Breakthrough Games with Tizen

Tizen Graphics

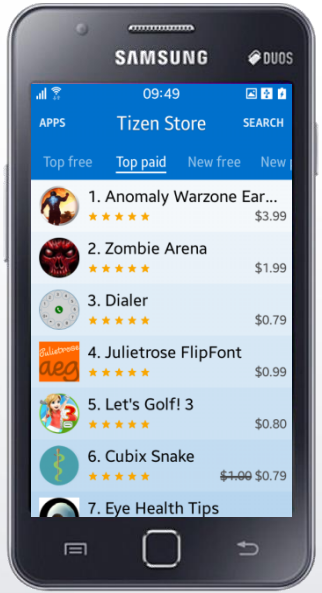
Samsung

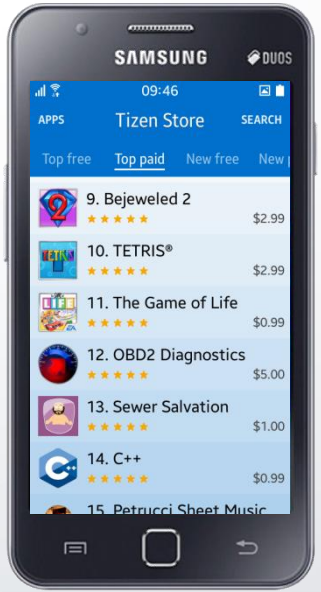
Agenda

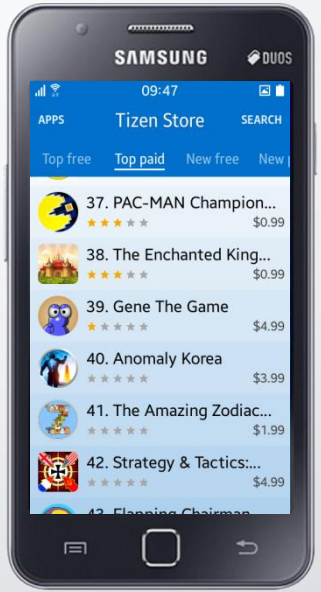
1. Introduction
2. Game Porting to Tizen
3. Tips for Development
4. Monetization
5. Summary

Introduction

- Market Status
  - 27 Games in TOP rank 50 (2015.06)







Why Tizen?

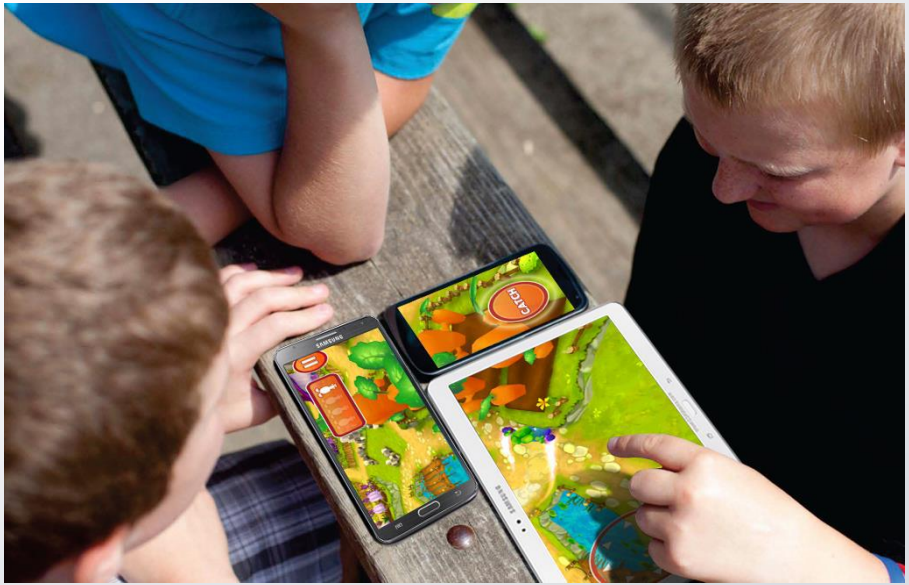
- Expandability and Convergence

Why Tizen?

- Unexplored and New Game Area

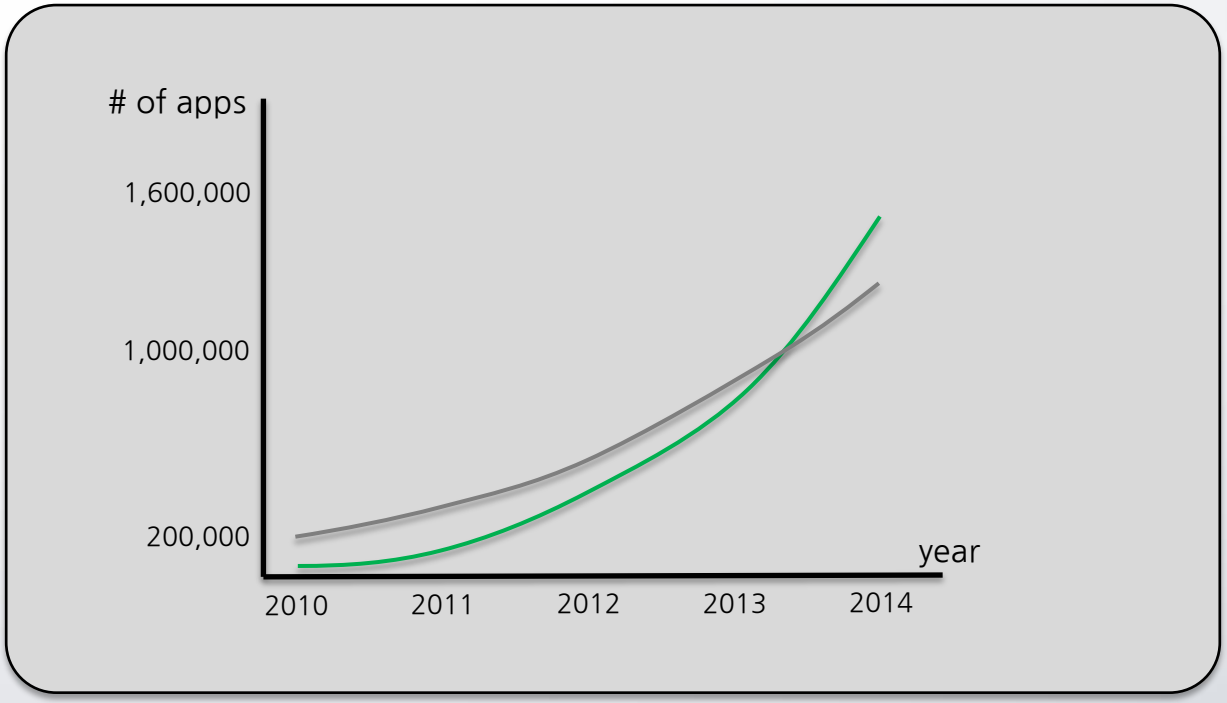
Multi-user Gaming Experience

Multiple screens Game Experience



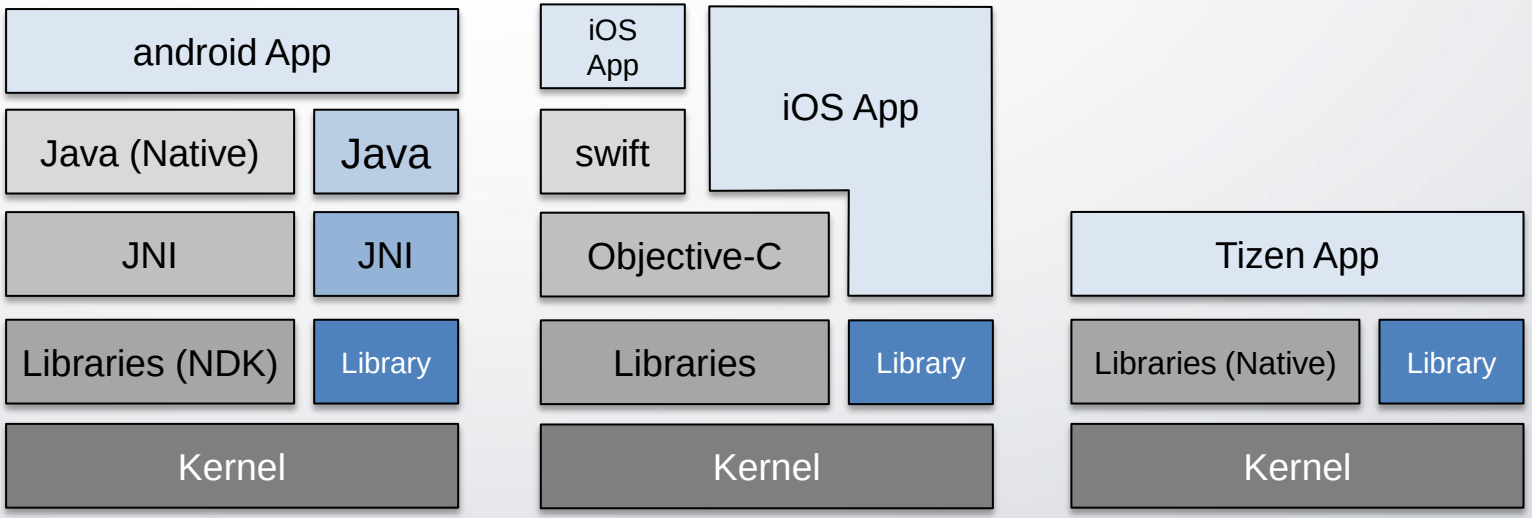
Why Tizen?

- New devices, New marketplace, New opportunity
  - Hard to make your games visible to users



Why Tizen?

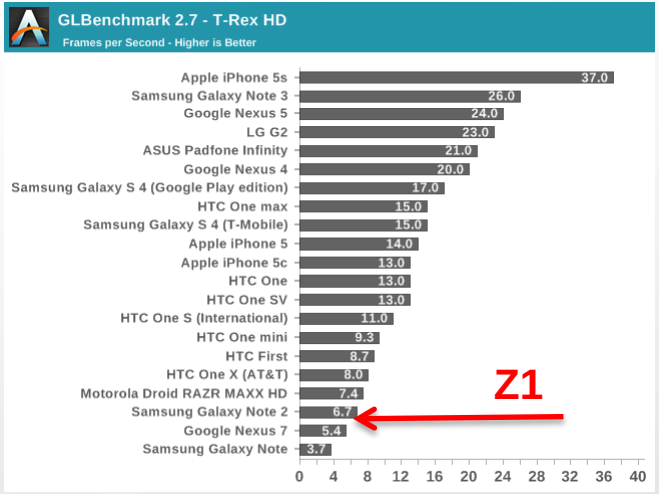
- Efficiency
  - Development efficiency
    - C-based modules accelerate porting of open source modules

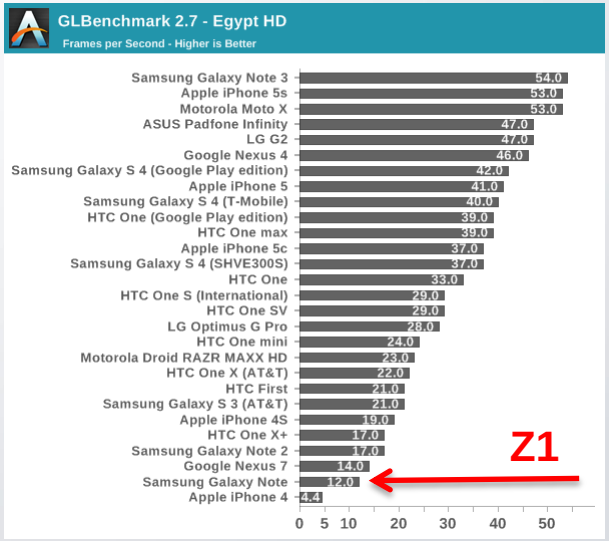


Why Tizen?

- Efficiency
  - Device performance
    - Graphics is highly optimized, which is deeply impressive for mass model with limited resources

Result		
Direct		
GLBenchmark 2.7 T-Rex HD C24Z16 Onscreen ETC1	385 frames 6.9 fps	
GLBenchmark 2.7 T-Rex HD C24Z16 Offscreen ETC1	111 frames 2.0 fps	
GLBenchmark 2.5 Egypt HD C24Z16 Onscreen ETC1	1739 frames 15 fps	
GLBenchmark 2.5 Egypt HD C24Z16 Offscreen ETC1	960 frames 8.5 fps	
None		
No results yet	-1	



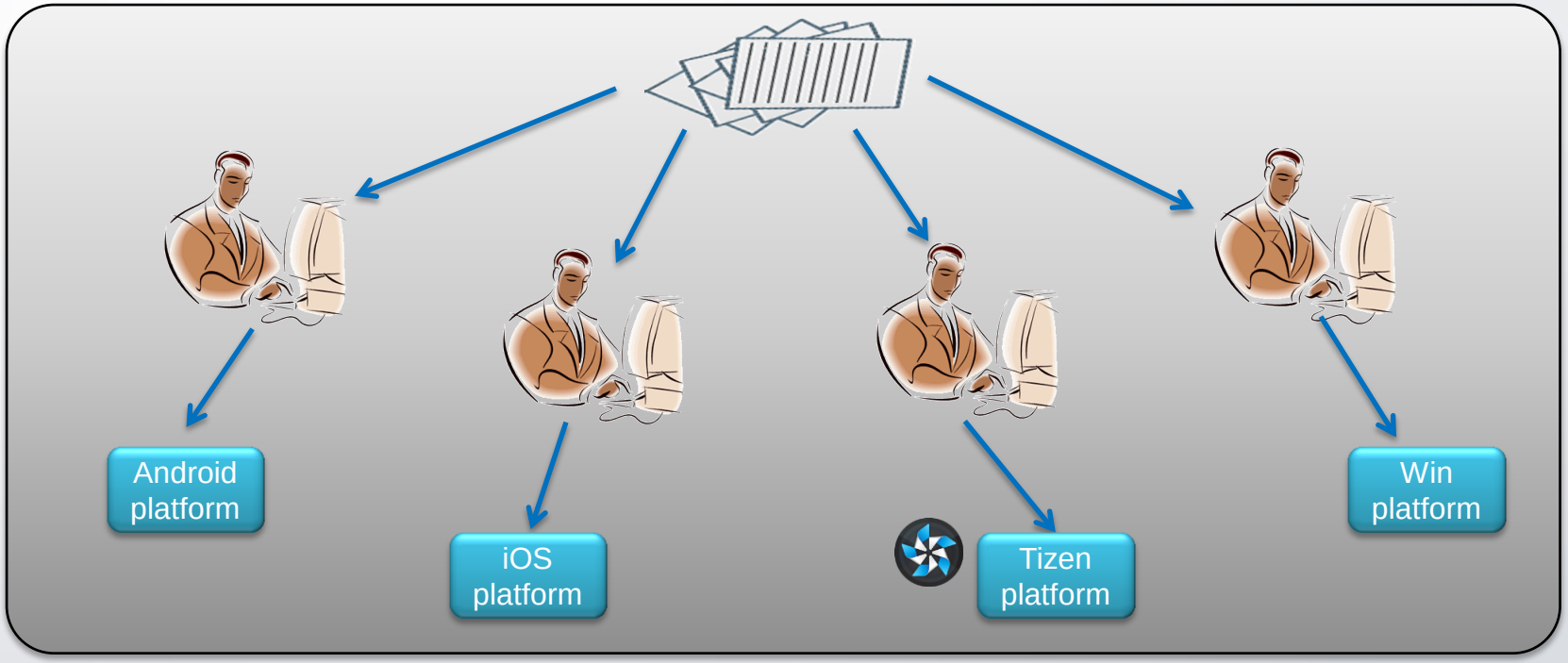


Why Tizen?

- Developer friendly Tizen Store Seller Promotion

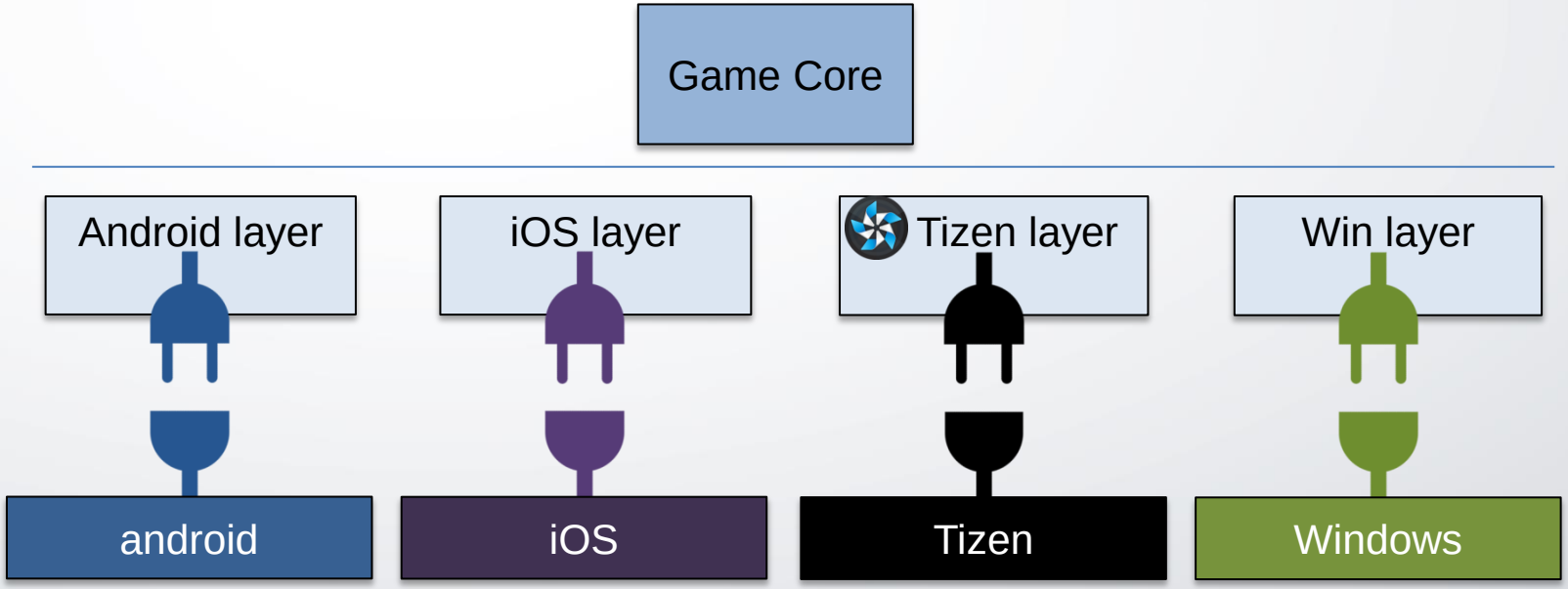
Game Porting to Tizen

- Typical way
  - Develop game for Tizen with the same scenario



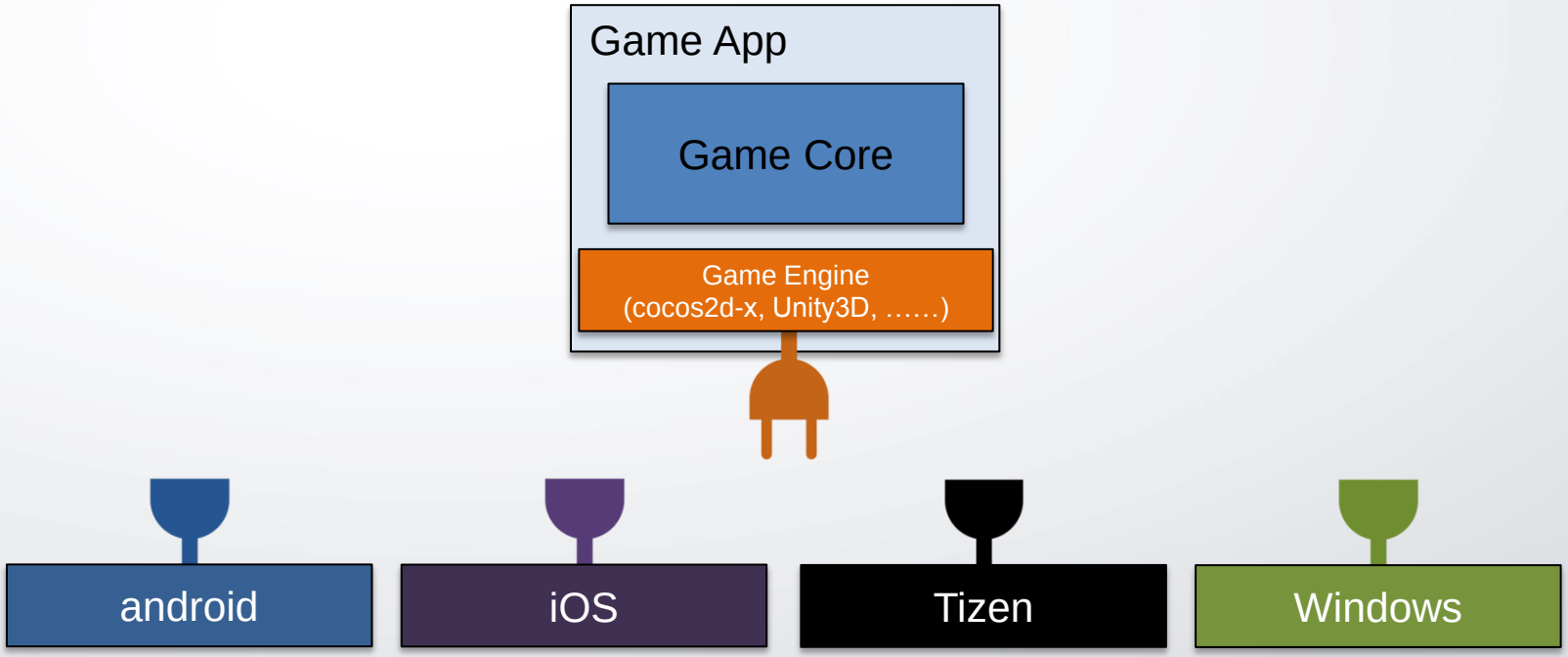
Game Porting to Tizen

- Better way
  - Divide porting layer from game core, and adapt only porting layer



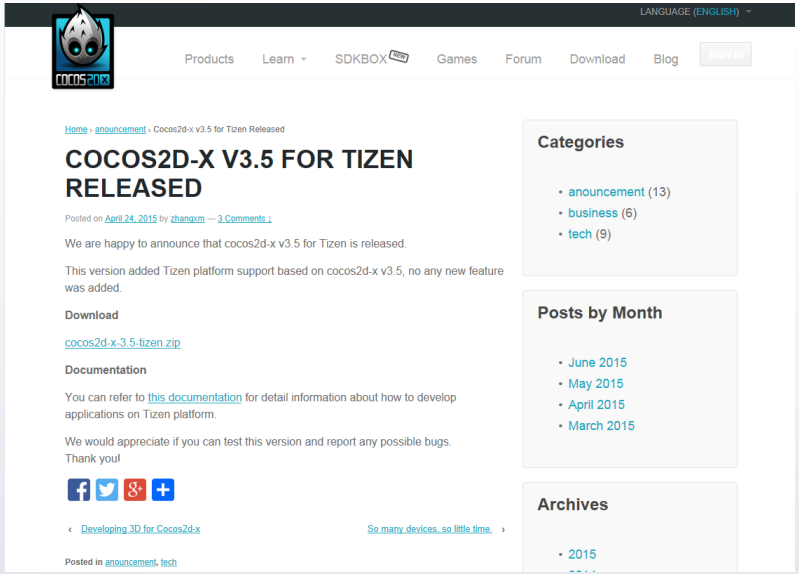
Game Porting to Tizen

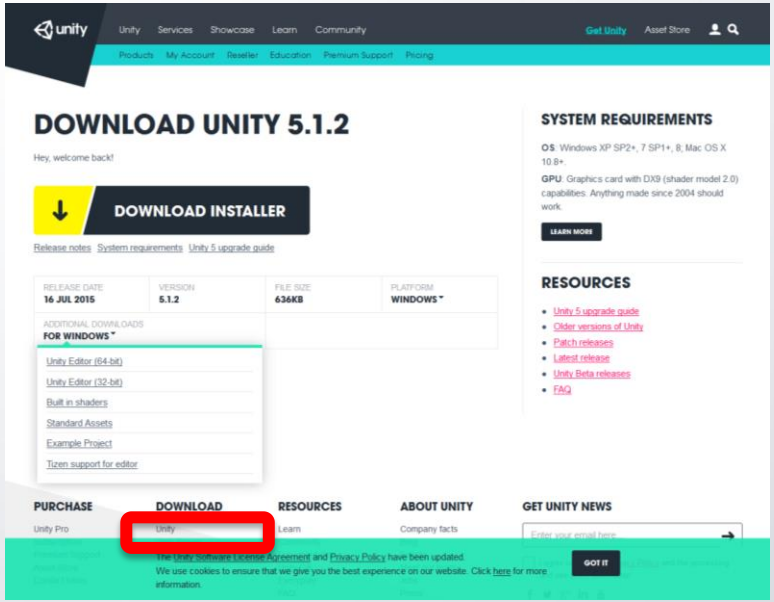
- Best way
  - Adopt game engines, such as cocos2d-x & Unity3D



Game Porting to Tizen

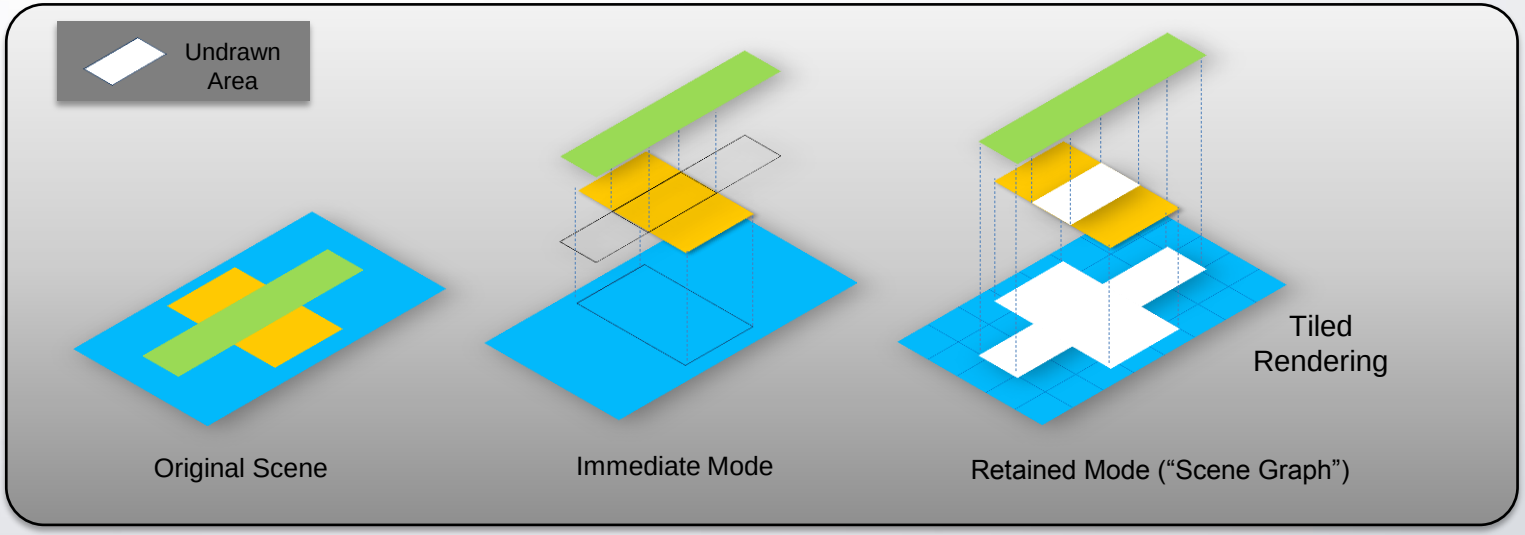
- Famous Game Engines are ready for Tizen
  - Cocos2d-x (since ver.3.5.1)
  - Unity3D (since ver.5.1)





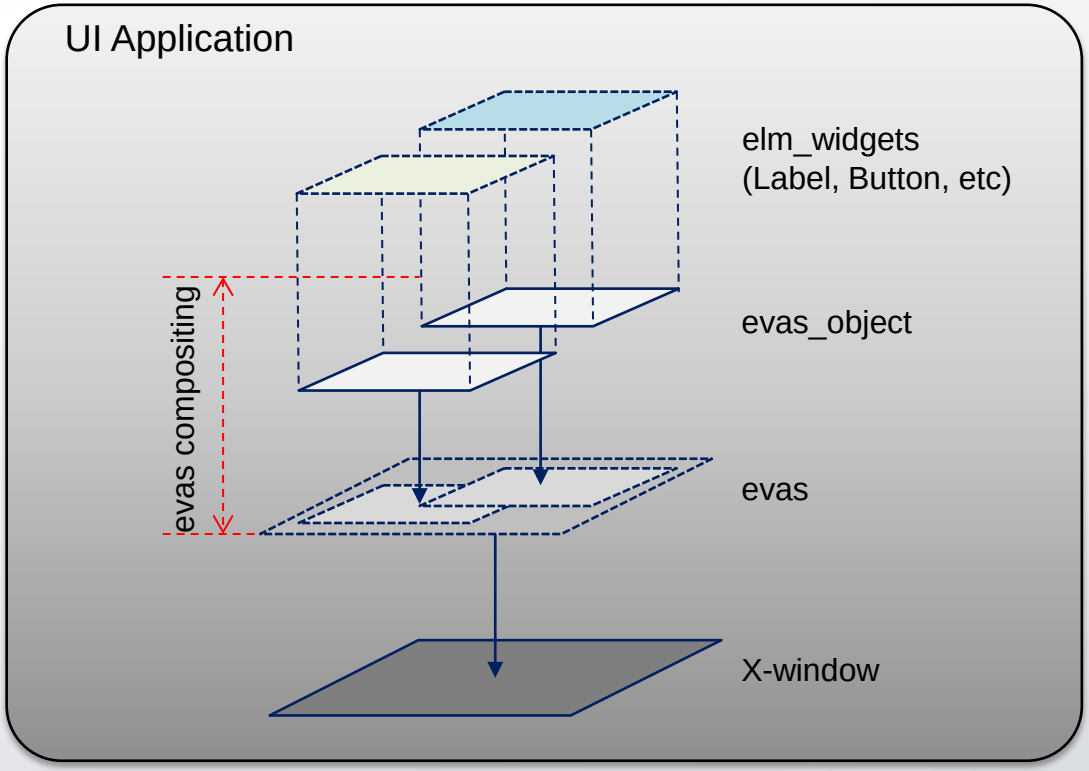
Tips for Development - evasgl basics (1)

- EFL (Enlightenment Foundation Libraries)
  - Collection of open source libraries from Enlightenment
- evas (Efl + canVAS)
  - evas is Scene Graph composed of ‘evas objects’



evasgl basics (2)

- EFL View Hierarchy

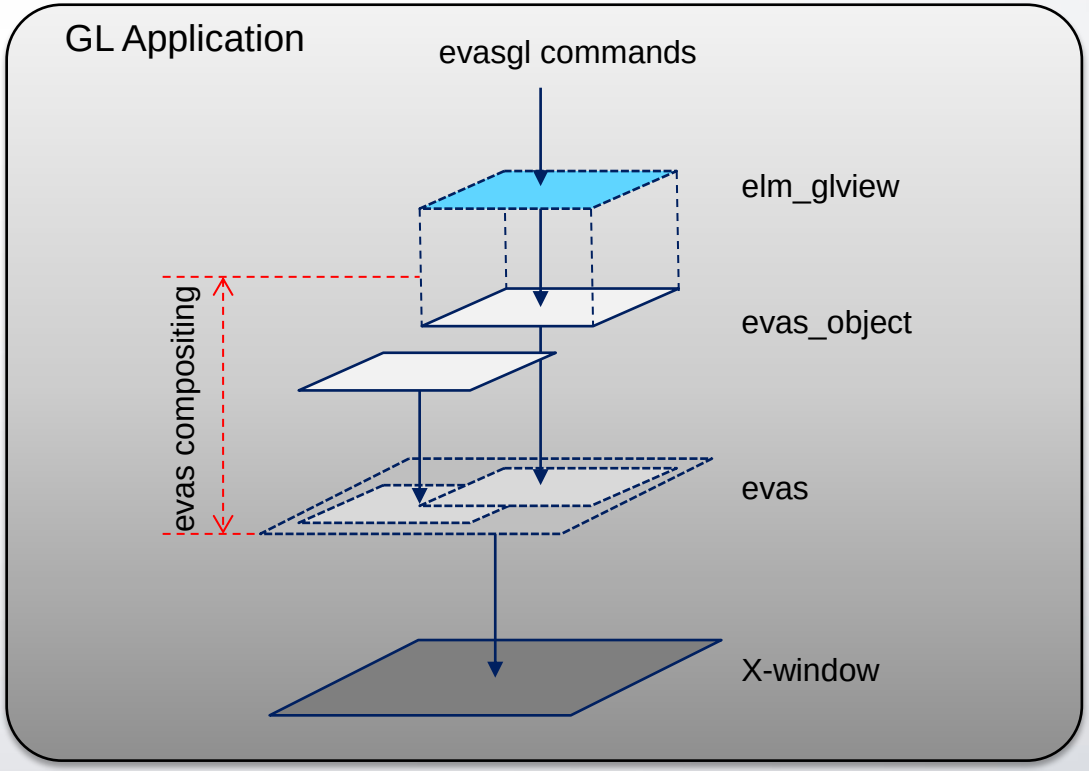


evasgl basics (3)

- GPU Accelerated Rendering in EFL
  - How to make a surface for GLES?
  - How the surface is composited with other widgets?
- evasgl
  - Abstraction for EGL and OpenGL-ES
    - EGL related operations are automatically and internally processed in evas
    - Provides wrappers for the native OpenGL-ES calls
  - Rendering results by evasgl goes to evas object
    - All evas objects are smoothly composited in EFL view hierarchy

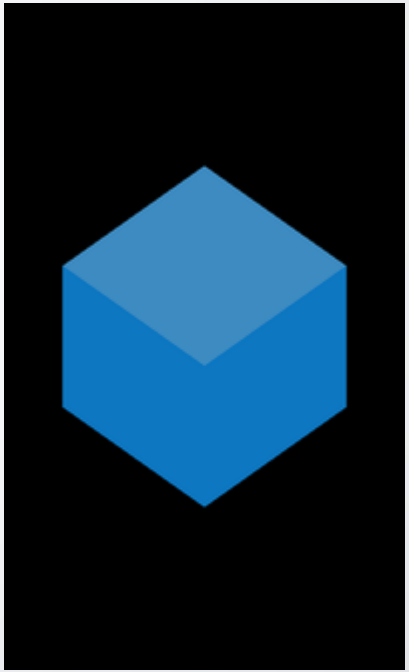
evasgl basics (4)

- Revisit EFL View Hierarchy



Sameple code – Draw one cube

- Overall sequence of sample codeS
  - Application initialization
  - evasgl initialization
  - Animation and rendering settings
  - Add animator and renderer to ecore main loop
  - Define rendering with evasgl functions



1. Application Initialization

app_main part

```
#include <Elementary.h>
#include <Evas_GL.h>
......
```

```
// Define a global context for the application
typedef struct appdata {
    Evas_Object *win;
    Evas_Object *img;
    Evas_GL *evasgl;
    Evas_GL_API *glapi;
    Evas_GL_Context *ctx;
    Evas_GL_Surface *sfc;
    Evas_GL_Config *cfg;
    unsigned int program;
    unsigned int vtx_shader;
    unsigned int fgmt_shader;
    unsigned int vbo;
} appdata_s;
```

```
int main(int argc, char *argv[])
{
appdata_s ad = {0,};
int ret = 0;

ui_app_lifecycle_callback_s event_callback = {0,};
......
```

```
event_callback.create = app_create;
event_callback.terminate = app_terminate;
event_callback.pause = app_pause;
event_callback.resume = app_resume;
event_callback.app_control = app_control;
```

```
......
```

```
ret = ui_app_main(argc, argv, &event_callback, &ad);
```

```
return ret;
}
```

2. evasgl Initialization

evasgl initialization

```
/* Set config of the surface for evas gl */
ad->cfg = evas_gl_config_new();
ad->cfg->color_format = EVAS_GL_RGBA_8888;    // Surface Color Format
ad->cfg->depth_bits   = EVAS_GL_DEPTH_BIT_24; // Surface Depth Format
ad->cfg->stencil_bits = EVAS_GL_STENCIL_NONE; // Surface Stencil Format
ad->cfg->options_bits = EVAS_GL_OPTIONS_NONE; // Configuration options (here, no extra options)
```

```
/* Add Window */
ad->win    = elm_win_util_standard_add("Evas_GL Example", "Evas_Gl Example");
```

```
/* Get the evas gl handle for doing gl things */
ad->evasgl = evas_gl_new(evas_object_evas_get(ad->win));
ad->glapi  = evas_gl_api_get(ad->evasgl);
```

```
/* Get the window size */
Evas_Coord w,h;
evas_object_geometry_get(ad->win, NULL, NULL, &w, &h);
```

```
/* Create a surface and context */
ad->sfc = evas_gl_surface_create(ad->evasgl, ad->cfg, w, h);
ad->ctx = evas_gl_context_create(ad->evasgl, NULL);
```

```
/* Initialization GLES including shader gneration and other stuffs */
......
```

3. Animation and Rendering setting

Animation and Rendering

```
/* Set up the image object. A filled one by default. */
ad->img = evas_object_image_filled_add(evas_object_evas_get(ad->win));
evas_object_image_pixels_get_callback_set(ad->img, img_pixels_get_cb, ad);

/* Add Event Callbacks */
evas_object_event_callback_add(ad->img, EVAS_CALLBACK_DEL, img_del_cb, ad);
evas_object_event_callback_add(ad->img, EVAS_CALLBACK_MOUSE_DOWN, mouse_down_cb, ad);
evas_object_event_callback_add(ad->img, EVAS_CALLBACK_MOUSE_UP, mouse_up_cb, ad);
evas_object_event_callback_add(ad->img, EVAS_CALLBACK_MOUSE_MOVE, mouse_move_cb, ad);
evas_object_event_callback_add(ad->win, EVAS_CALLBACK_RESIZE, win_resize_cb, ad);

/* Add animator */
ani = ecore_animator_add(animate_cb, ad->img);
```

```
static Eina_Bool
animate_cb(void *data)
{
  Evas_Object *img = data;
  evas_object_image_pixels_dirty_set(img, EINA_TRUE);

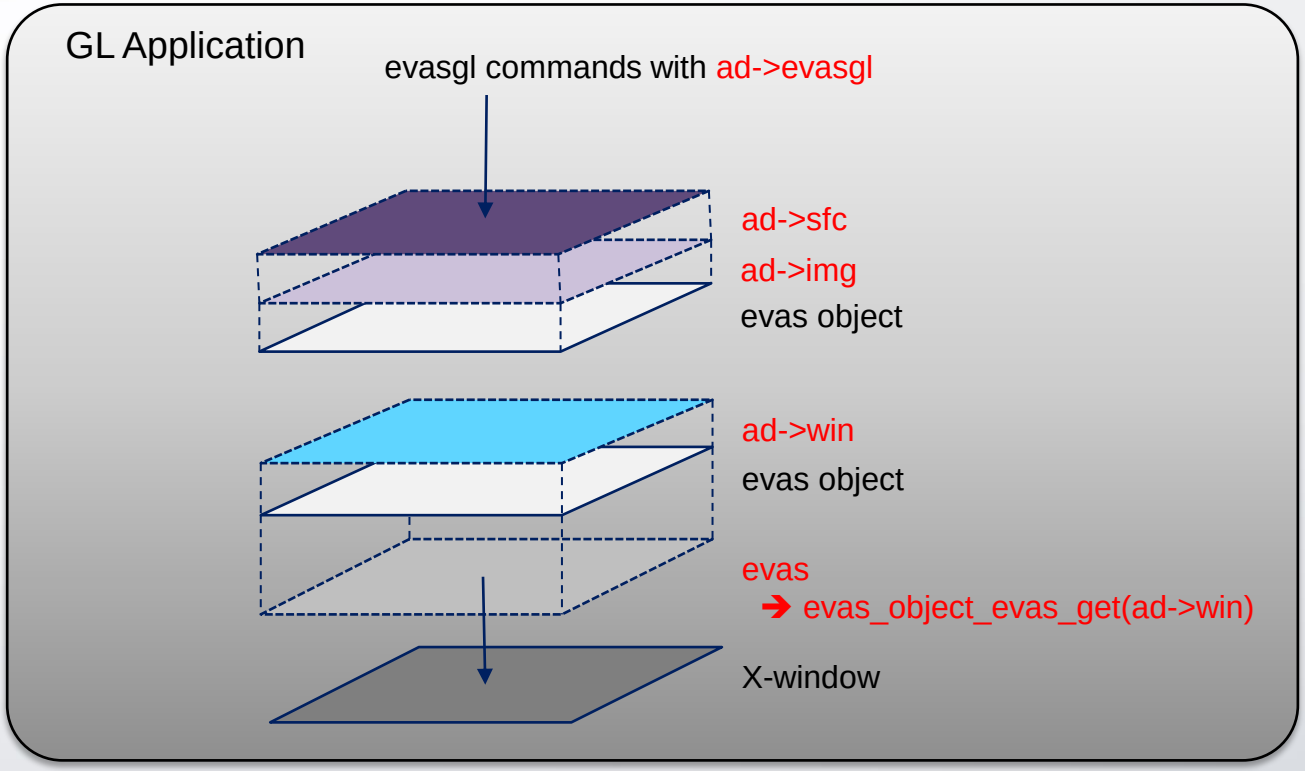
  return ECORE_CALLBACK_RENEW;
}
```

```
static void
img_pixels_get_cb(void *data, Evas_Object *obj)
{
   appdata_s *ad = data;
   Evas_GL_API *gl = ad->glapi;

   // Rendering process here
   ......
}
```

Sameple code – Draw one cube

- EFL View Hierarchy for evasgl initialization



3. Animation and Rendering setting

Animation and Rendering

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```

```
static void
img_pixels_get_cb(void *data, Evas_Object *obj)
{
   appdata_s *ad = data;
   Evas_GL_API *gl = ad->glapi;

   // Rendering process here
   ......
}
```

4. Rendering with evasgl

Rendering with evasgl

```
static void
img_pixels_get_cb(void *data, Evas_Object *obj)
{
   appdata_s *ad = data;
   Evas_GL_API *gl = ad->glapi;
   ......

   /* Make the application context as current */
   evas_gl_make_current(ad->evasgl, ad->sfc, ad->ctx);

   /* Render the scene with evasgl functions */
   gl->glViewport(0, 0, WIDTH, HEIGHT);

   gl->glClearColor(0.0f, 0.0f, 0.0f, 1.0f);
   gl->glClear(GL_COLOR_BUFFER_BIT | GL_DEPTH_BUFFER_BIT);

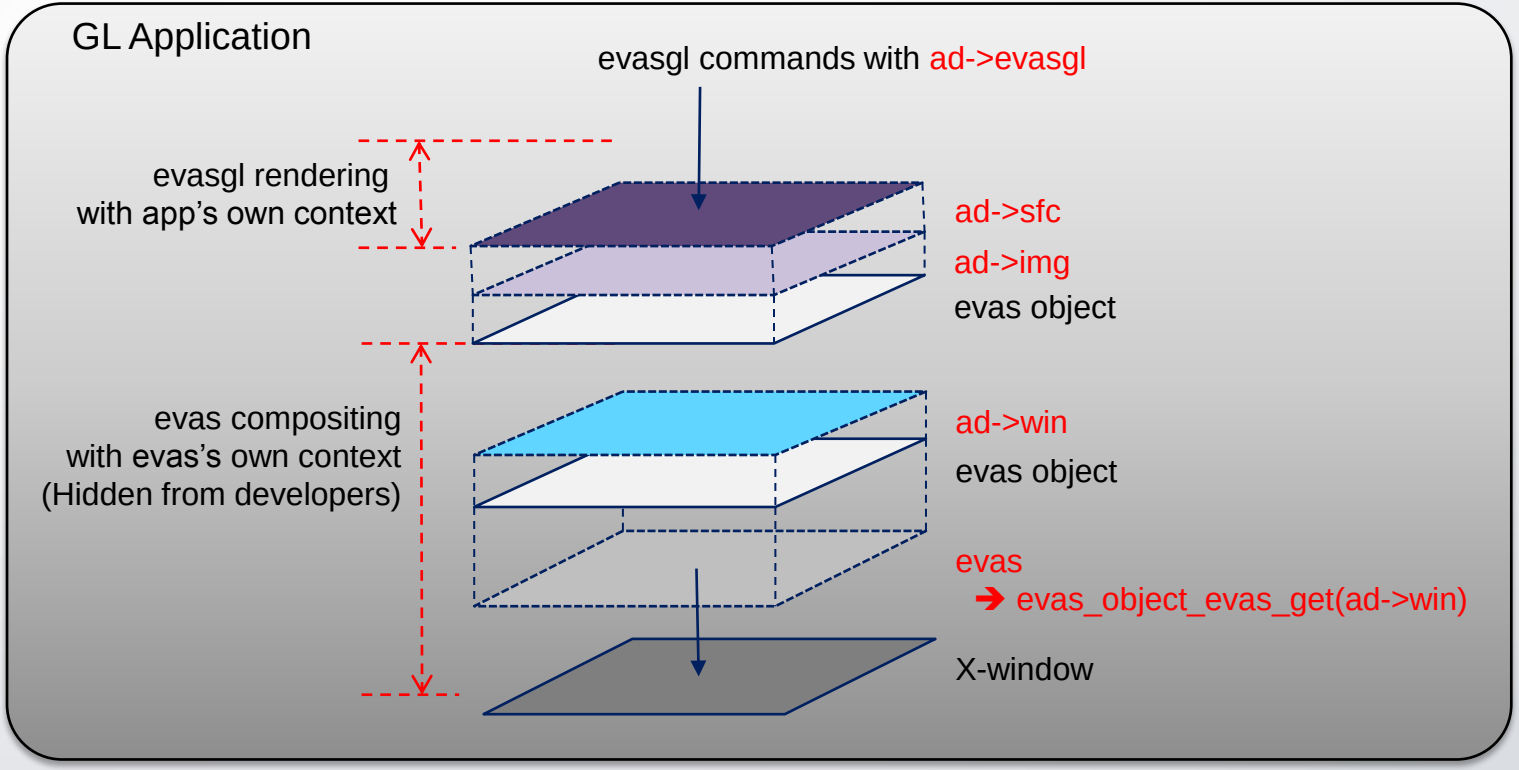
   gl->glUseProgram(ad->program);

   gl->glVertexAttribPointer(0, 3, GL_FLOAT, GL_FALSE, sizeof(float) * 6, 0);
   gl->glEnableVertexAttribArray(0);

   gl->glVertexAttribPointer(1, 3, GL_FLOAT, GL_FALSE, sizeof(float) * 6, (void*)(sizeof(float)*3));
   gl->glEnableVertexAttribArray(1);
   ......
}
```

[Caution] Context Handling

- GLES context maintaining with **evas_gl_make_current**



elm_glview

- Elementary widget specialized for evasgl rendering
  - Preset tedious work for evasgl rendering for developers
    - Comparable to android.opengl.GLSurfaceView
    - Help developers to focus on only rendering task
  - What does elm_glview work for you?
    - Context & Drawable Surface generation
    - Setup all required callbacks including all useful events, such as touch and rendering
    - Guarantee the context maintaining automatically
    - Preset all necessary EGL properties according to the user input requirements
      (➔ **elm_glview_mode_set**)

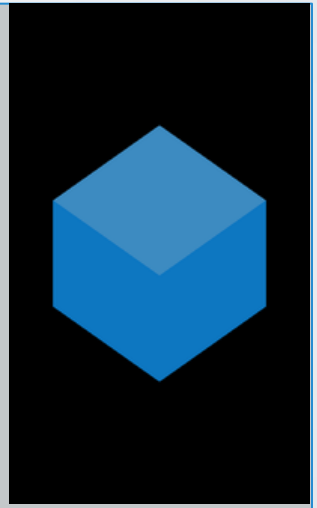
Sample Code – Change Initialization

```
EAPI int elm_main(int argc EINA_UNUSED, char **argv EINA_UNUSED)
{
   Evas_Object *win;
   Evas_Object *glview;
   ......
   win = elm_win_util_standard_add("glview", "GLView");
   evas_object_show(win);

   /* Initialize & Setup elm_glview */
   {
      glview = elm_glview_add(win);
      elm_win_resize_object_add(win, glview);
      elm_glview_mode_set(glview, ELM_GLVIEW_ALPHA | ELM_GLVIEW_DEPTH );
      elm_glview_resize_policy_set(glview, ELM_GLVIEW_RESIZE_POLICY_RECREATE);
      elm_glview_render_policy_set(glview, ELM_GLVIEW_RENDER_POLICY_ON_DEMAND);

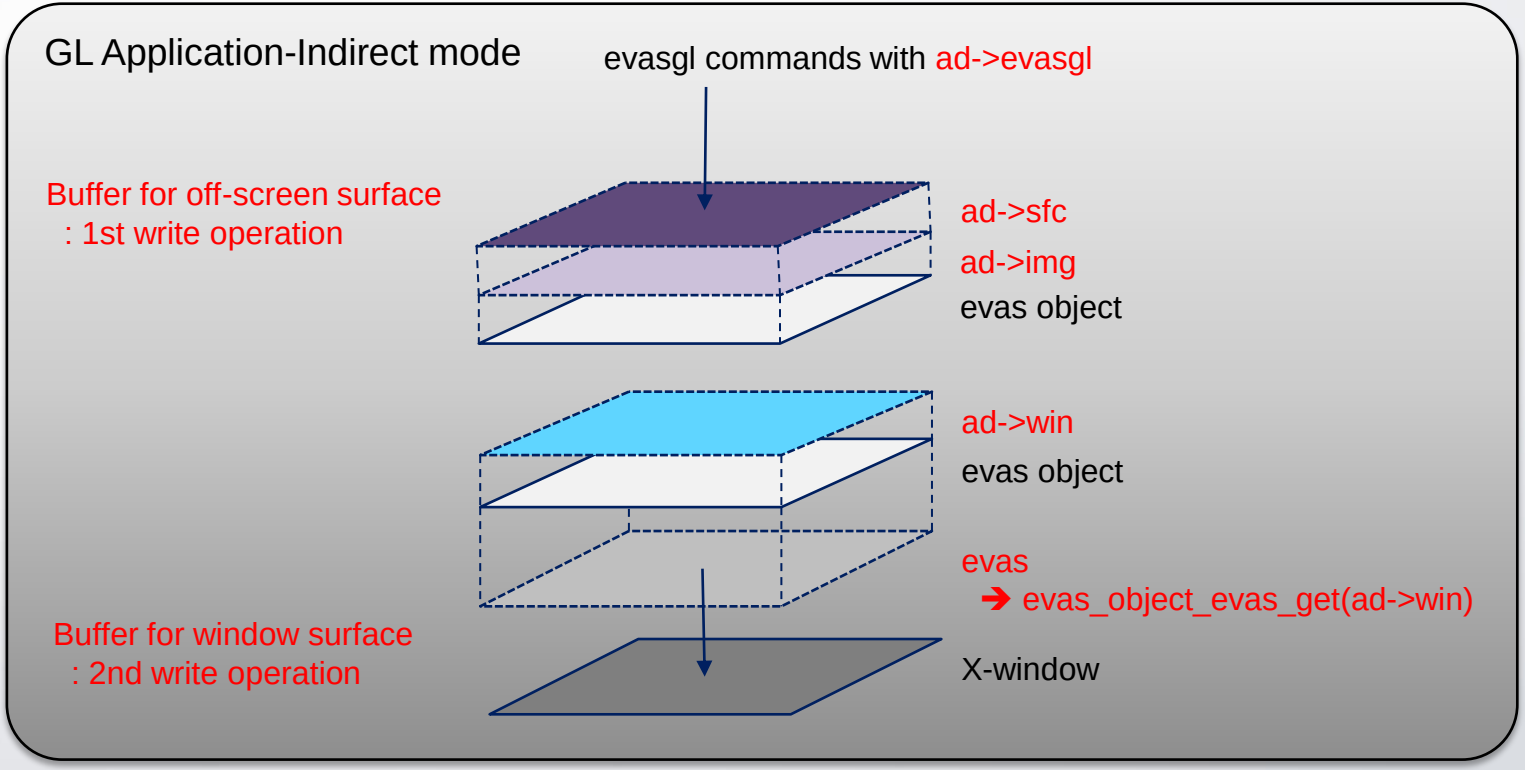
      elm_glview_init_func_set(glview, _init_gl);
      elm_glview_del_func_set(glview, _del_gl);
      elm_glview_render_func_set(glview, _draw_gl);
      elm_glview_resize_func_set(glview, _resize_gl);

      evas_object_size_hint_min_set(glview, 250, 250);
      evas_object_show(glview);
   }
   ......
}
```



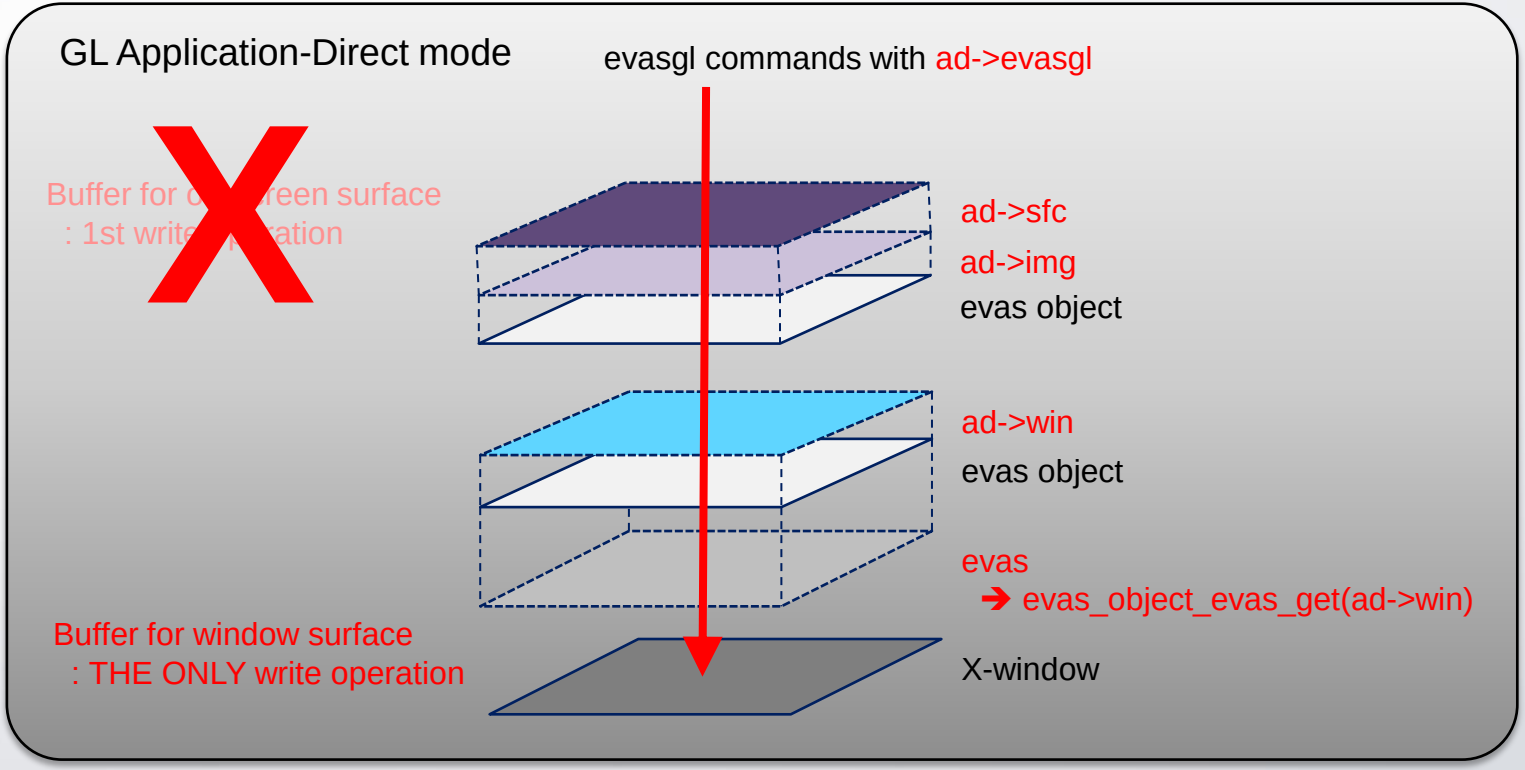
Performance Improvement (1): DIRECT mode

- EFL View Hierarchy of full-screen GLES application



Performance Improvement (1): DIRECT mode

- EFL View Hierarchy of full-screen GLES application



Sample Code – Change Initialization

elm_glview case

```
EAPI int elm_main(int argc EINA_UNUSED, char **argv EINA_UNUSED)
{
   ......
   /* Initialize & Setup elm_glview */
   {
      glview = elm_glview_add(win);
      elm_win_resize_object_add(win, glview);
      elm_glview_mode_set(glview, ELM_GLVIEW_ALPHA | ELM_GLVIEW_DEPTH | ELM_GLVIEW_DIRECT);
   ......
}
```

evasgl case

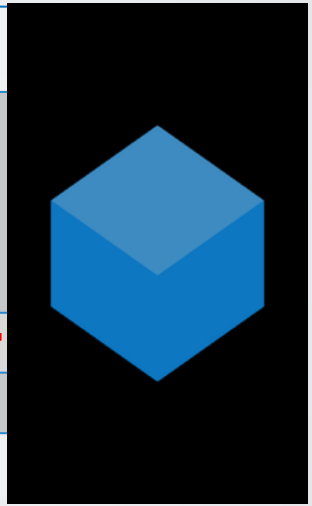
```
/* Set config of the surface for evas gl */
......
ad->cfg = evas_gl_config_new();
ad->cfg->options_bits = EVAS_GL_OPTIONS_DIRECT; // Configuration options (here, DIRECT mode on)
......

/* Create a surface and context */
ad->sfc = evas_gl_surface_create(ad->evasgl, ad->cfg, w, h);
ad->ctx = evas_gl_context_create(ad->evasgl, NULL);
......
```

Sample Code – Change Initialization

elm_glview case

```
EAPI int elm_main(int argc EINA_UNUSED, char **argv EINA_UNUSED)
{
   ......
   /* Initialize & Setup elm_glview */
   {
      glview = elm_glview_add(win);
      elm_win_resize_object_add(win, glview);
      elm_glview_mode_set(glview, ELM_GLVIEW_ALPHA | ELM_GLVIEW_DEPTH | ELM_GLVIEW_DIRECT);
   ......
}
```



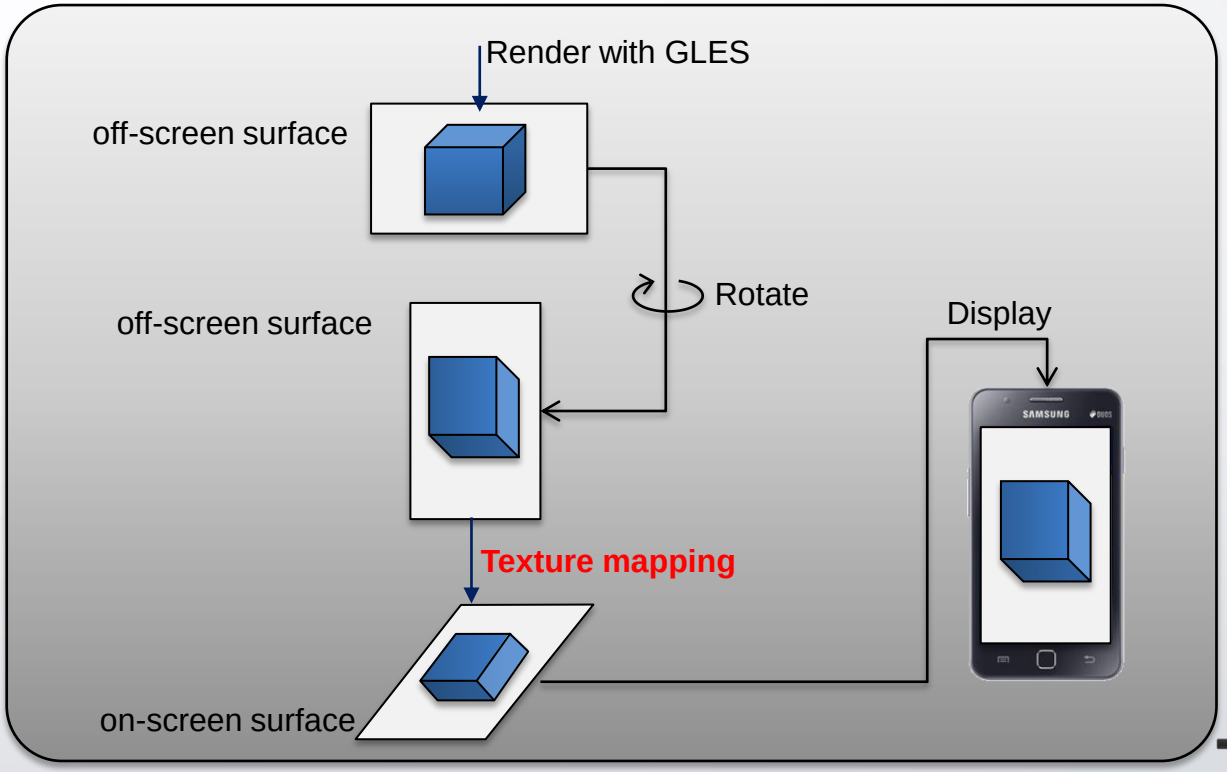
evasgl case

```
/* Set config of the surface for evas gl */
......
ad->cfg = evas_gl_config_new();
ad->cfg->options_bits |= EVAS_GL_OPTIONS_DIRECT; Configuration options (here, DIRECT mode on)
......

/* Create a surface and context */
ad->sfc = evas_gl_surface_create(ad->evasgl, ad->cfg, w, h);
ad->ctx = evas_gl_context_create(ad->evasgl, NULL);
......
```

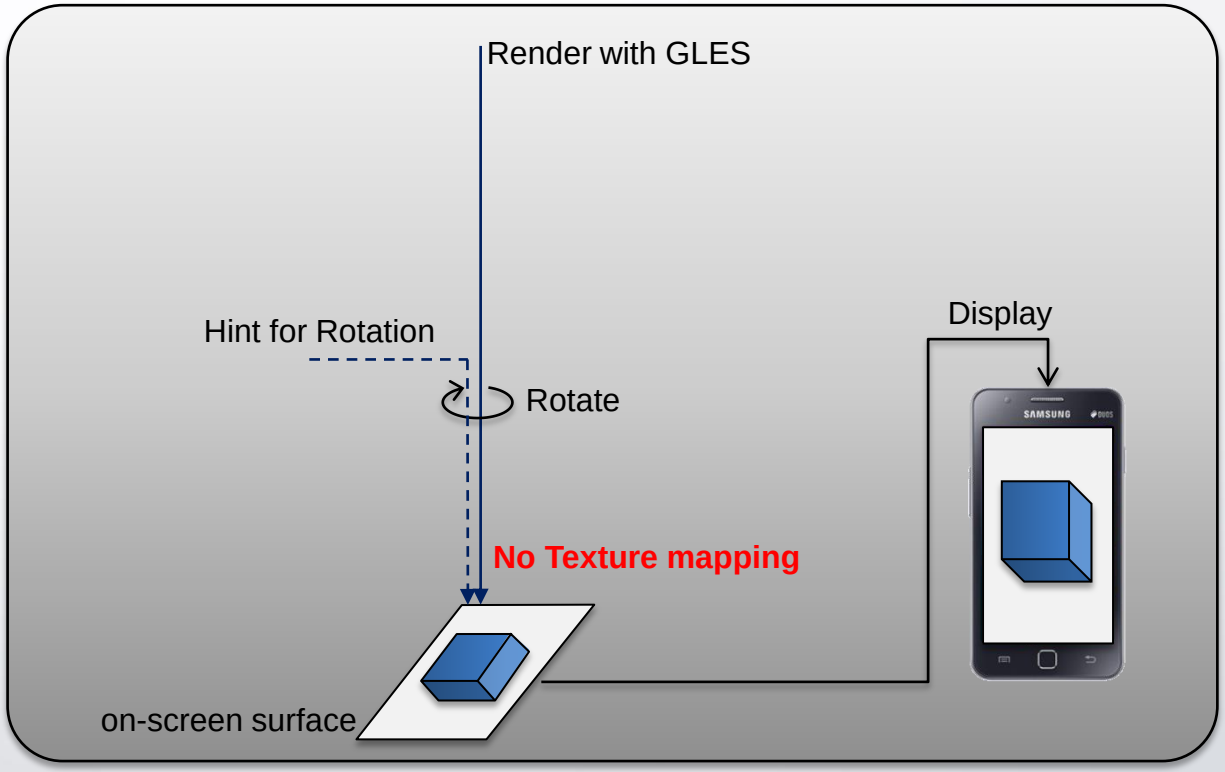
Performance Improvement (2): Pre-rotation feature

- Landscape typical way:
  - Use Intermediate off-screen Surface for Rotation



Performance Improvement (2): Pre-rotation feature

- Landscape efficient way:
  - Pre-rotation which does not need the Intermediate Surface



Pre-rotation in evasgl (1)

- How to use the feature?
  - Just turn-on DIRECT mode
  - Requirements
    - GPU Driver must supports pre-rotation feature
    - When GPU does not support, then the rendering mode fallbacks to INDIRECT mode

Case 1: EVAS_GL_OPTIONS_DIRECT mode

```
/* Set config of the surface for evas gl */
......
ad->cfg = evas_gl_config_new();
ad->cfg->options_bits = EVAS_GL_OPTIONS_DIRECT; // DIRECT mode on
......

/* Get rotation angle for developers */
angle = evas_gl_rotation_get(ad->evas_gl); // angle is zero, and there is nothing for developers to do
                                           // when pre-rotation is not supported,
                                           //   render mode fallbacks to INDIRECT mode for LANSCAPE state
......
```

Pre-rotation in evasgl (2)

- Workaround for devices not supporting pre-rotation?
  - Rotate the scene by application side
  - *EVAS_GL_OPTIONS_CLIENT_SIDE_ROTATION*
    - System is rotated (ex. touch), exception the on-screen surface

```
Case 2: EVAS_GL_OPTIONS_CLIENT_SIDE_ROTATION
```

```
/* Set config of the surface for evas gl */
......
ad->cfg = evas_gl_config_new();
ad->cfg->options_bits = EVAS_GL_OPTIONS_CLIENT_SIDE_ROTATION   // DIRECT mode on,
                                                               // Rendering is always for Portrait
.......

/* Get rotation angle for developers */
angle = evas_gl_rotation_get(ad->evas_gl); // angle shows the current device orientation
                                           // developers must rotate the rendered scene according to angle
......
```

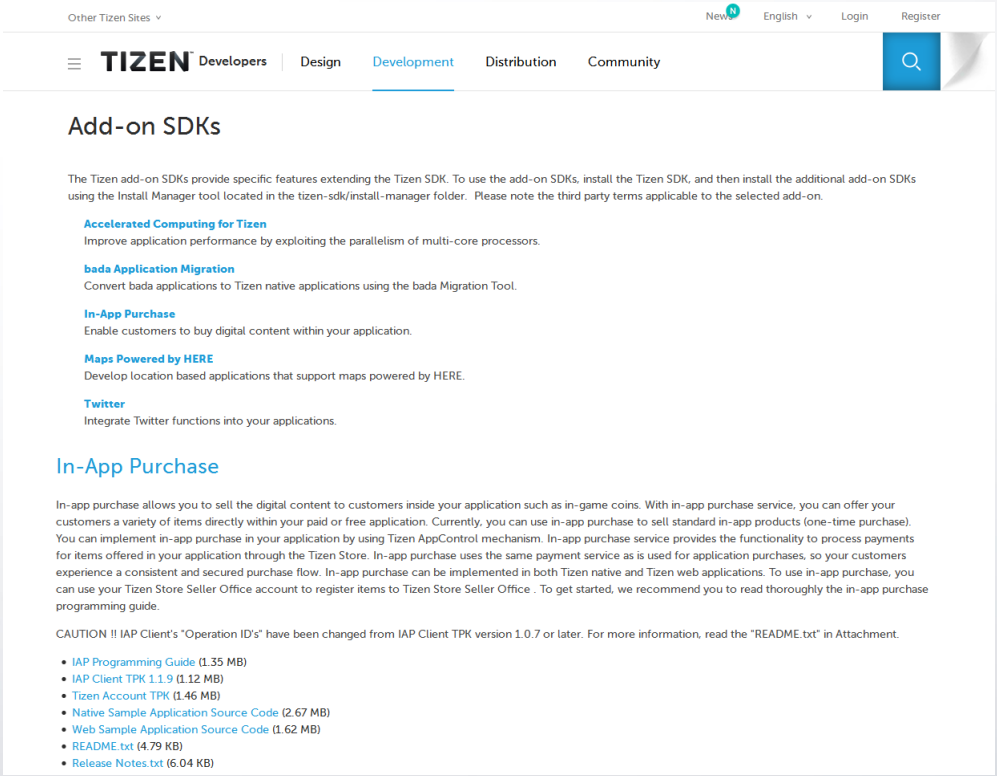
In-App-Purchase (IAP) in Tizen (1)

- Tizen IAP
  - IAP feature based on AppControl mechanism
    - You can borrow the functionality of TizenStore Client
    - There is no prerequisite in your projects
  - Basic work flow
    - Register items to Tizen Store Seller Office (**http://seller.tizenstore.com**)
    - Make your applications to work with IAP
    - Test and upload your application
  - Just check the ‘IAP Programming Guide’ and do IAP right now

In-App-Purchase (IAP) in Tizen (2)

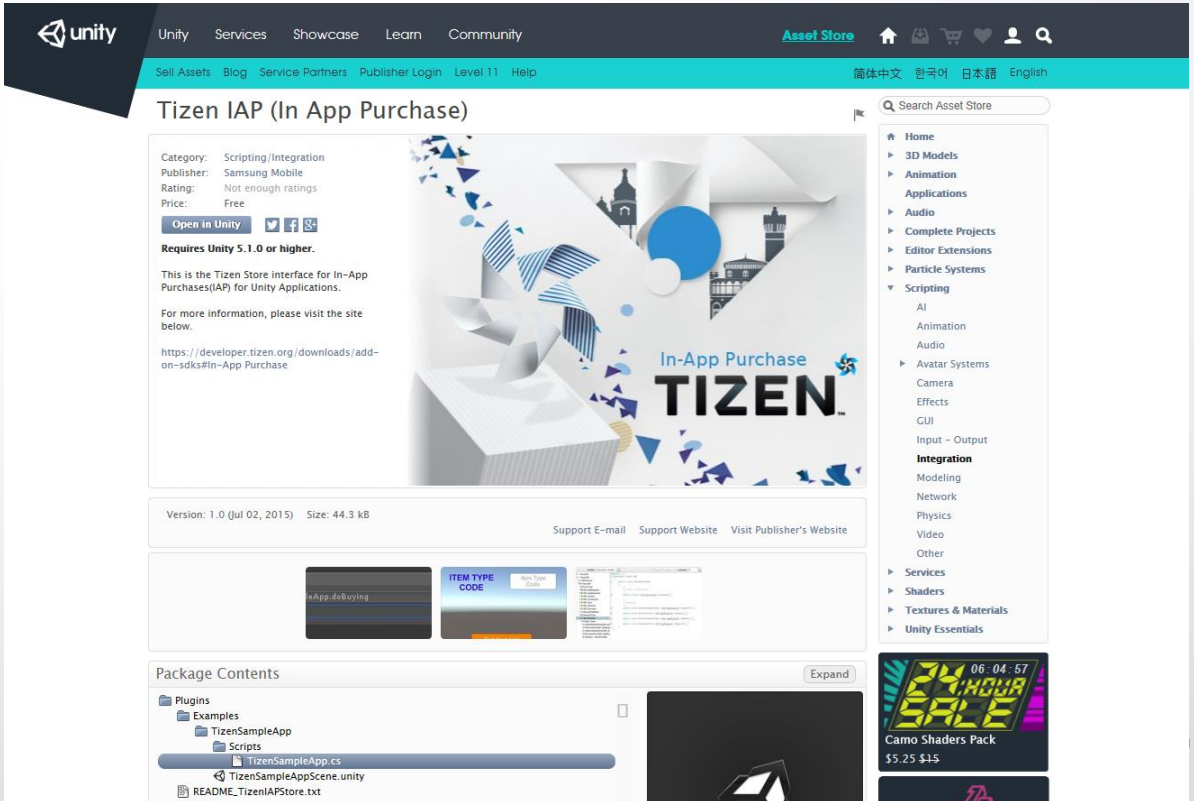
- Materials for IAP feature

http://developer.tizen.org/downloads/2.2.1-add-on-sdks



Tizen IAP with Unity

- Unity Plugin for Tizen IAP
  - Integrate C-based Tizen AppControl into .NET-based Unity scripts



Tizen IAP with cocos2d-x

- Brute force way to integrate Tizen IAP and cocos2d-x
  - Use Tizen AppControls in cocos2d-x app directly
- cocos2d-x plugin for Tizen IAP
  - cocos2d-x is open-source, and we are considering,
    - to integrate Tizen IAP to Plugin-x
    - to integrate Tizen IAP to SDKBOX

Summary

- Games for Tizen
  - New opportunity for business
  - Expandability, convergence and performance
- Porting to Tizen
  - Game engines help your joining to Tizen
- Basics and Tips for your development and optimization
  - evasgl and elm_glview
  - DIRECT mode and pre-rotation
- Monetization
  - Tizen IAP, and plugin supports

Q&A

and **THANK YOU** for your time.

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