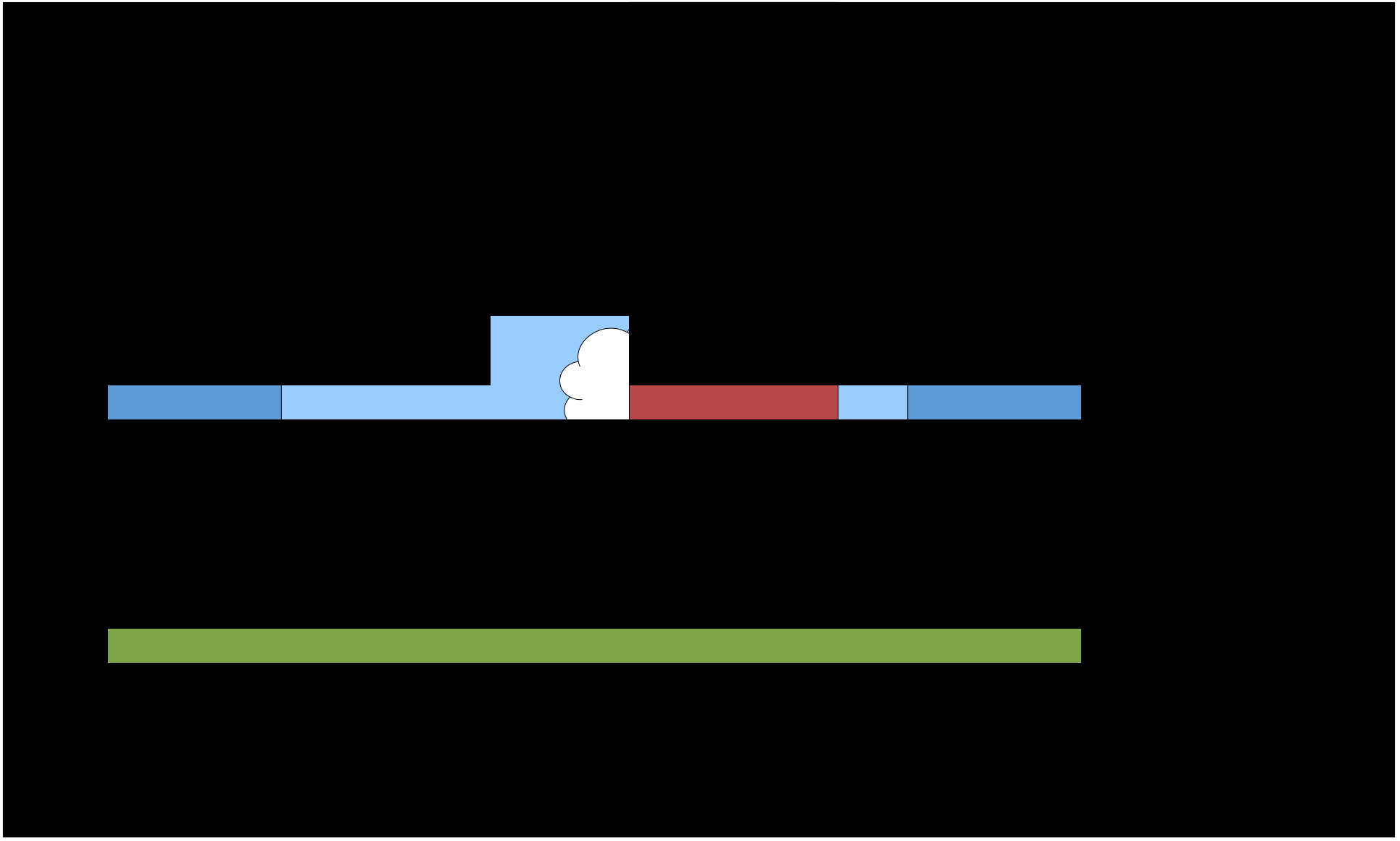
Automated update handling

Calculate actual update region deltas (up to each engine to implement)



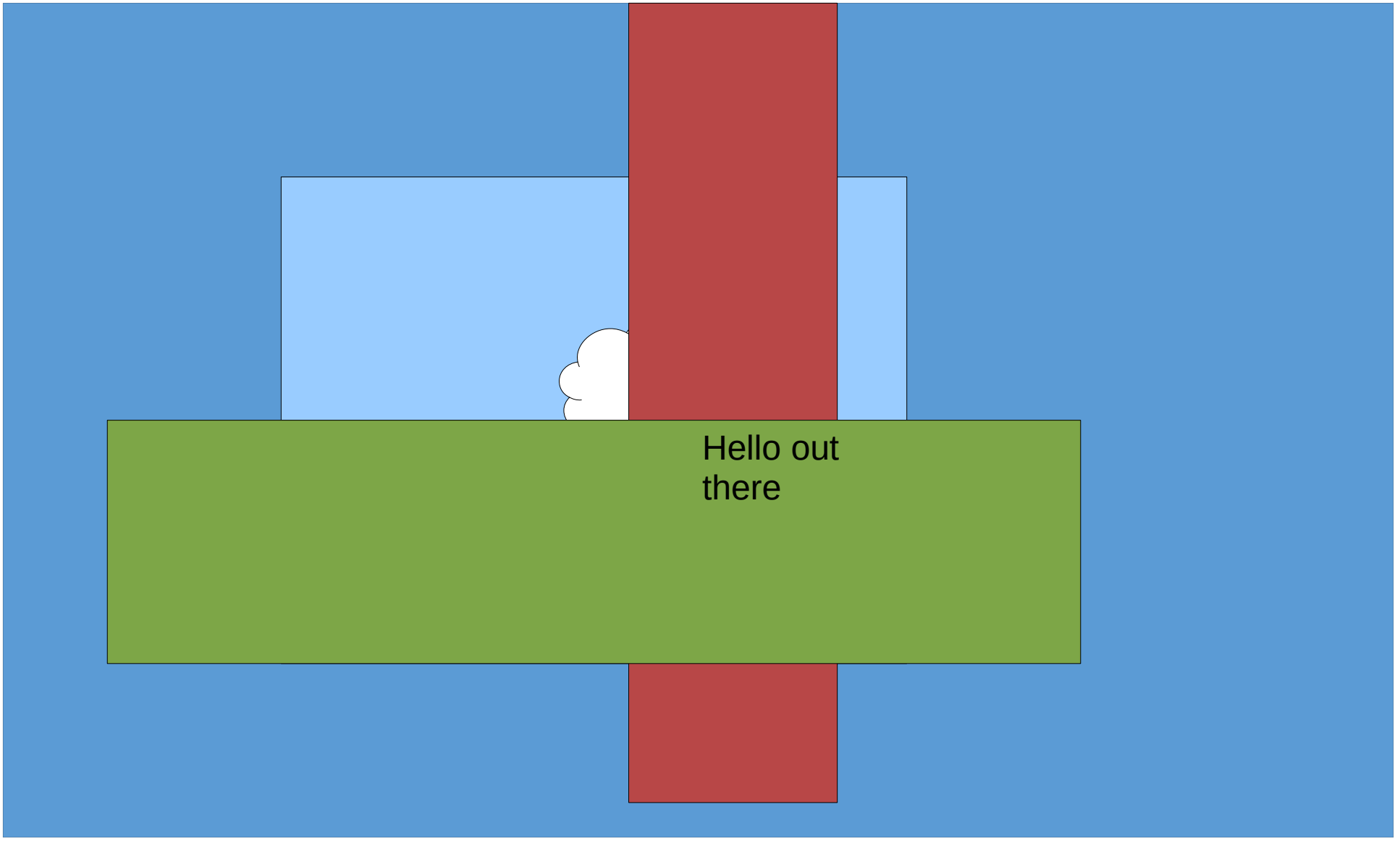
Automated update handling

Only draw updated regions (up to each engine to



Automated update handling

Result



Multiple output paths

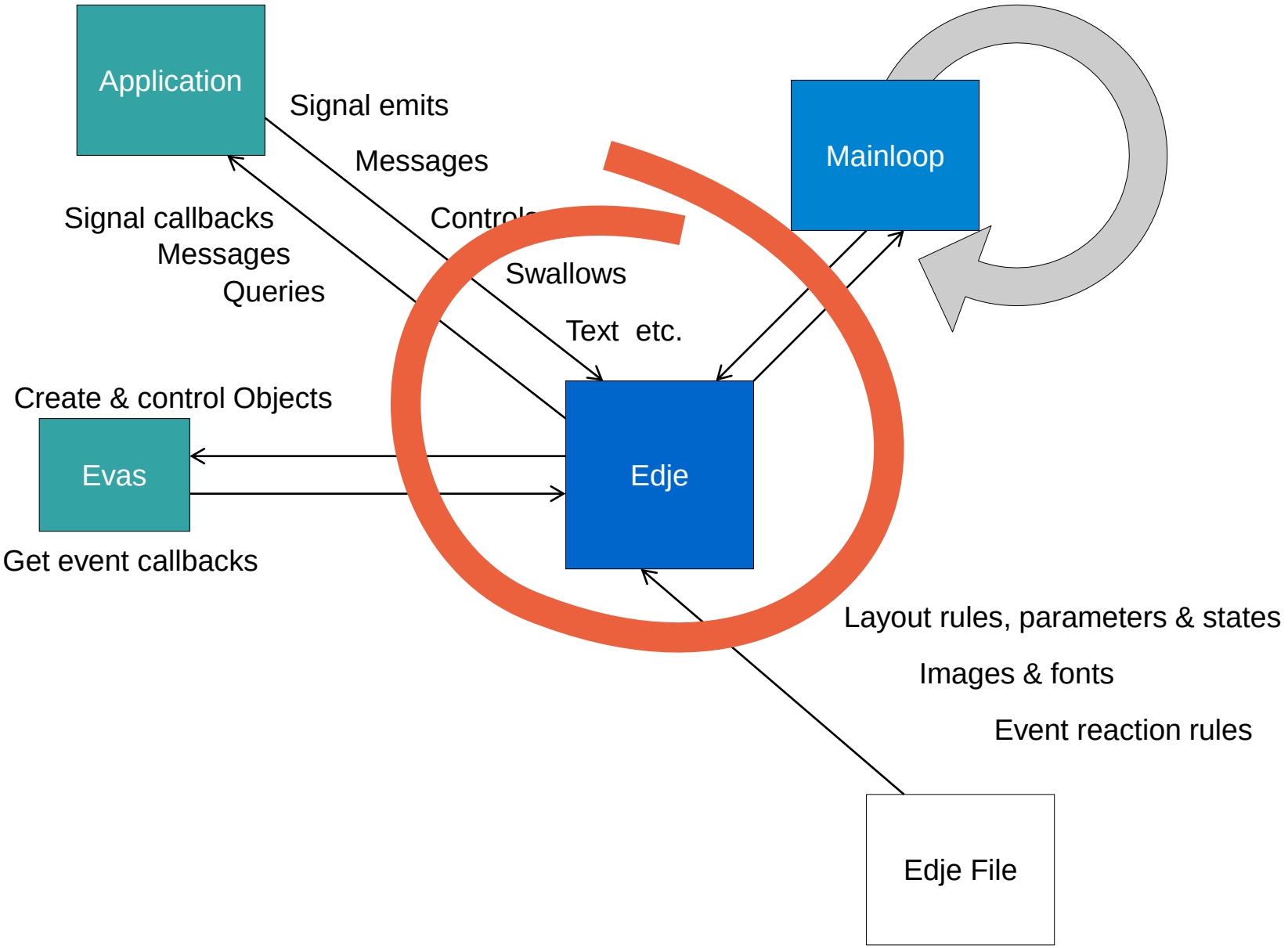
- X11 (OpenGL, Xlib & XCB)
- Wayland (OpenGL & SHM)
- Raw Framebuffer
- Memory buffers
- PS3 Native
- SDL (OpenGL)
- Windows (32/64/CE) (GDI & DirectDraw)
- … others too

EDJE

Pre-made objects for designers (Edje)

- Edje allows a designer to store objects in files
- Pre-made layout with rules and reactions to events
- Stored separately to code in binary files for runtime replacement
- Fast & compact random access designed for realtime use
- All layout, image data, etc. etc. all in 1 file (zero-unpacking)
- Intended for designers & developers to work independently
- Supports scalable and resizeable layouts
- Provides the core ability to re-theme and entire UI or OS

How it works


Application
Signal emits
Messages
Signal callbacks
Messages
Queries
Swallows
Text etc.
Mainloop
Create & control Objects
Evas
Edje
Get event callbacks
Layout rules, parameters & states
Images & fonts
Event reaction rules
Edje File

An example

```
collections {
   group { name: "hello";
      images {
         image: "plant.jpg" LOSSY 80;
         image: "shadow.png" COMP;
      }
      parts {
         part { name: "bg";
            description { state: "default" 0.0;
               aspect: 1.0 1.0; aspect_preference: NONE;
               image.normal: "plant.jpg";
            }
         }
         part { name: "label"; type: TEXT; scale: true;
            description { state: "default" 0.0;
               text {
                  font: "Sans"; size: 20;
                  text: "Hello World!";
               }
            }
         }
         part { name: "shadow";
            description { state: "default" 0.0;
               image.normal: "shadow.png";
            }
         }
      }
   }
```

ELEMENTARY

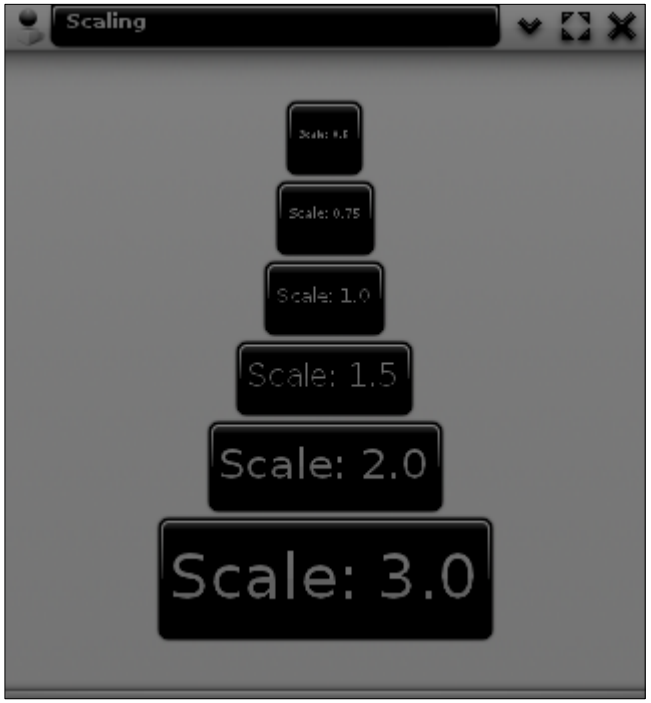
So what is Elementary?

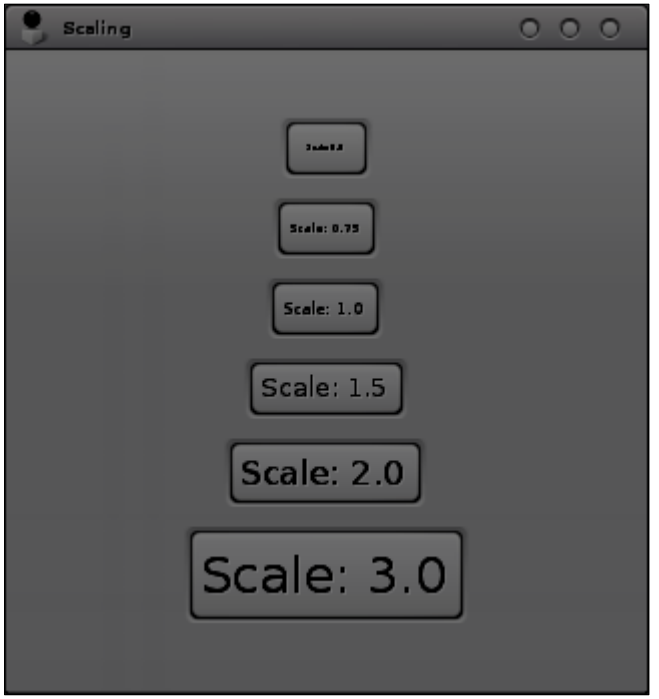
- A widget set built on top of the lower-level EFL layers
- Brings coherent policy and consistency to widgets
- Pre-made common widgets most applications need
- Central theme setup so applications look consistent
- Utilities saving extra footwork by the developer
- Touch friendly design
- Scaling of UI from the get-go
- Also adjusts for input resolution (finger vs mouse etc.)

So what is Elementary?

- It can be seamlessly merged with lower level objects
- Programmer can use Elementary containers or hand-arrange widgets and control them
- Since all objects can be stacked and layered, so can elementary widgets
- Widgets can be transformed like any object
- Handles dealing with IME (Virtual keyboard) for you
- Does many other useful things to save you time

Results with Elementary





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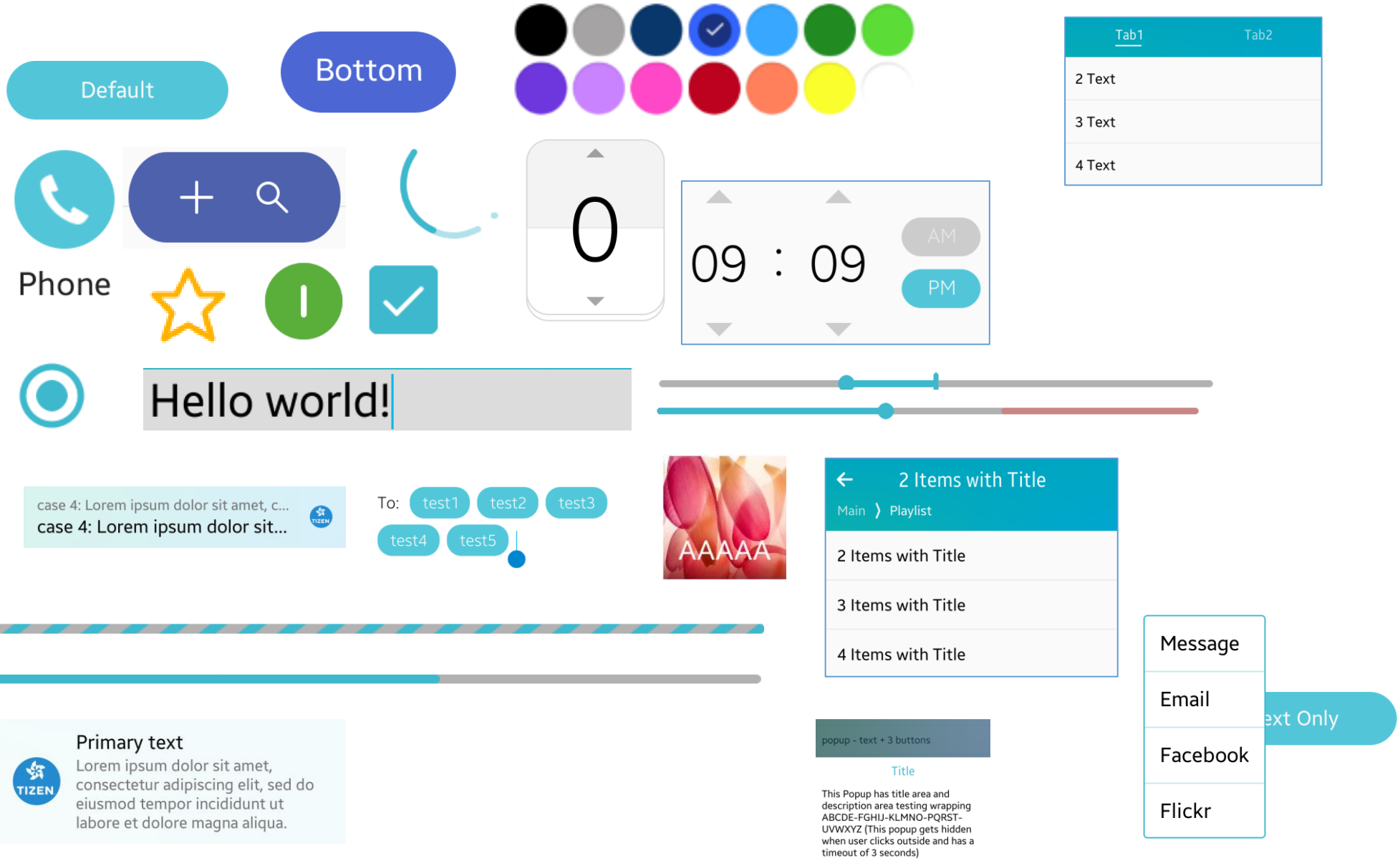


- EMOTION

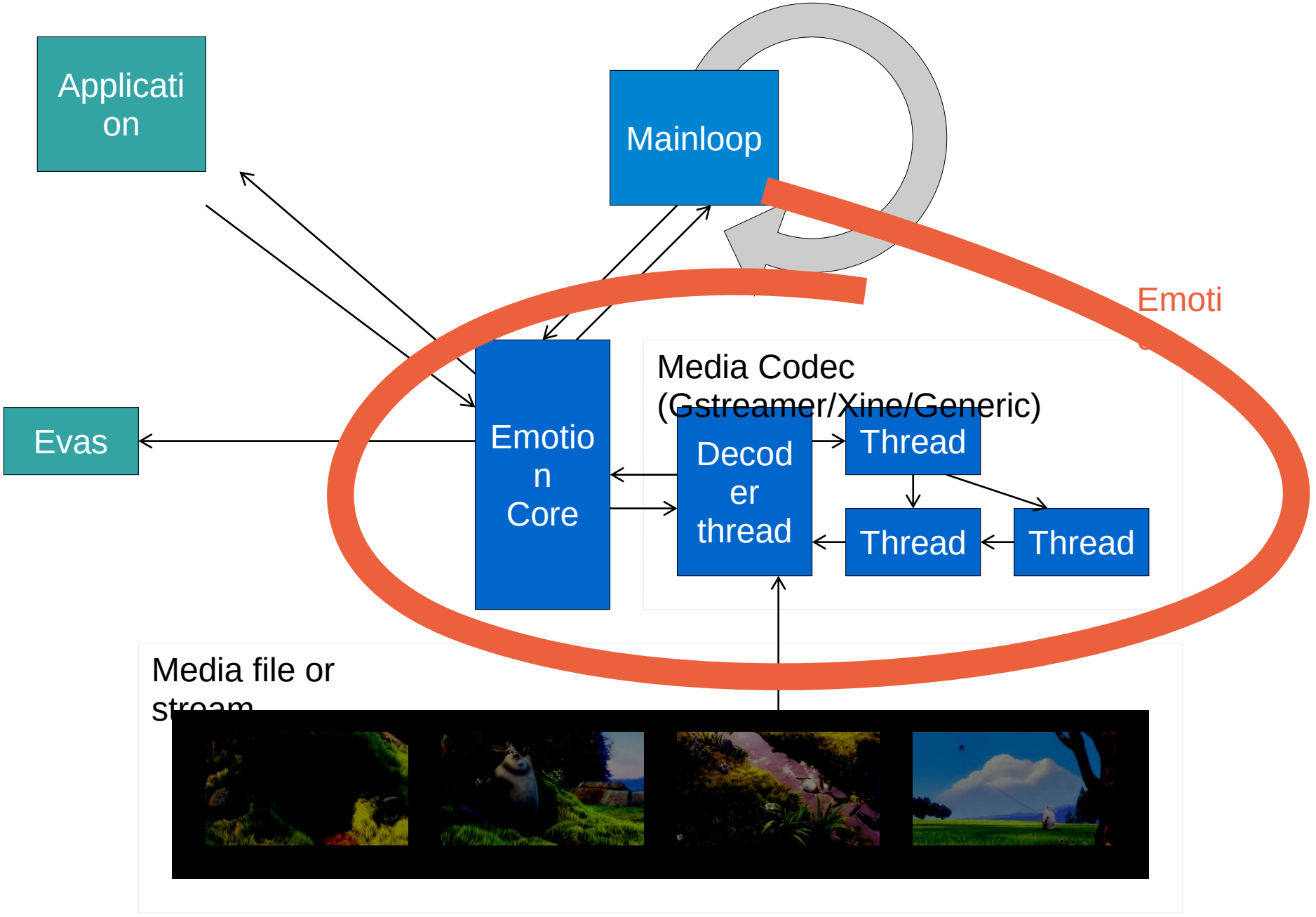
Video & Sound in your world

- Gives you a high level API to include video
- Abstracts to different video decode back-ends
- Optimizes decode via YUV paths or video overlay
- Simple to use

Simple Video

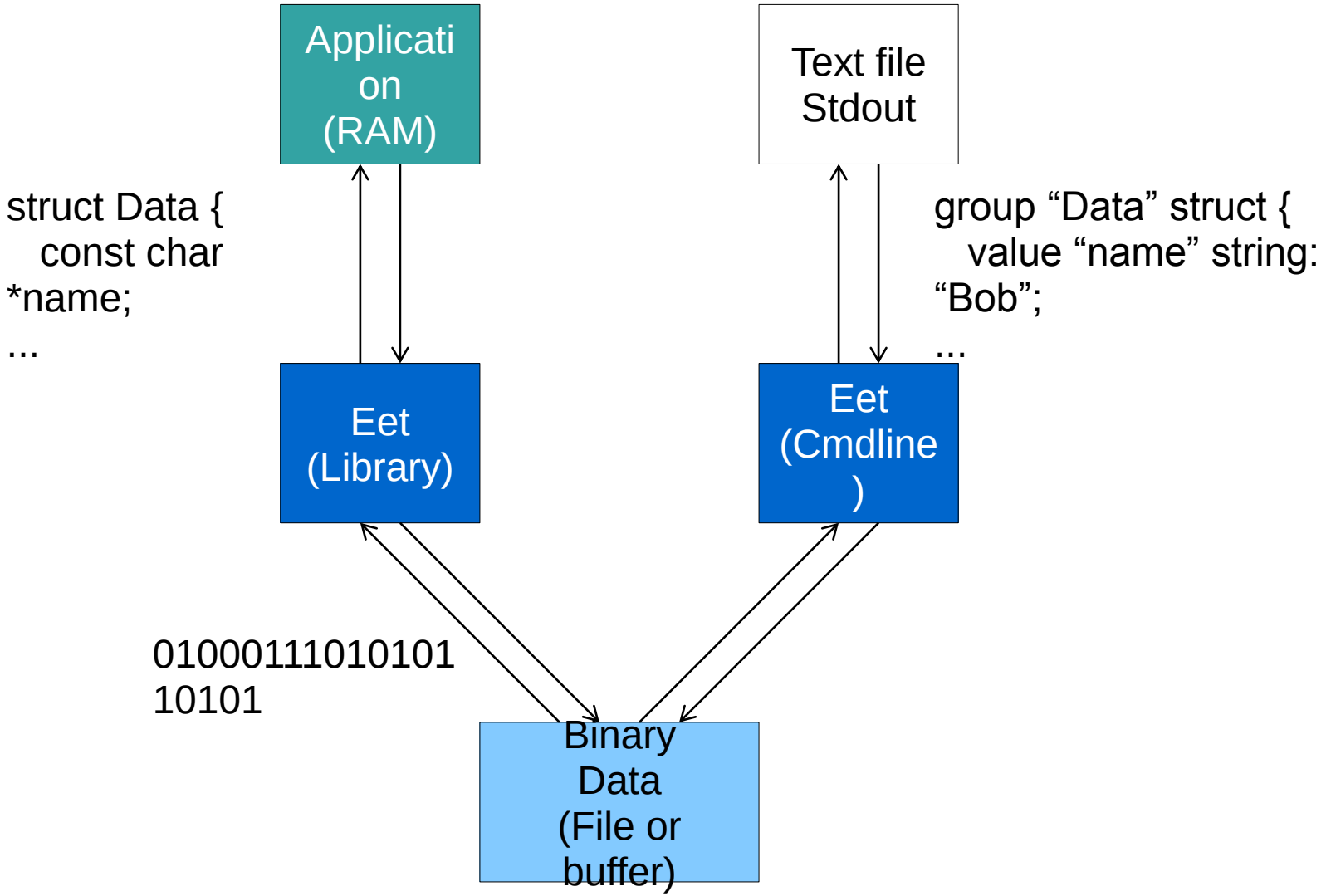
```
• Evas_Object *vid = emotion_object_add(canvas);
• emotion_object_init(vid, NULL);
• emotion_object_file_set(vid, "file.avi");
• evas_object_resize(vid, 640, 360);
• emotion_object_play_set(vid, EINA_TRUE);
• evas_object_show(vid);
```

How it works


Applicati
on
Mainloop
Emoti
Media Codec
(Gstreamer/Xine/Generic)
Evas
Emotio
n
Core
Decod
er
thread
Thread
Thread
Thread
Media file or
stream

EET

Garbage in, garbage out



XML/JSON … for C programmers

- Parsing text is painful
- Parsing correctly without bugs, overflows is harder
- Most programmers hate parsing
- XML, JSON etc. optimized for editing, not runtime
- Programs read/write data 1000x more than humans
- So optimize for the common use case, not the uncommon one
- Make it as easy 1-liners for C code to load or save data
- Edje, Enlightenment config, Elementary config built on EET

Flexible, portable and robust

- Allows you to store data in a file (key/value pair)
- Random access read optimized
- Data can be any binary, image, string or struct encoded
- Compresses separate keys (like zip)
- Allows you to en/decode structs to buffers (for network)
- Provides a protocol buffer handler for decodes
- Files and data all platform agnostic (portable)
- Structs encoded with nested key & types for robustness

- EDBUS EFREET EINA ETHUMB EEZE EMBRYO EIO ...

And the saga continues

- More EFL libraries with no time to mention them
- Expanding libs and scope on a daily basis

QnA

- Enlightenment Foundation Libraries
  - http://www.enlightenment.org
    - Join our
    - IRC : #edevelop, #e
    - Mailing Lists
- https://lists.sourceforge.net/lists/listinfo/enlightenment-devel