移动端图像加载优化与增强

基于图形硬件特性

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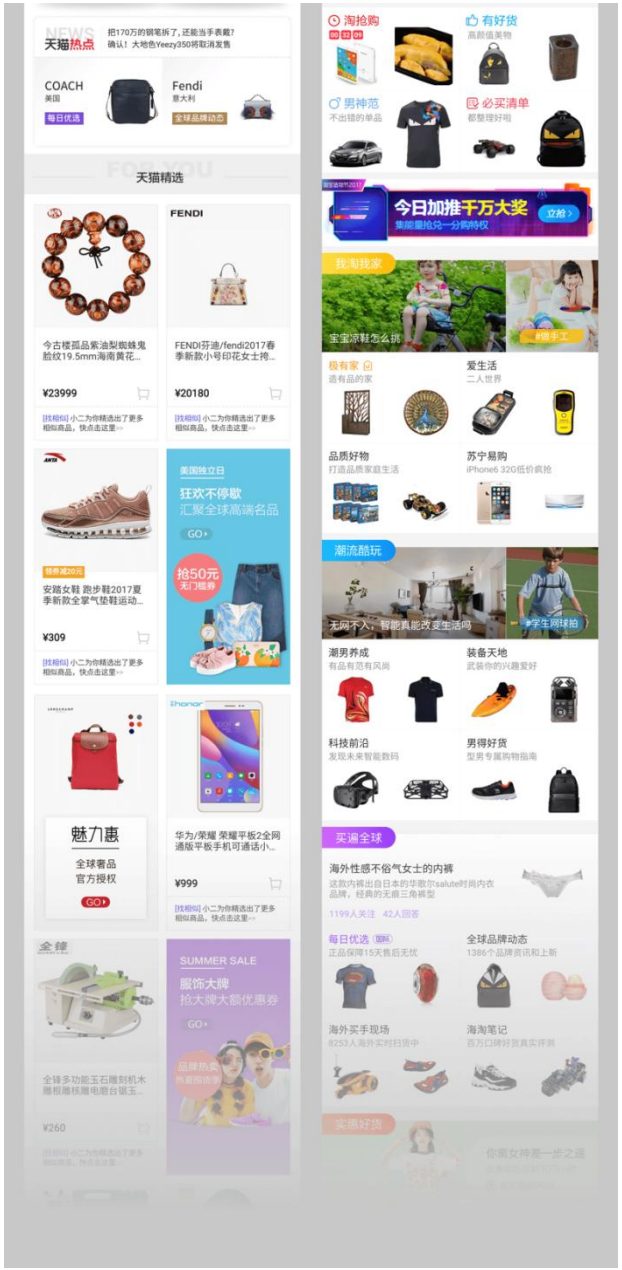
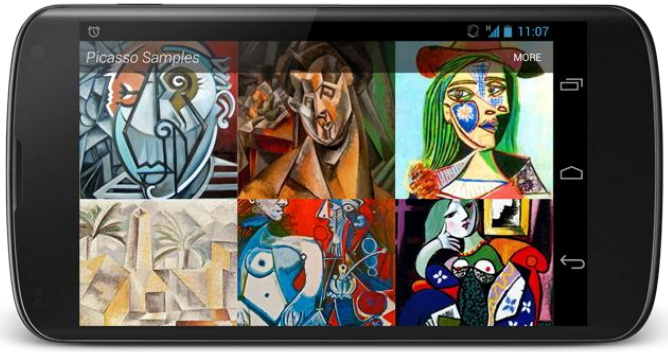
AGENDA

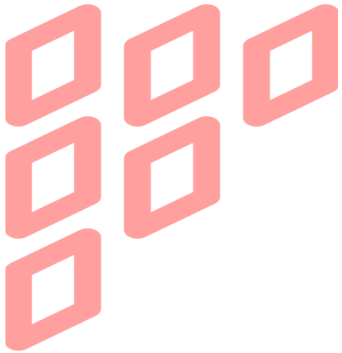
- 图片内容业务和行业现状
  - 图片内容业务
  - 现有解决方案和不足
- 技术背景和关键特性
- 框架设计与实现





本图由Picasso官方网站提供| Source: http://square.github.io/picasso

glide



- CDN解析度分级
- 文件头精简
- 长链接

网络效率

内存利用

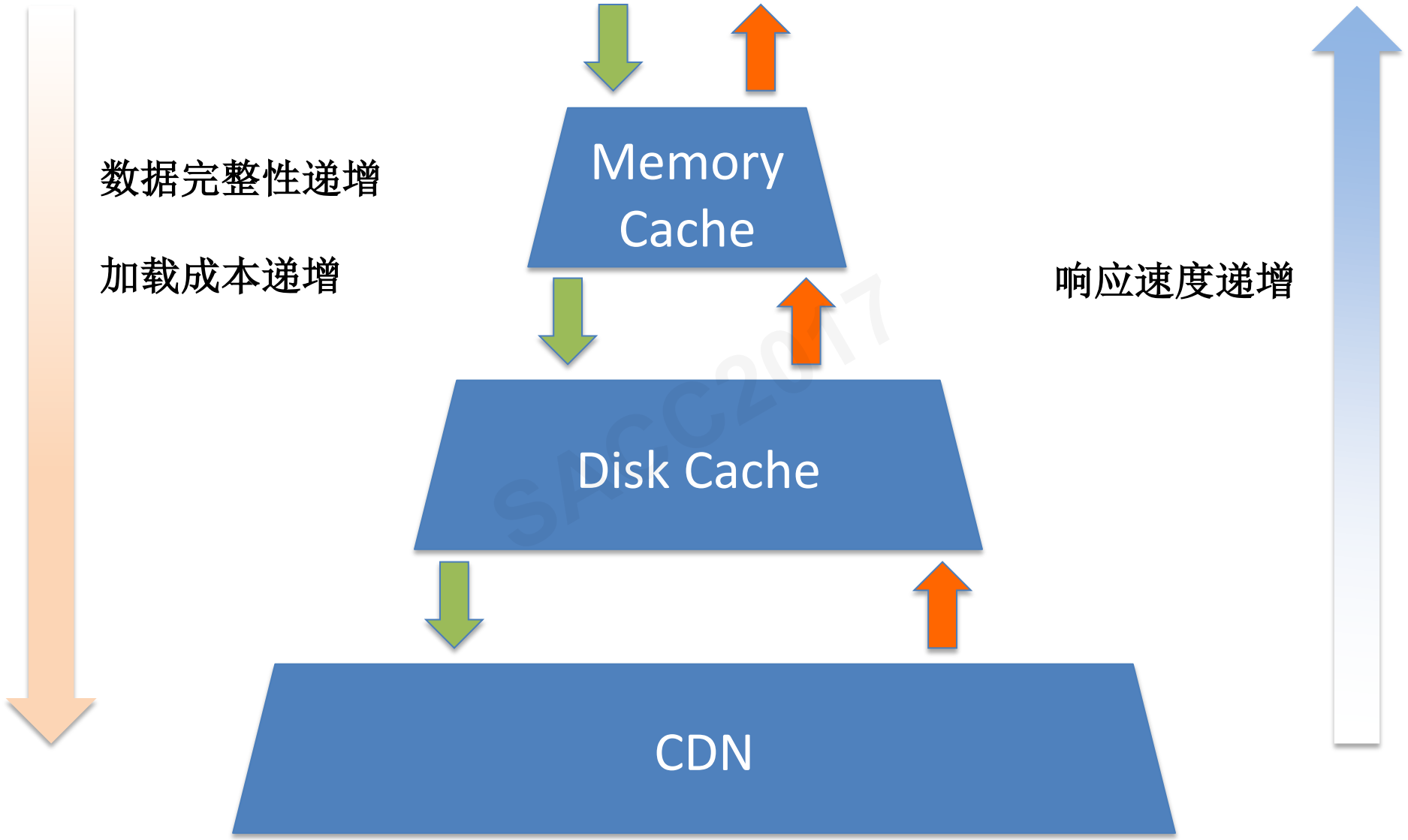
- Ashmem
- 位图复用

响应速度

- 缓存分级
- 淘汰策略
- 缩略图预加载

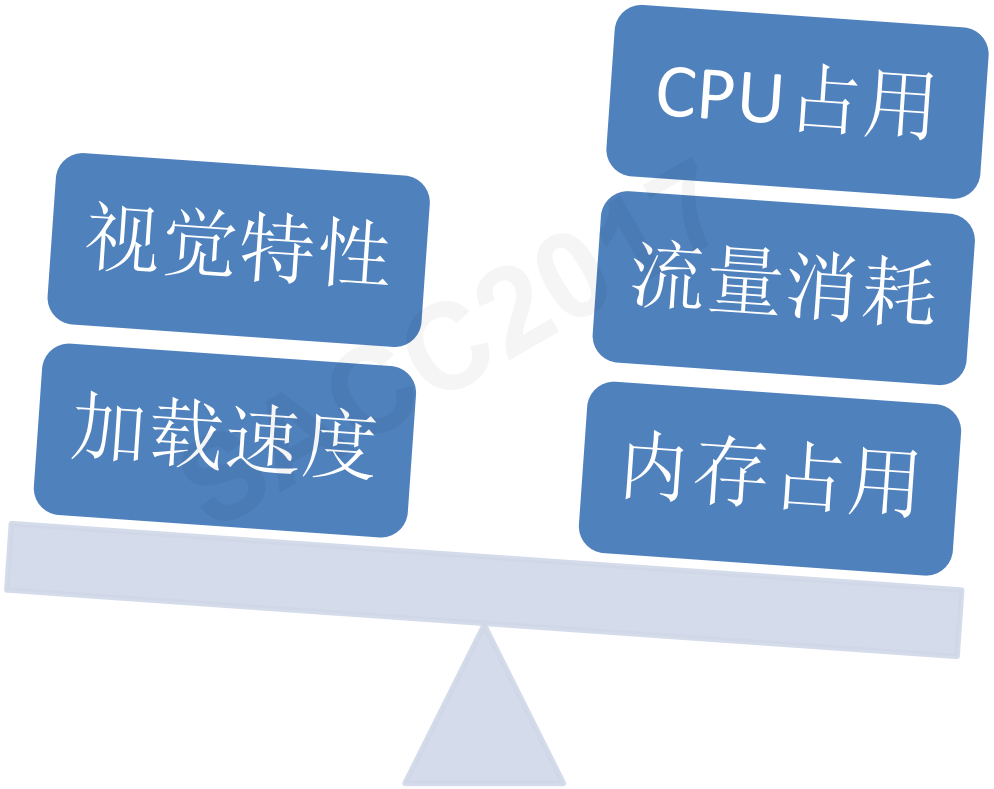
显示特性

- 异构并行处理
- 占位图


Request
Return
数据完整性递增
加载成本递增
Memory Cache
Disk Cache
CDN
响应速度递增

图片性能

系统限制



AGENDA

- 图片内容业务和行业现状
- 技术背景和关键特性
  - 移动图形硬件的发展
  - 可编程渲染管线和图像渲染
  - 纹理缓存
  - 渲染线程和OpenGL上下文共享
  - 基于时序的缓存预测
- 框架设计与整合

Evolution of Mobile Graphics

2010: TrueForce

Hardware: Galaxy S2
GPU: Mali-400MP4
API support: OpenGL ES 2.0
Primitives per frame: 16k
Cycles per pixel: 3.7
Draw calls per frame: 50

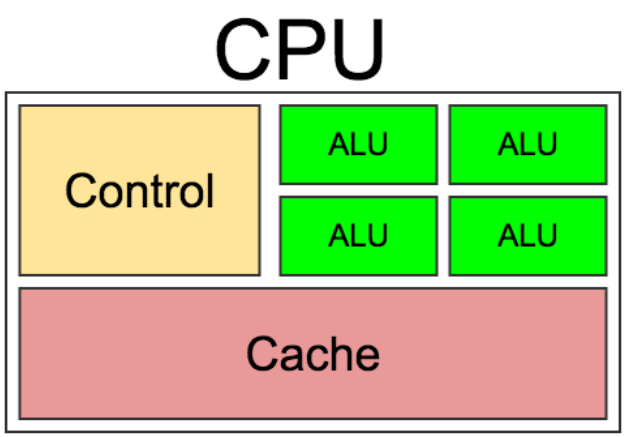
2013: Trollheim

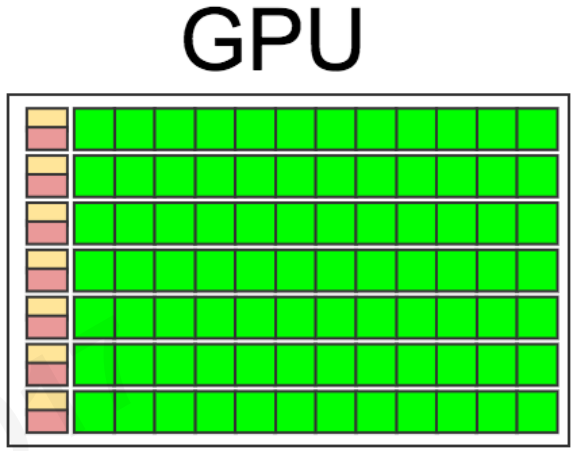
Hardware: Nexus 10
GPU: Mali-T604
API support: OpenGL ES 3.0, OpenCL 1.1
Primitives per frame: 150k
Cycles per pixel: 16
Draw calls per frame: 60

2016: Lofoten

Hardware: Galaxy S7
GPU: Mali-T880MP12
API support: Vulkan 1.0
Primitives per frame: 600k
Cycles per pixel: 40
Draw calls per frame: 500

本图由ARM提供| Source: http://community.arm.com

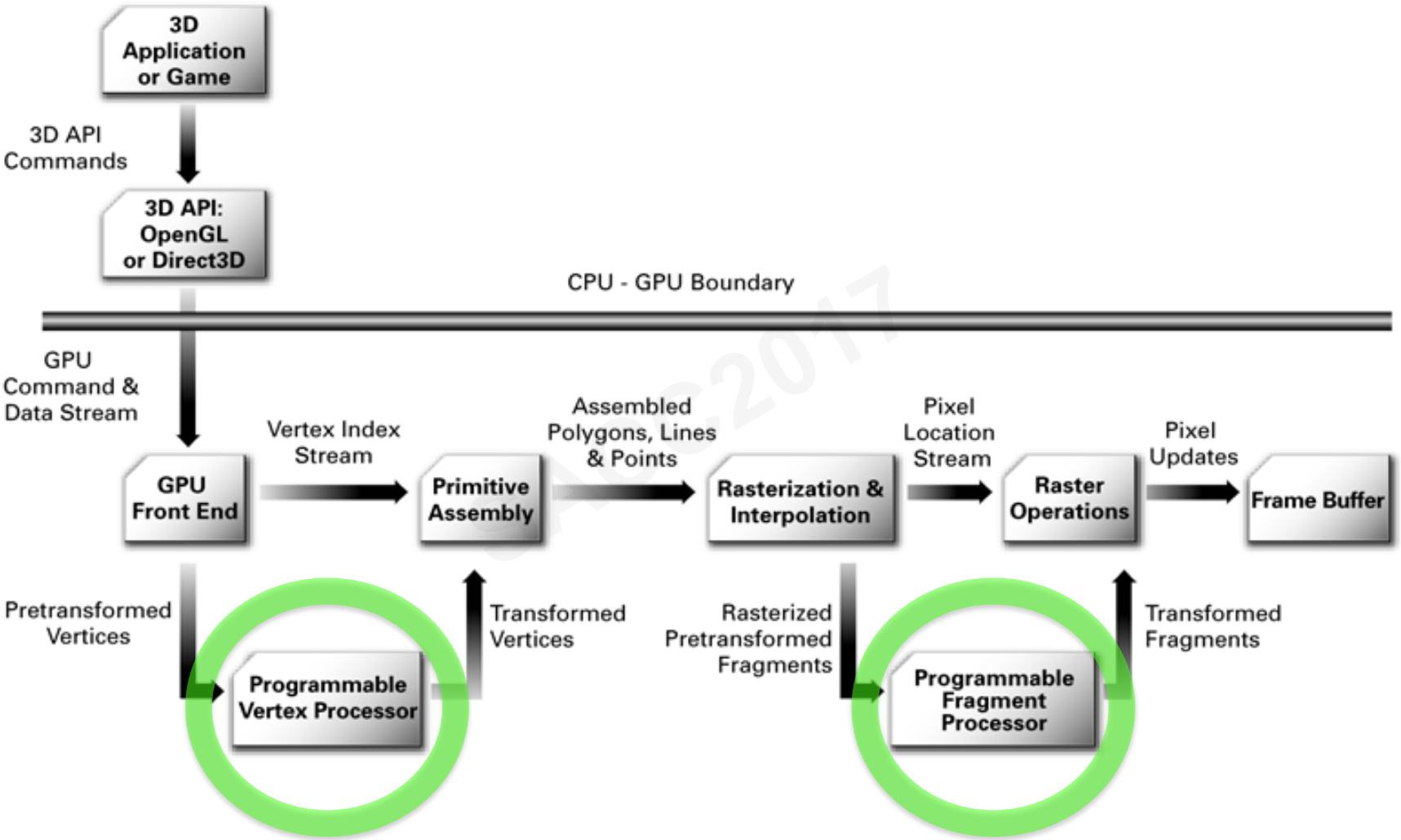




- 低运算单元密度
- 复杂控制逻辑
- 大缓冲存储器
- 串行操作优化
  - 高时钟频率
  - 少逻辑运算单元(ALUs)
- 短流水线（一般少于30个阶段）

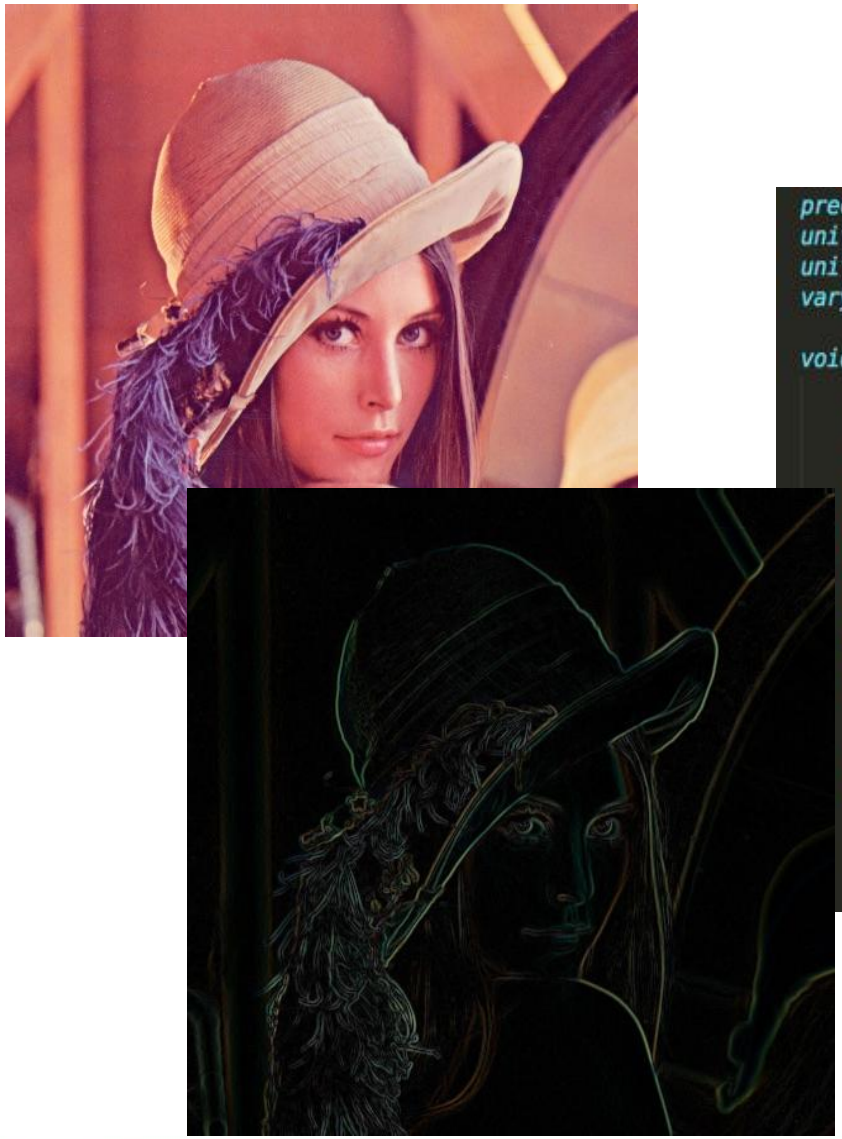
- 高运算单元密度
- 高计算内存访问
- 基于并行计算设计
  - 大量并行逻辑运算单元
  - 向量计算优化
- 深度流水线设计
- 高数据吞吐量

可编程图形渲染管线



本图由Nvidia提供| Source: http://developer.nvidia.com

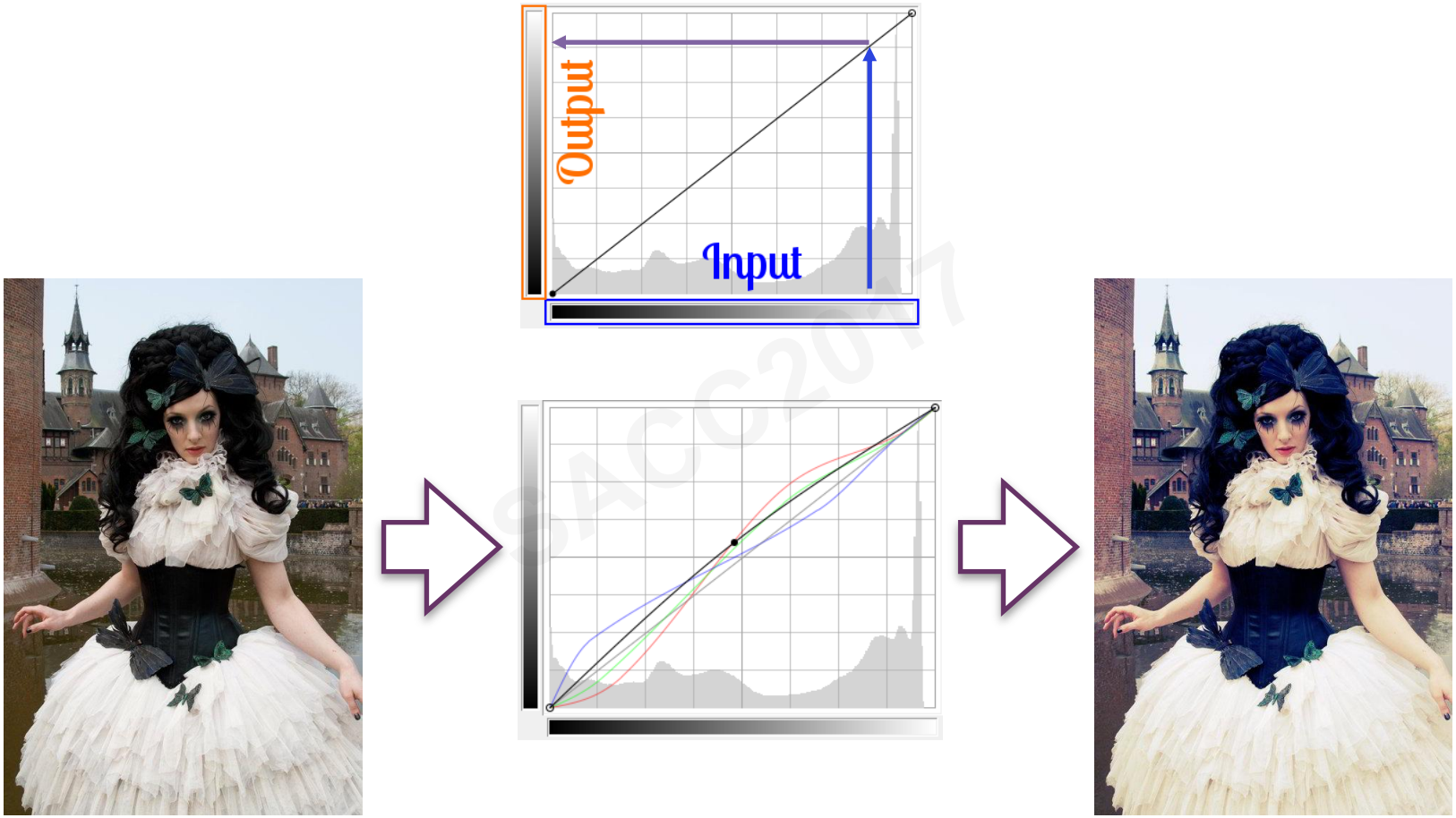
基于片段汇编的图像处理



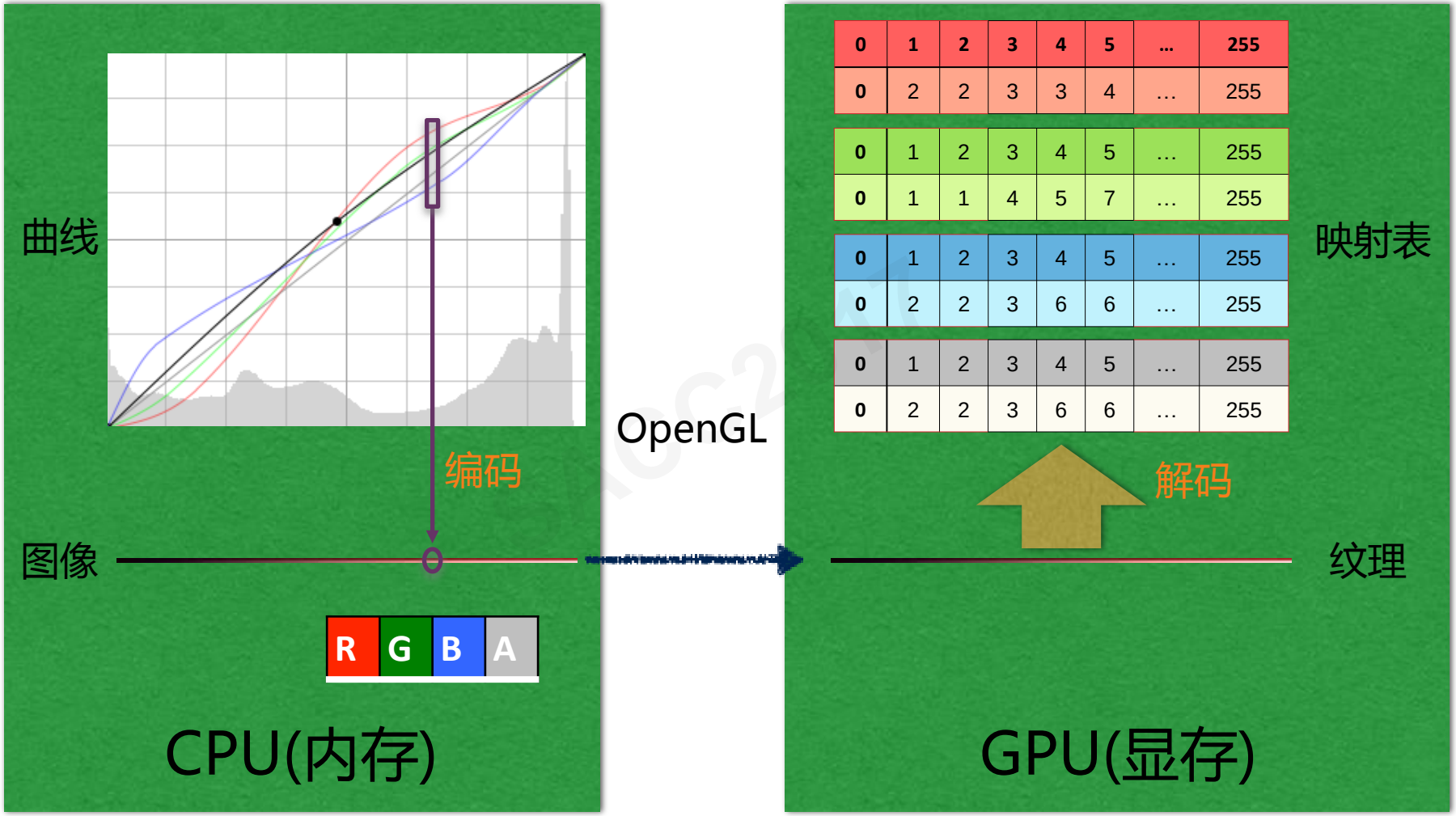
Fragment Shader Program

```
precision mediump float;
uniform vec2 u_pixsize;
uniform sampler2D tex_origin;
varying vec2 v_texcoord;

void main() {
    float dx = u_pixsize.x * u_param_0;
    float dy = u_pixsize.y * u_param_0;

    vec4 sam1 = texture2D(tex_origin, vec2(v_texcoord.x - dx, v_texcoord.y - dy));
    vec4 sam2 = texture2D(tex_origin, vec2(v_texcoord.x,      v_texcoord.y - dy));
    vec4 sam3 = texture2D(tex_origin, vec2(v_texcoord.x + dx, v_texcoord.y - dy));
    vec4 sam4 = texture2D(tex_origin, vec2(v_texcoord.x - dx, v_texcoord.y));
    vec4 sam5 = texture2D(tex_origin, vec2(v_texcoord.x + dx, v_texcoord.y));
    vec4 sam6 = texture2D(tex_origin, vec2(v_texcoord.x - dx, v_texcoord.y + dy));
    vec4 sam7 = texture2D(tex_origin, vec2(v_texcoord.x,      v_texcoord.y + dy));
    vec4 sam8 = texture2D(tex_origin, vec2(v_texcoord.x + dx, v_texcoord.y + dy));

    vec4 gx = (sam3 - sam1) + (sam5 - sam4) * 2 + (sam8 - sam6);
    vec4 gy = (sam6 - sam1) + (sam7 - sam2) * 2 + (sam8 - sam3);

    gl_FragColor = dot(gx, gx) + dot(gy, gy);
```

曲线调节效果



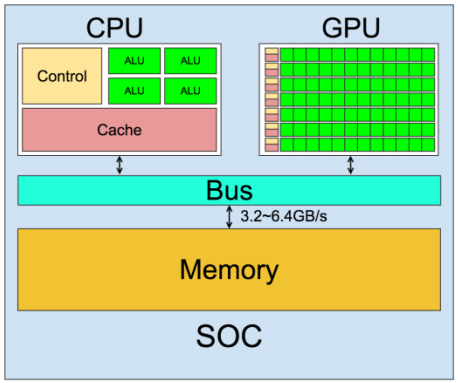
曲线调节效果

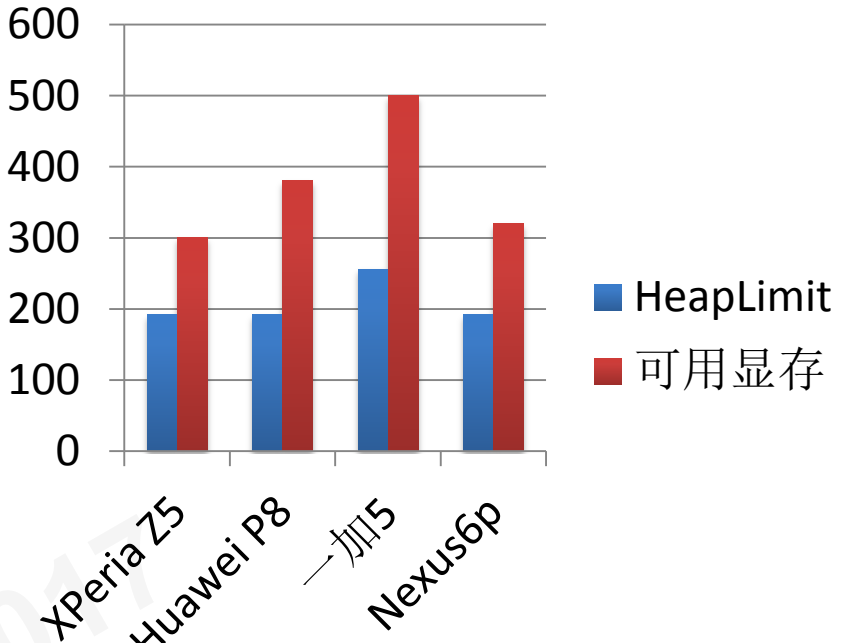

曲线
编码
图像
R
G
B
A
CPU(内存)
OpenGL
0 1 2 3 4 5 ... 255
0 2 2 3 3 4 ... 255
0 1 2 3 4 5 ... 255
0 1 1 4 5 7 ... 255
0 1 2 3 4 5 ... 255
0 2 2 3 6 6 ... 255
0 1 2 3 4 5 ... 255
0 2 2 3 6 6 ... 255
映射表
解码
纹理
GPU(显存)

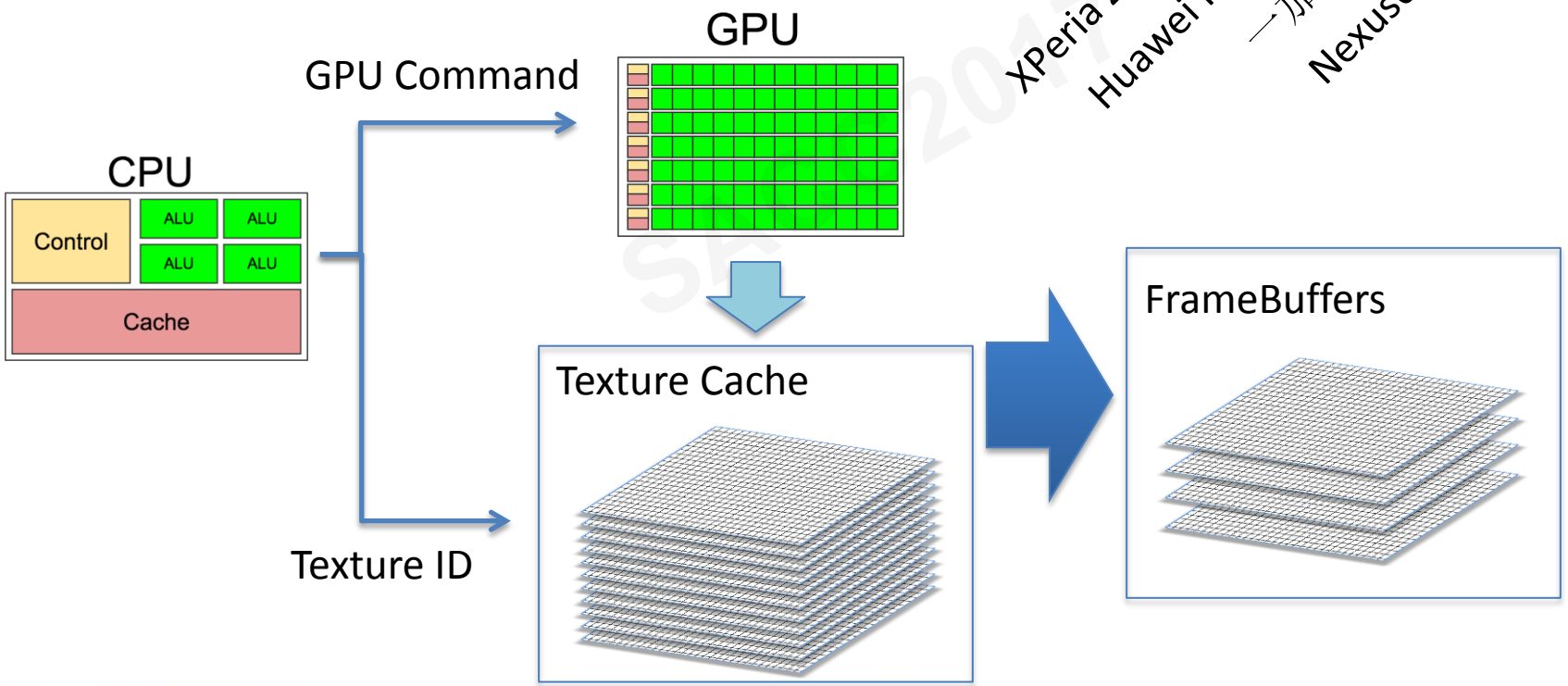
图片的动态显示效果

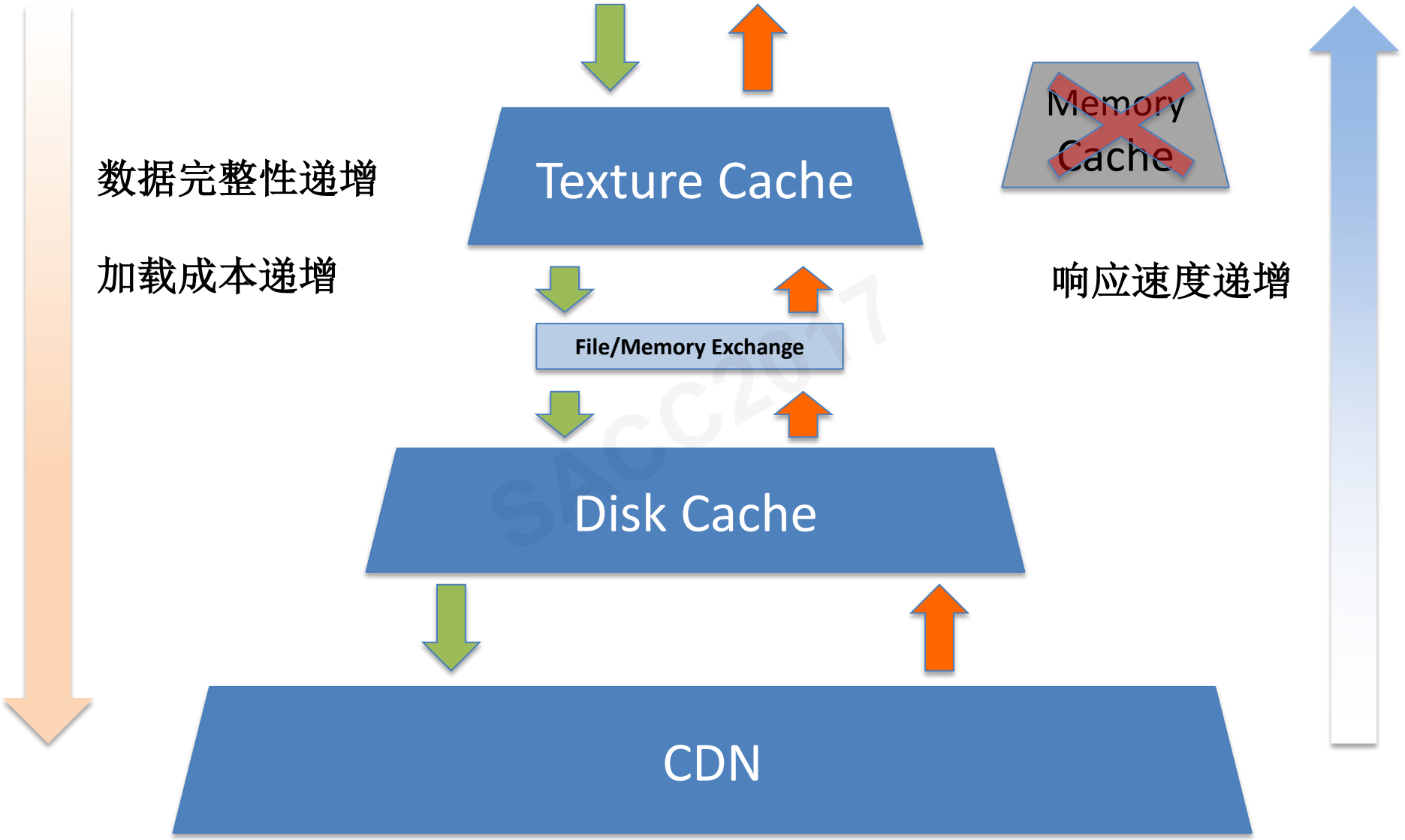

中国联通
12:32
扫码
缤纷T恤 凹千百种造型
消息
还有总价千万无门槛优惠券
爱生活
生活家
好生活并不贵
量贩团
多送1斤
喵鲜生
产地空运直达
美家
发现品质生活
品牌资讯
品牌街
职场时髦范儿
大牌入驻
世界小车领袖
5.16
盛大开业
什么牌子好
今夏露肉显瘦
微胖显瘦必备
国际海购
新版本
GO
环球口碑榜
芬迪人字拖
有礼
魅力惠 · 奢品
衬衫工艺巅峰
天猫
关注
购物车
我

纹理缓存

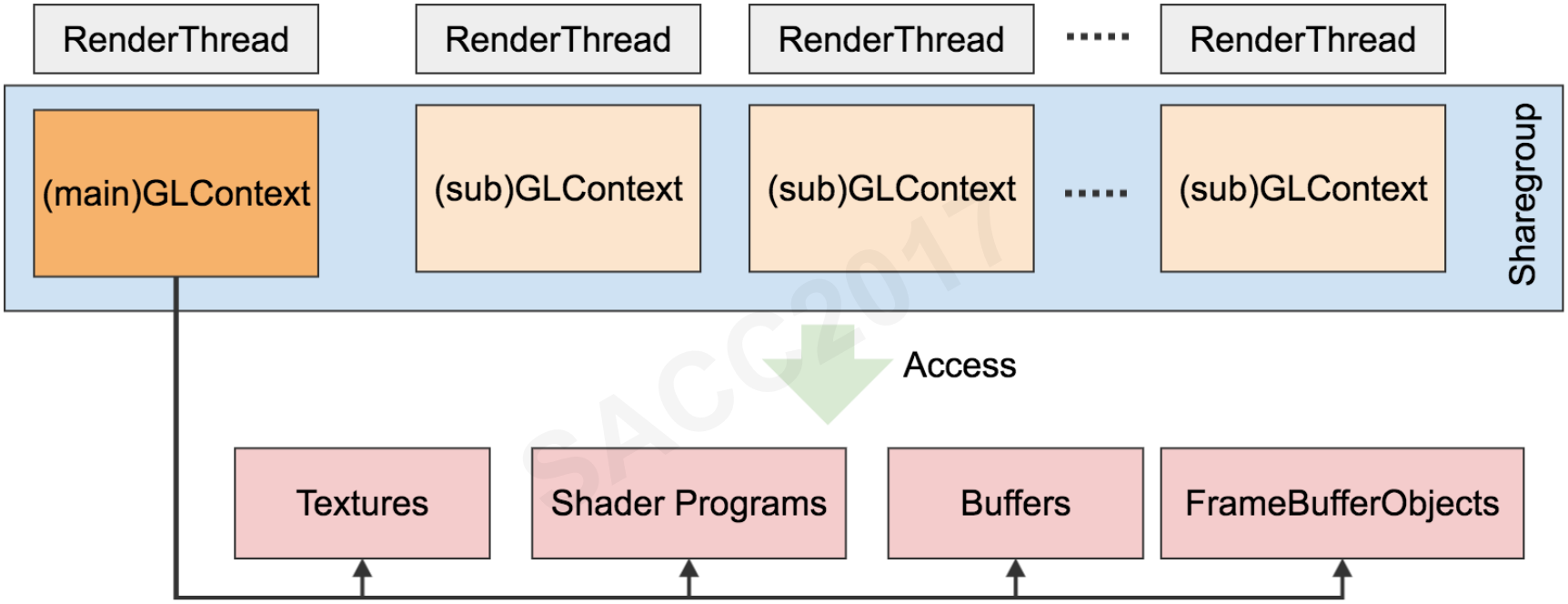




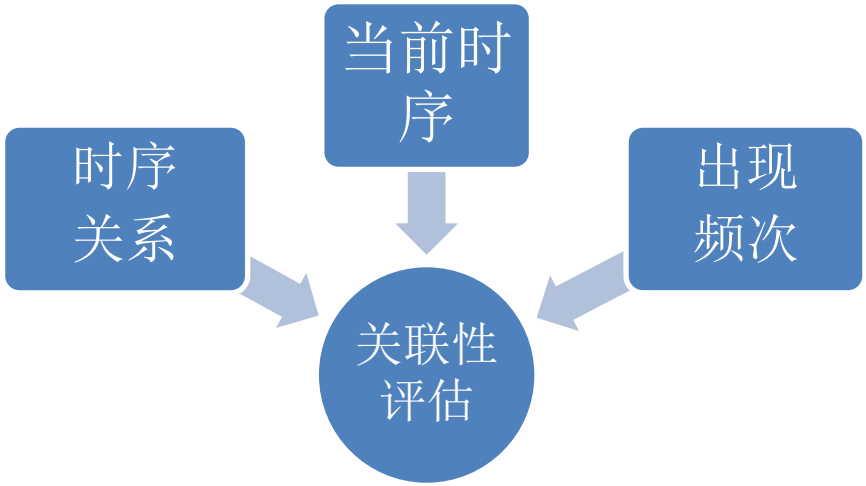



Request
Return
数据完整性递增
加载成本递增
Texture Cache
Memory Cache
响应速度递增
File/Memory Exchange
Disk Cache
CDN

渲染线程和共享上下文



基于时序的缓存策略

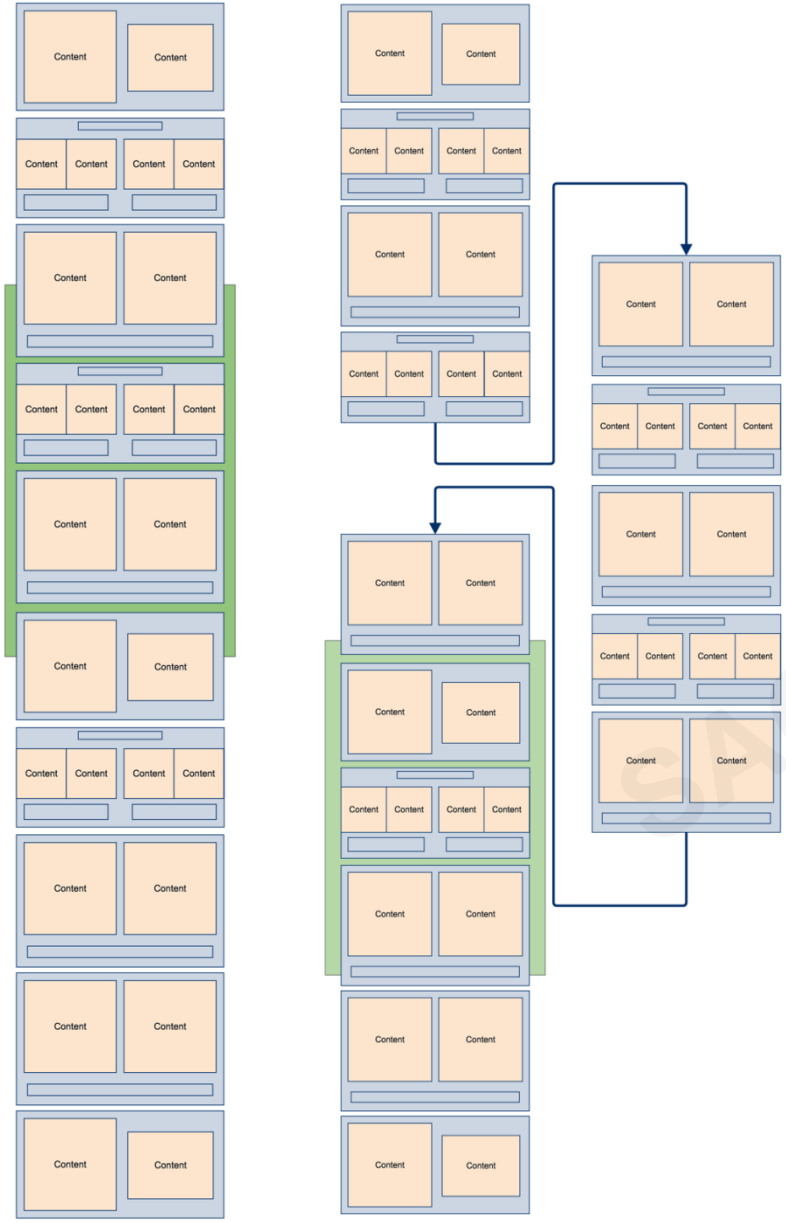


$$P(B|A) \propto P(B) * P(A|B)$$

P(A):当前内容被使用概率，P(B):待评估内容被使用概率

P(B|A):当前内容被使用时待评估内容也被使用的概率

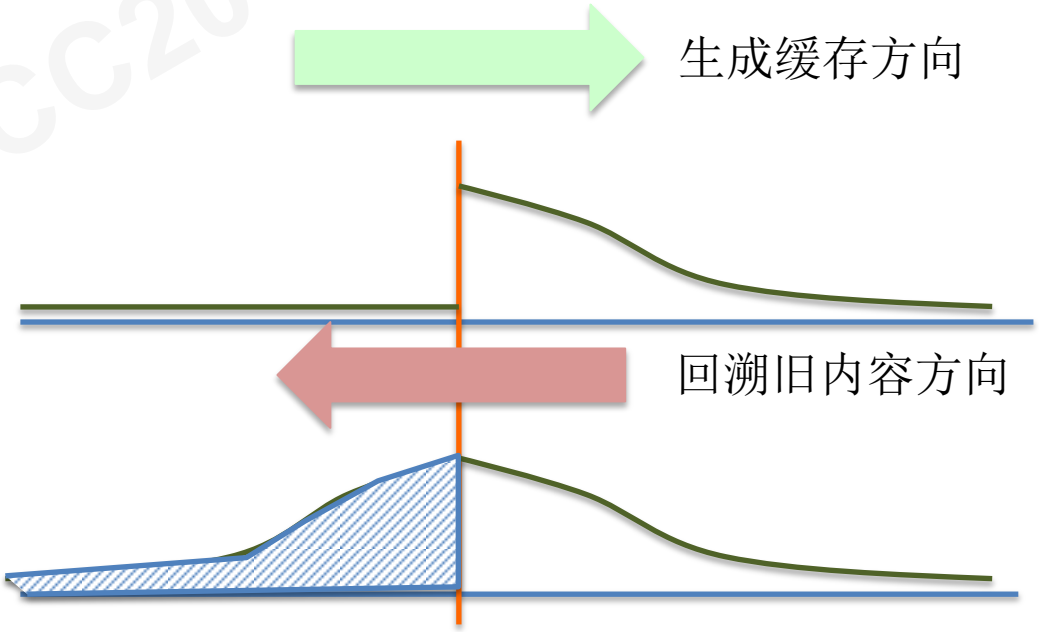
缓存预测　　缓存淘汰

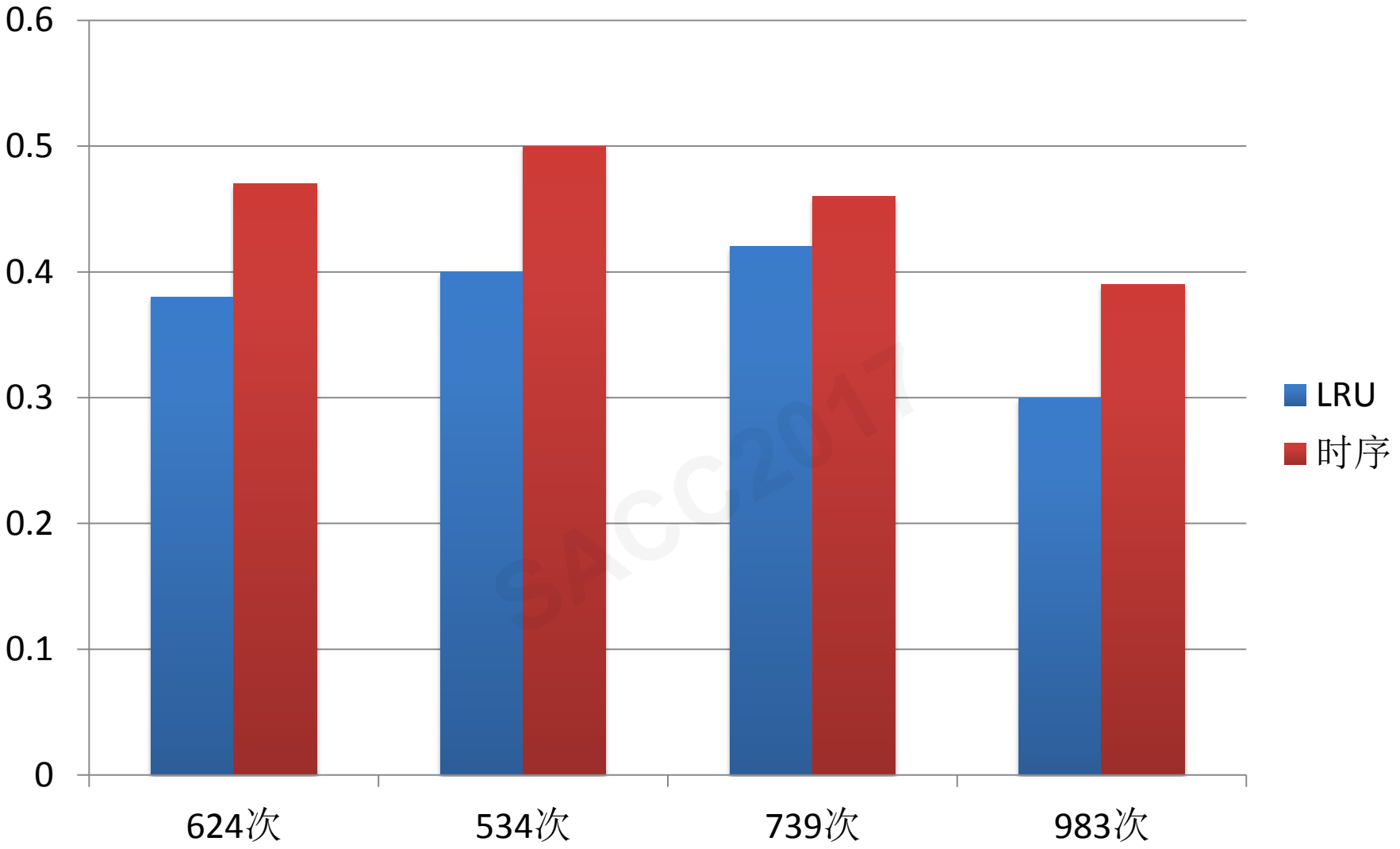


LRU: $P(B|t) \propto P(B) * \frac{1}{(t - t_b)}$

VS

内容时序相关性：$P(B|A) \propto P(B) * P(A|B)$

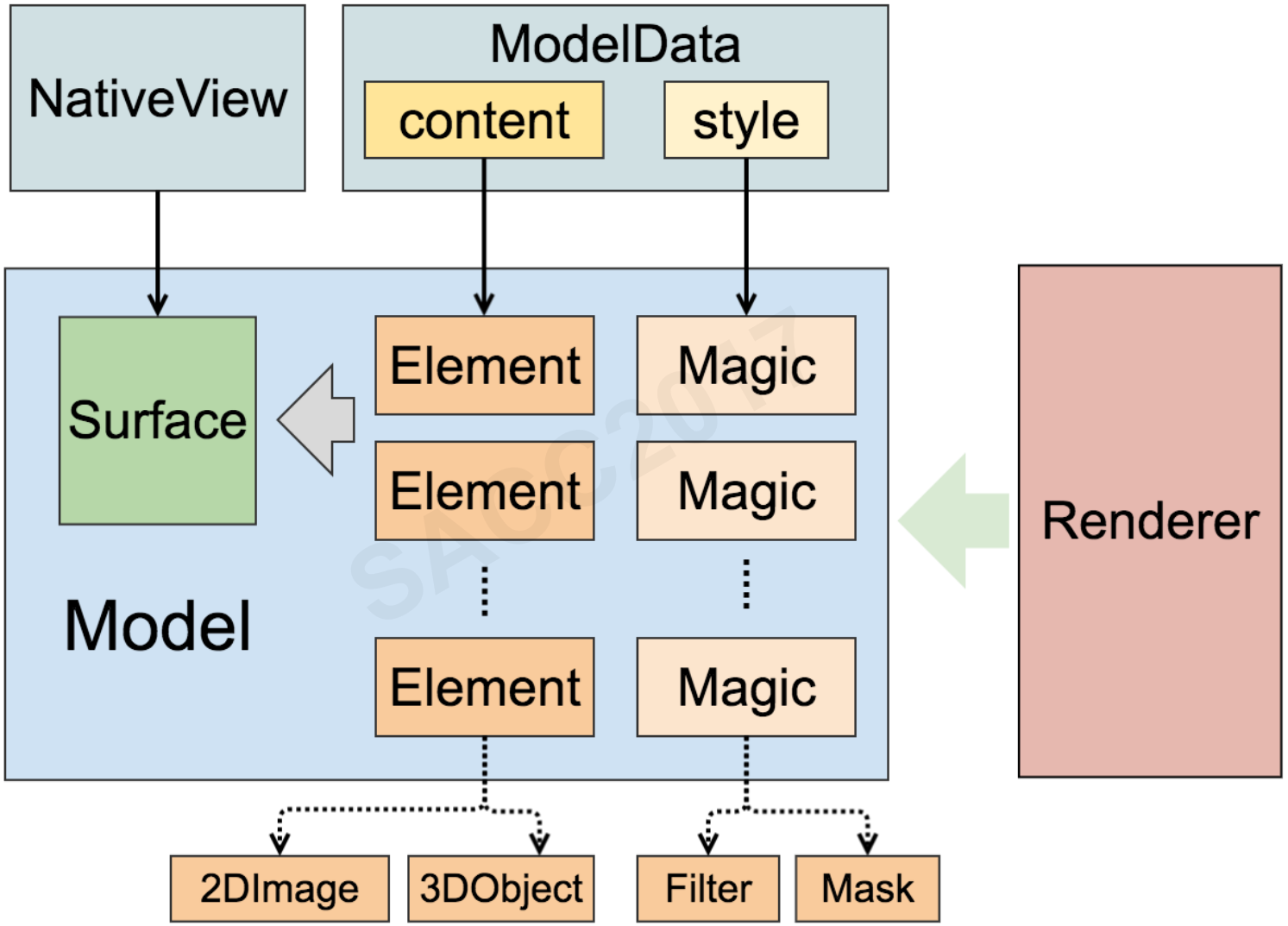




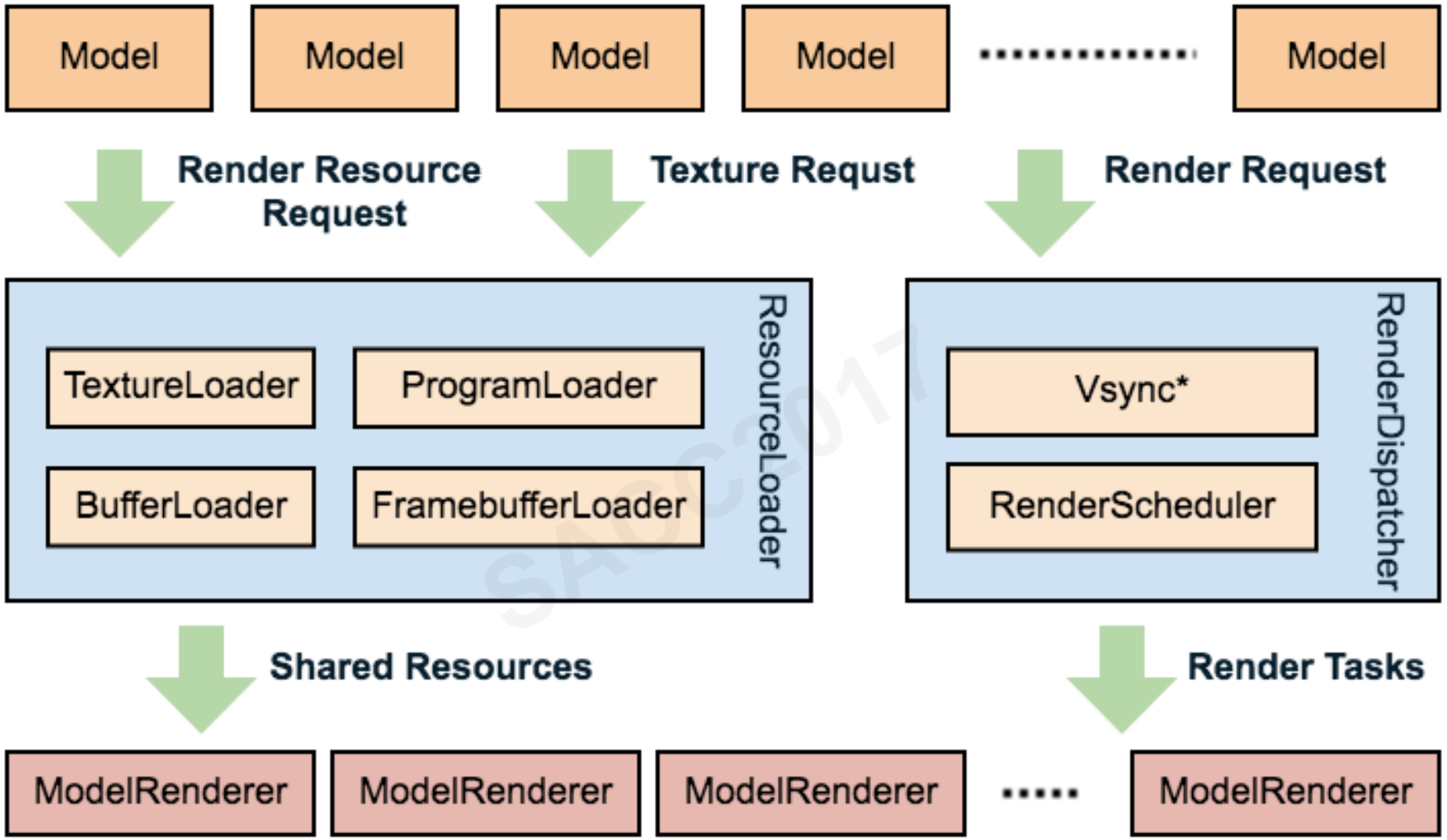
AGENDA

- 图片内容业务和行业现状
- 技术背景和关键特性
- 框架设计与整合
  - 模型渲染框架
  - 资源加载和渲染任务分发

组件模型渲染框架


NativeView
ModelData
content
style
Surface
Element
Element
Element
Magic
Magic
Magic
Model
Renderer
2DImage
3DObject
Filter
Mask

资源加载和渲染任务分发




THANKS