From Separated ECUs to a Display Cluster

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Jonathan Conrad, Violin Yanev, Bernhard Kißlinger
BMW Car IT

Challenge

- Multiple displays
- Different hardware, different companies
- Seamless integration of content

→ Content not fixed to one display

Agenda

1. Challenge
2. Solution Ideas
3. RAMSES Concepts & Features
4. Live Demonstration
5. Wrap-up

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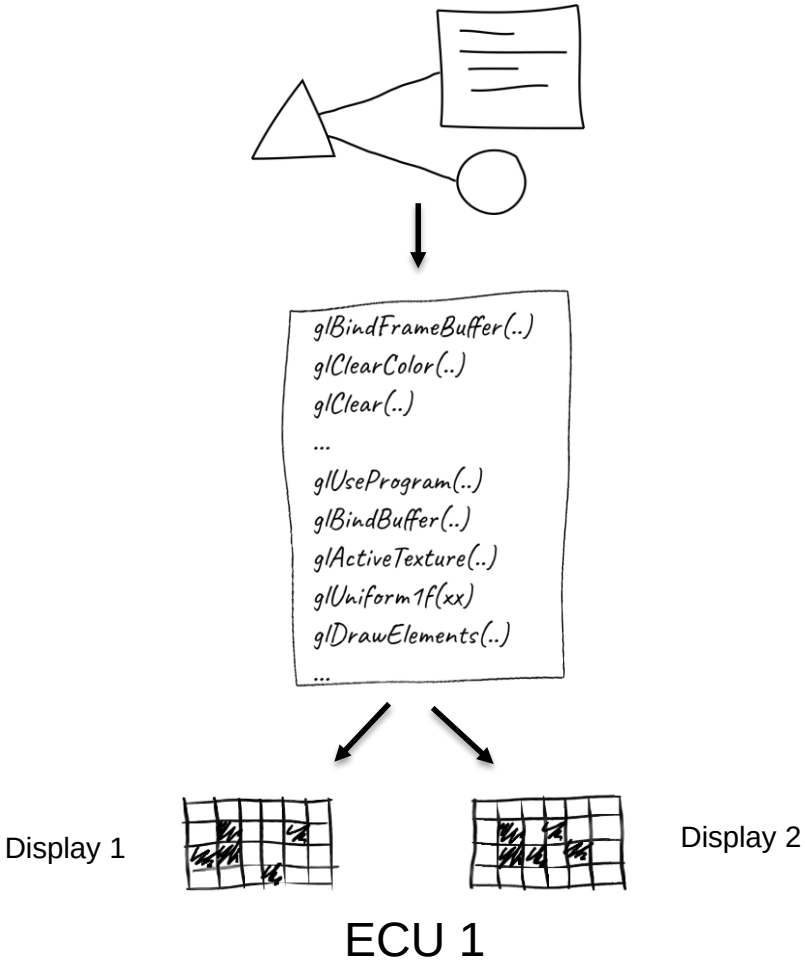
Solution ideas

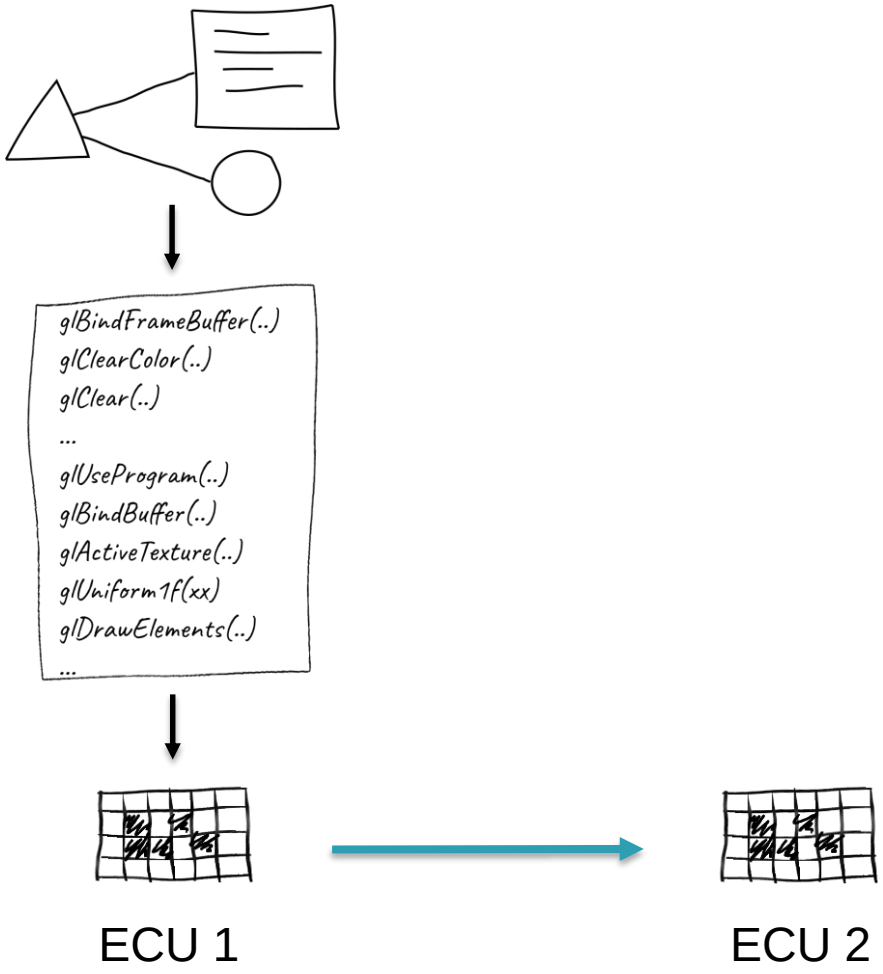
Solution ideas:
1. One ECU with multiple displays



- \+ No solution for distribution necessary
- \+ No network issues

- − High computation power needed, scaling to more displays problematic
- − Interaction between content from different processes limited

Solution ideas:
2. Video distribution



- ✚ Easy integration of existing applications

- ▬ High computation power needed
- ▬ High bandwidth requirements
- ▬ Compression artifacts possible
- ▬ Availability of hardware encoders and decoders can limit deployment
- ▬ Interaction between content from different sources limited

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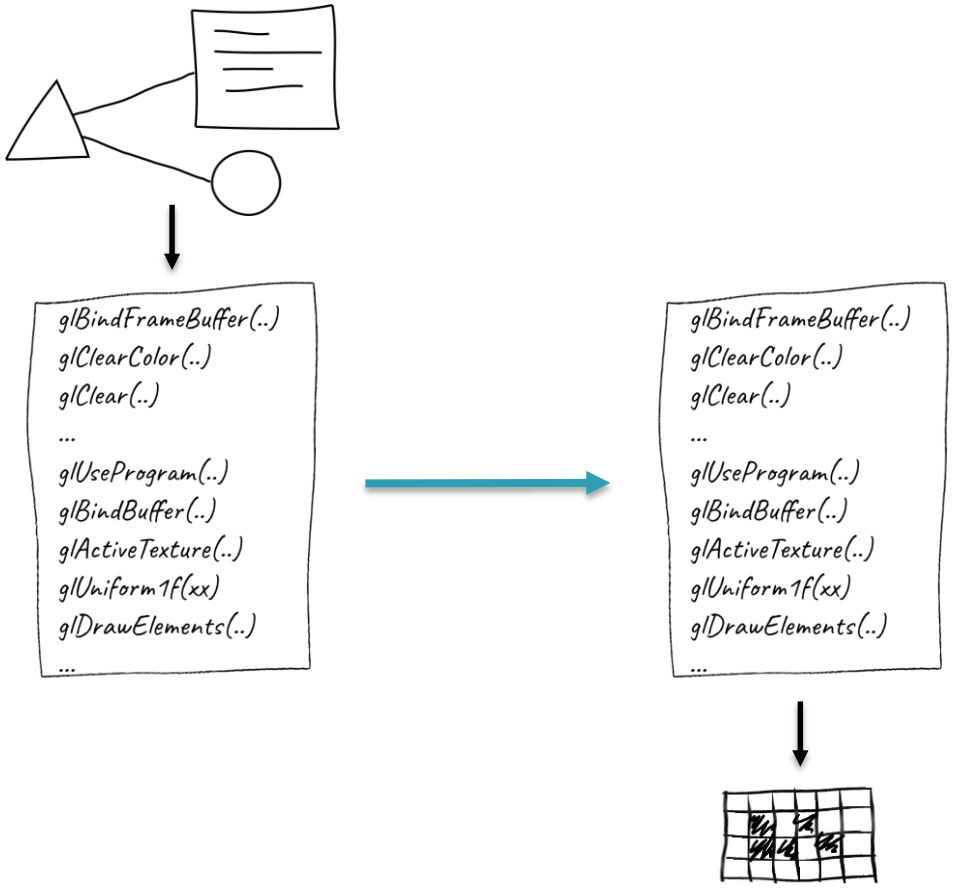
Solution ideas:
3. OpenGL commands streaming



- ✚ Easy integration of OpenGL-based applications
- ✚ No compression artifacts
- ✚ Easier scaling to higher resolutions
- ✚ No GPU needed on sending side

- ➖ Limited to OpenGL-based applications
- ➖ Medium bandwidth requirements (full description for each single frame has to be transferred)
- ➖ Platform-dependencies with receiving side
- ➖ Interaction between content from different sources complex

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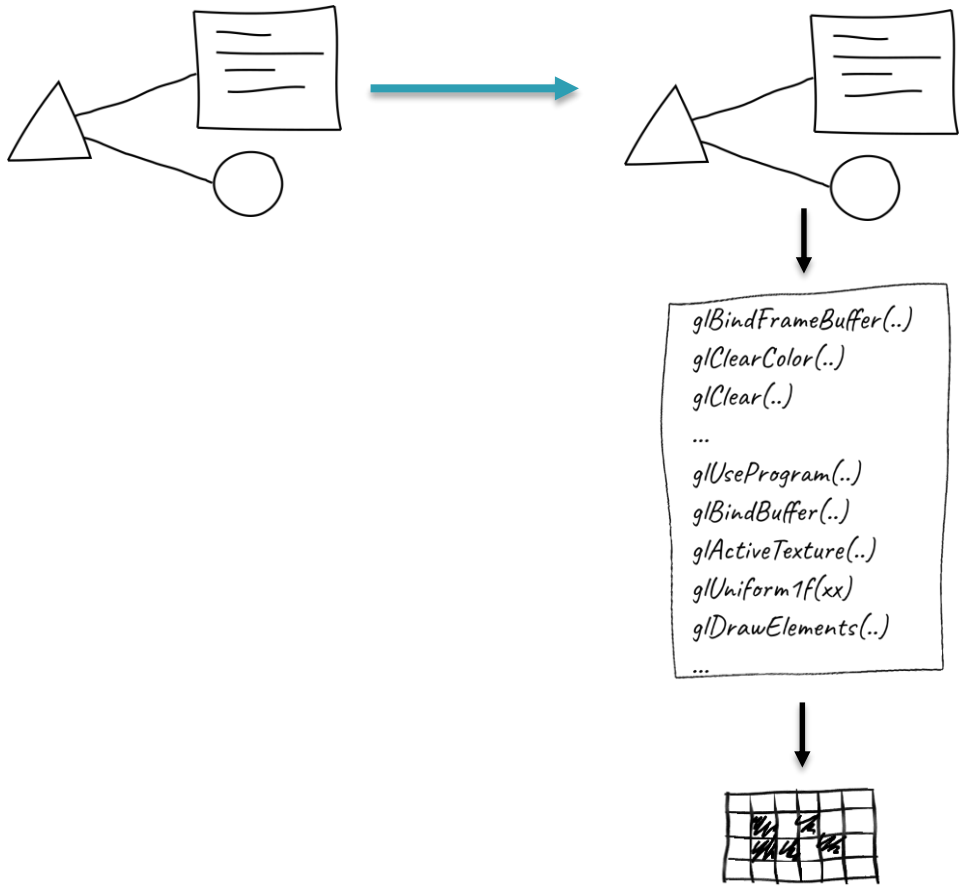
Solution ideas:
4. Scene-based distribution



ECU 1

ECU 2

- Low network bandwidth needed especially after initial transfer
- No compression artifacts
- Easier scaling to higher resolutions
- No GPU needed on sending side
- Graphical interaction possible between scenes from different ECUs

- Application has to provide content with special API

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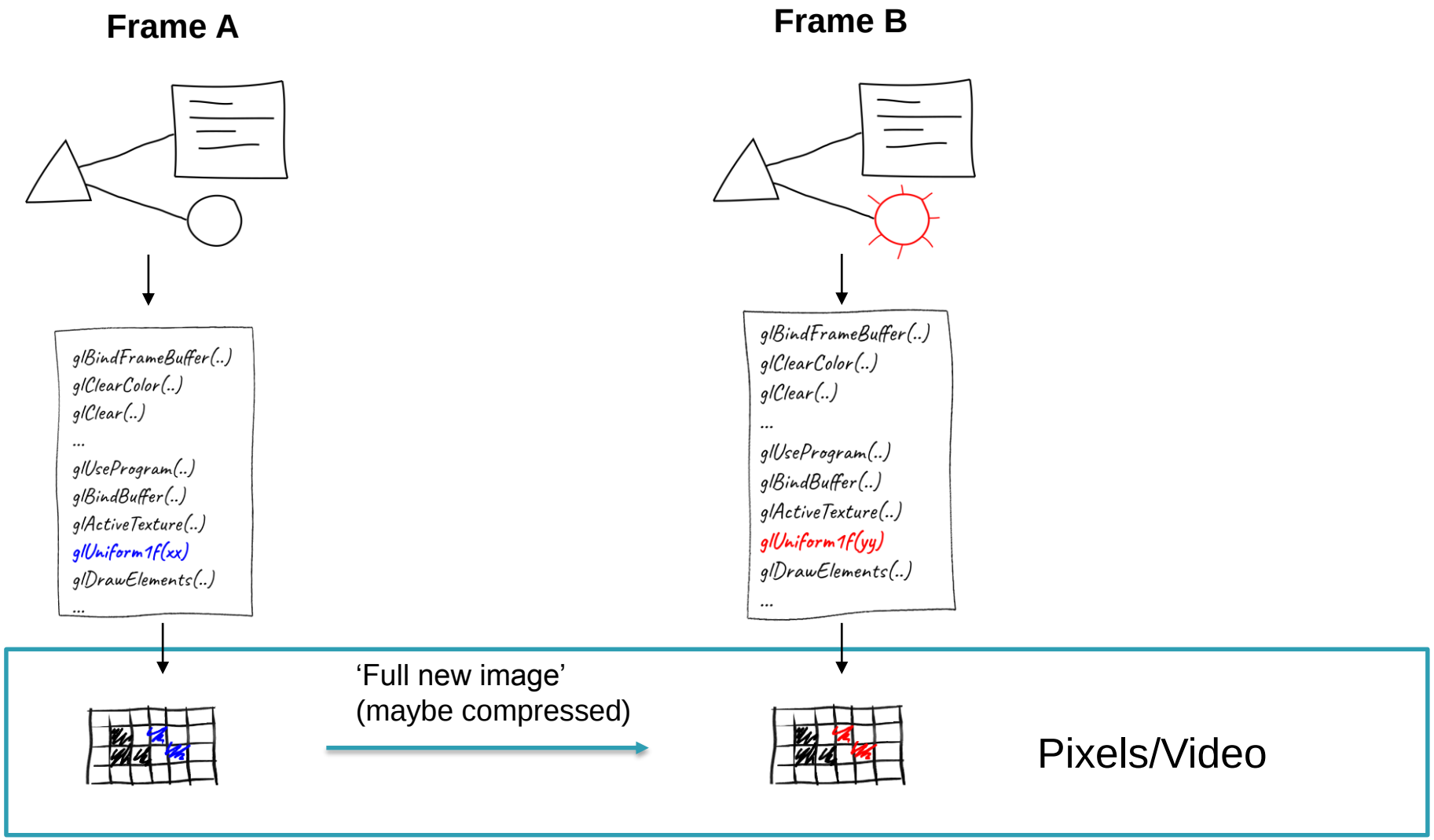
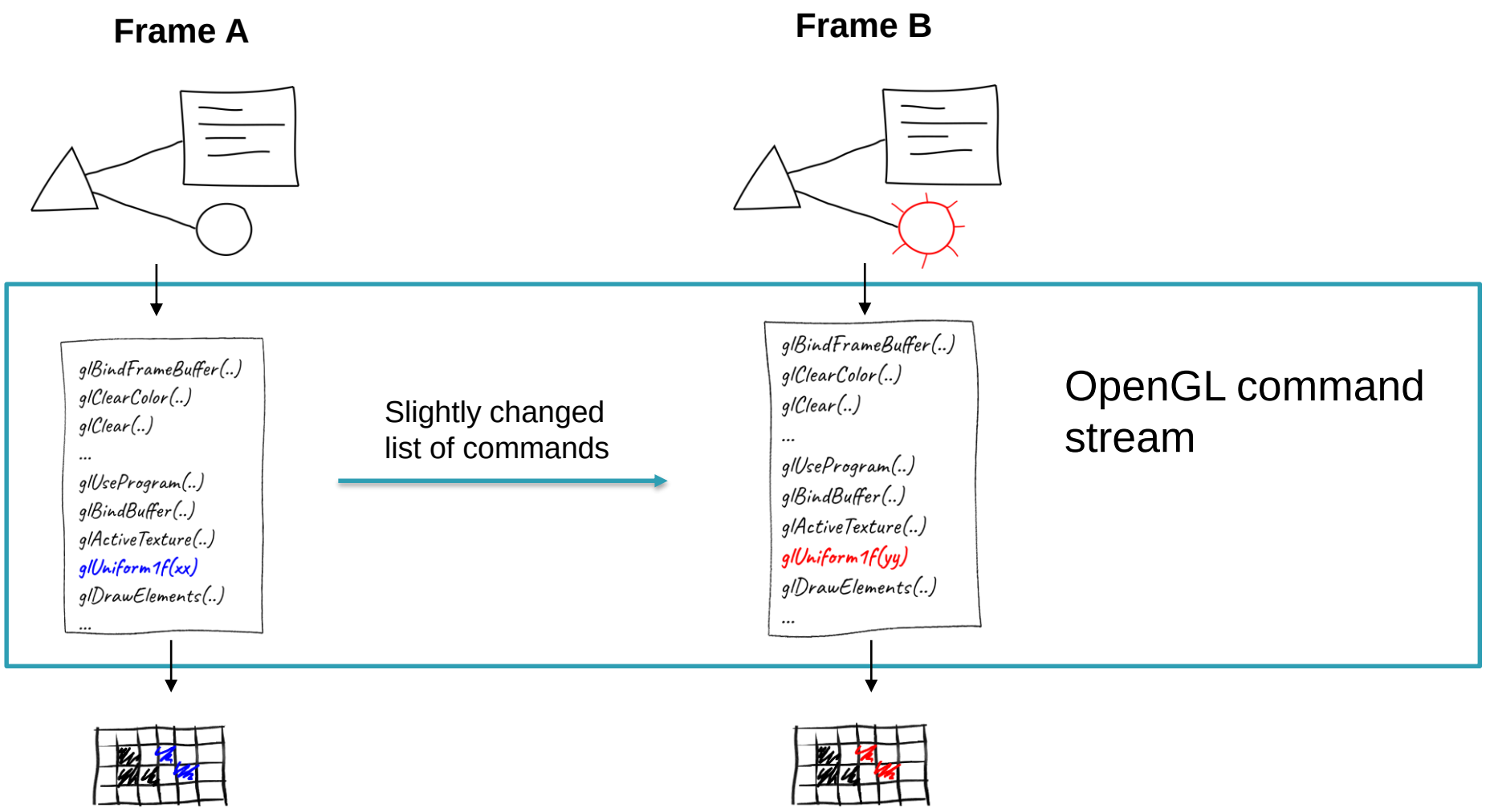
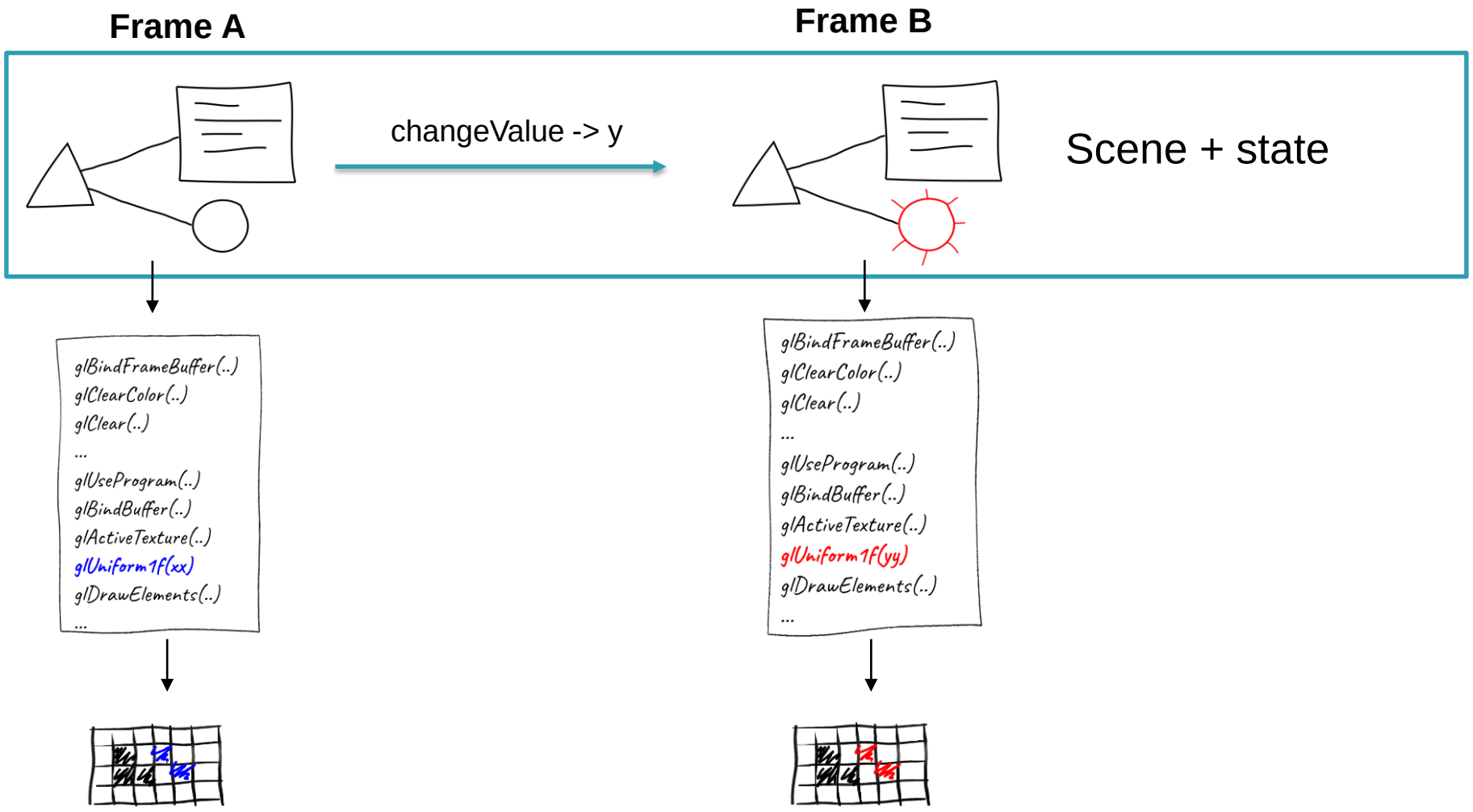
Update of frames: Video distribution



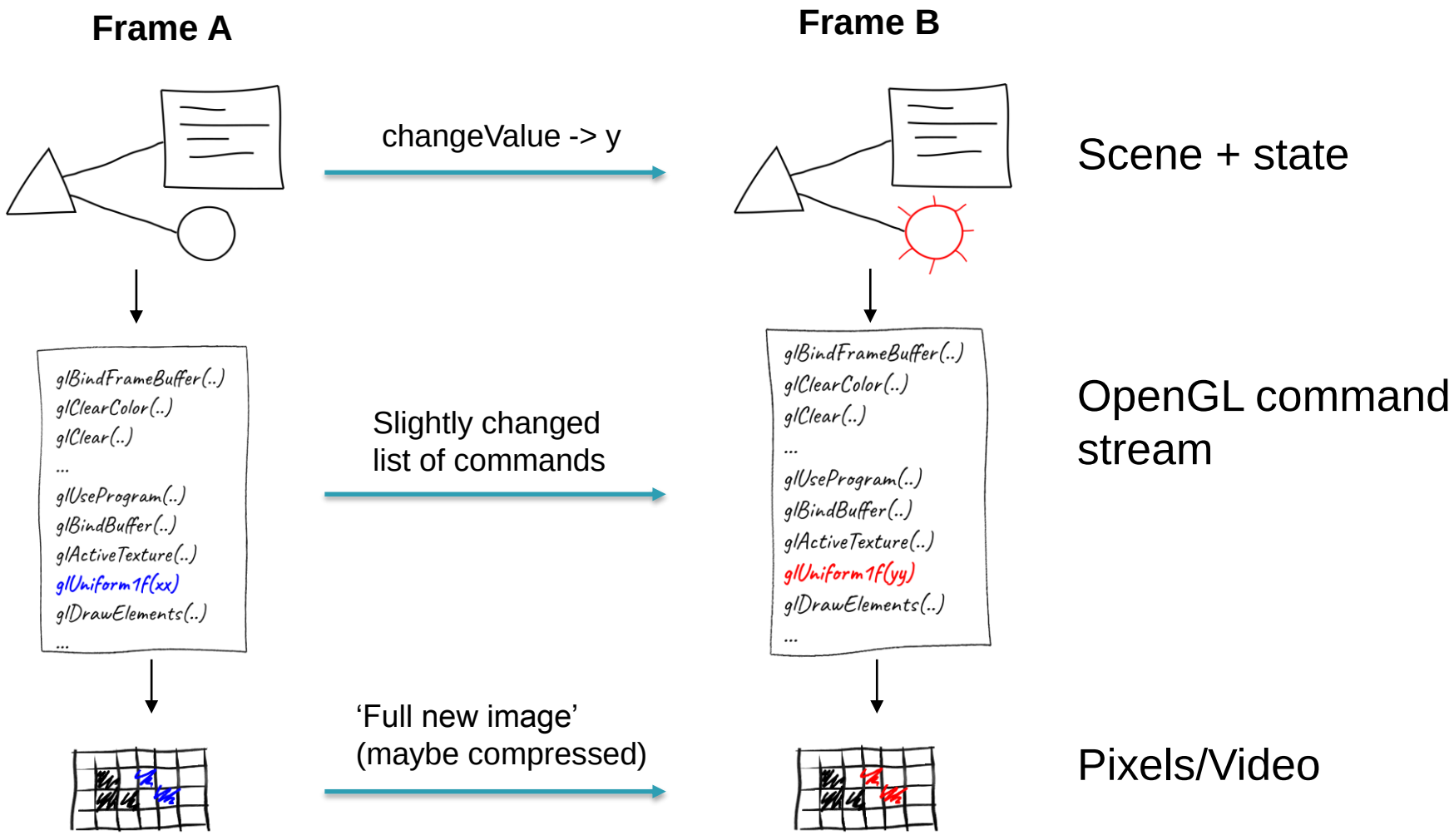
Update of frames: OpenGL commands streaming



Update of frames: Scene-based distribution



Update of frames



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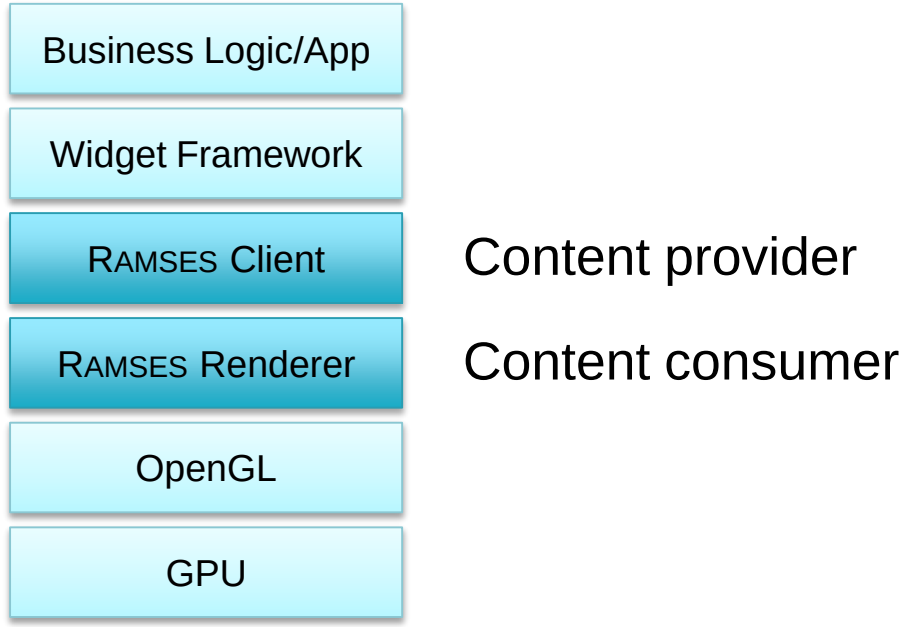
RAMSES Concepts & Features

RAMSES Software Stack



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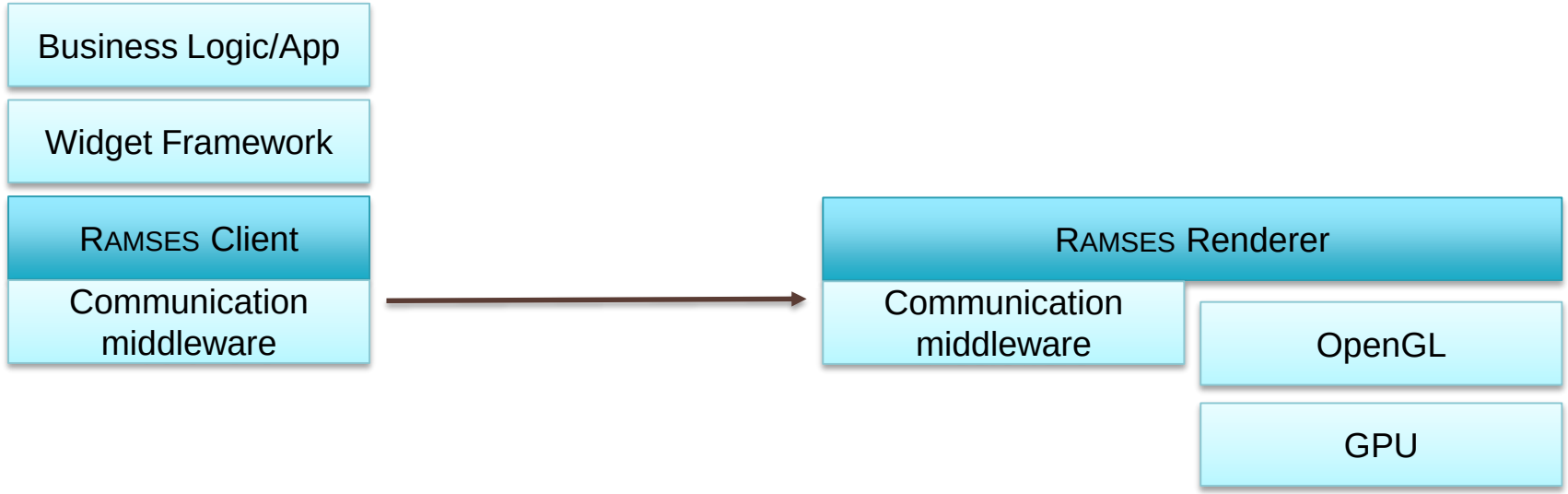
RAMSES Software Stack



Communication middlewares: SomeIP (abstraction for two different stacks), custom TCP communication

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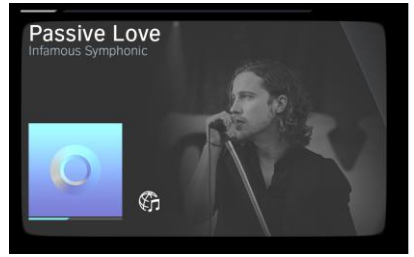
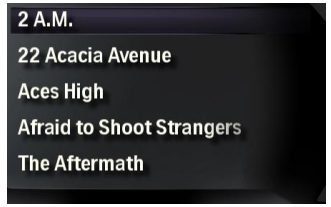
RAMSES scenes

- RAMSES works with scenes
- A scene == content which belongs together
- For example, a radio application could have two scenes:
  - Scene which has the radio's own UI



  - Scene which shows the list of all songs (targeted for display on different ECU)



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RAMSES scenes compared to OpenGL

- Converting OpenGL to RAMSES content is mostly easy
- Most OpenGL constructs have a RAMSES counterpart, e.g.:
  - glDrawElements() ~ ramses::MeshNode
  - glCreateProgram() + glCompileShader() ~ ramses::Effect
  - glBindFramebuffer() ~ ramses::RenderTarget
- Difference:
  - OpenGL's frame is continuously "recreated" – even with small changes
  - RAMSES objects lifecycle is not per-frame
  - Selective changes possible, can change individual objects or groups

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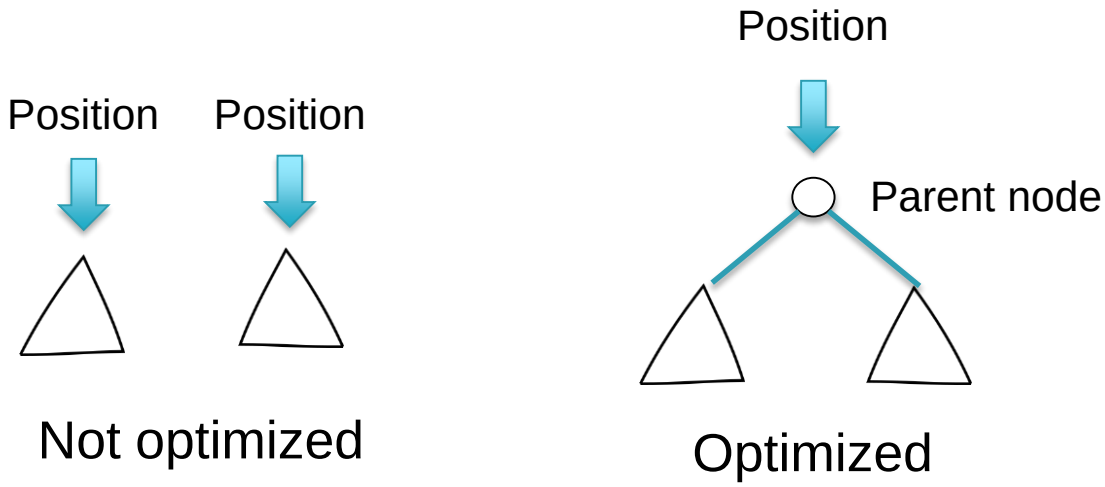
RAMSES scenes compared to OpenGL

- RAMSES offers additional features on top of OpenGL that help to reduce data bandwidth
- For example, have a scene graph instead of list of draw commands:



- Such optimizations benefit remote **and** local scenes

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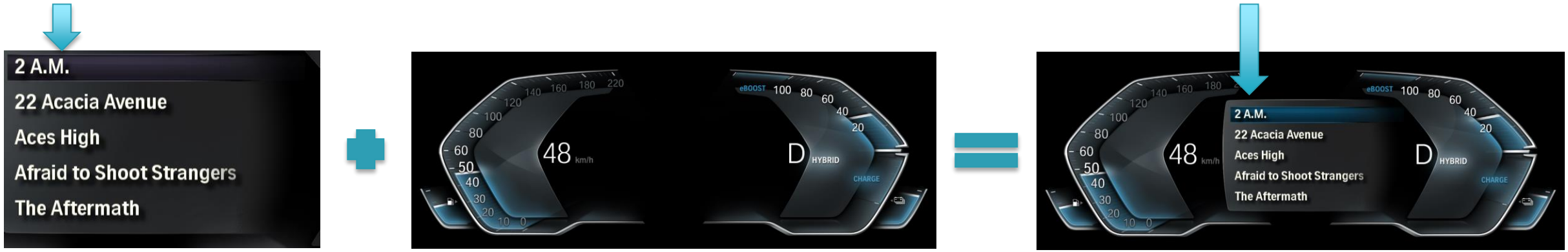
Interaction between scenes

- Independent scenes can exchange data via RAMSES
  - Any “uniform” or “constant” data – colors, animated values, etc.
  - Textures
  - Positions

  - Example with color:



Further features

- Cross platform:
  - Windows, Linux, Integrity OS
  - Wayland, X11, WGL, Integrity OS window system
  - Desktop OpenGL (4.2, 4.5)
  - Embedded OpenGL (ES 3.0+)
  - Clang, GCC, MSVC, Integrity OS compiler
- Wayland support with nested compositing
- Text rendering
- Animations
- Content authoring tool: RAMSES Studio

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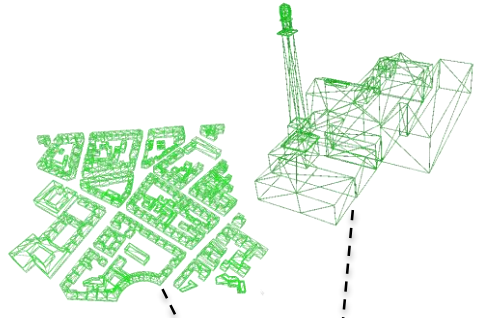
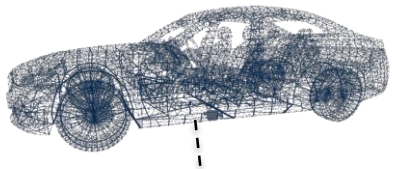
Live Demonstration

Demonstrator setup





Instrument Cluster UI

Central UI + List scene

City model

Car application

Ethernet

PC 1 (Linux)

PC 2 (Windows)

- All code/rendering is live with RAMSES
- Each application is own process

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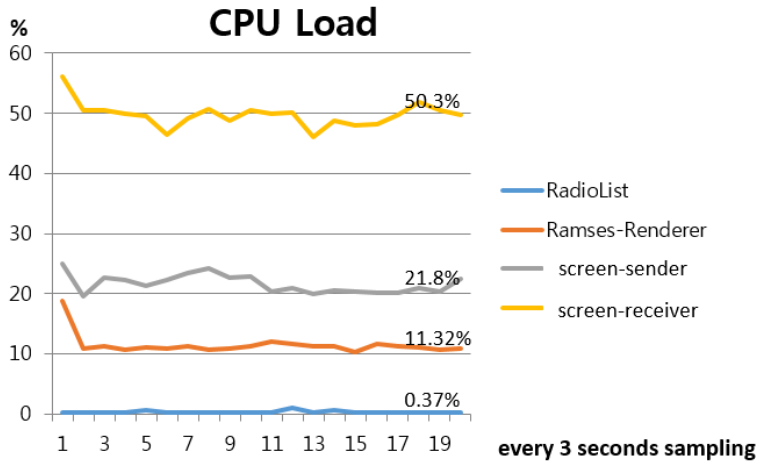
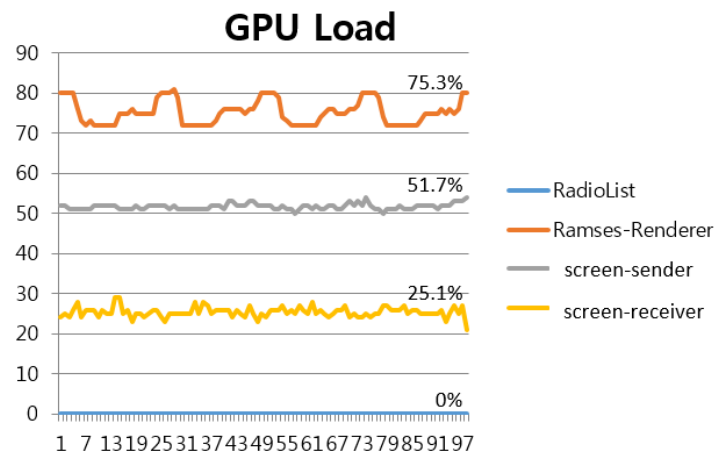
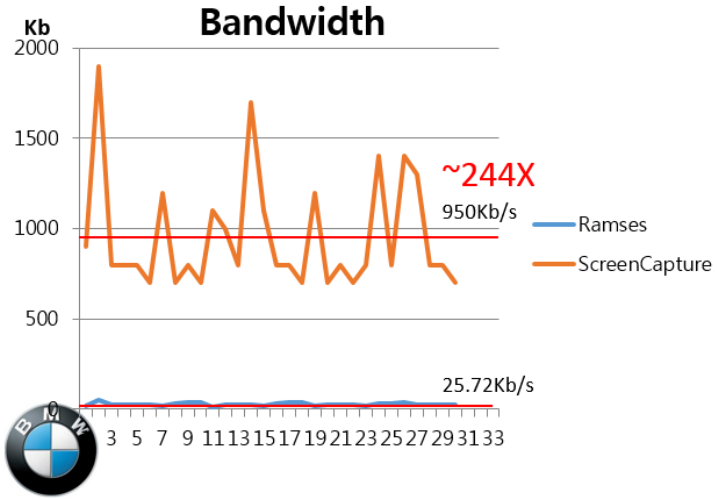
Benchmarks by LG Electronics

Compare the Performance of Radio List App



every 3 seconds sampling

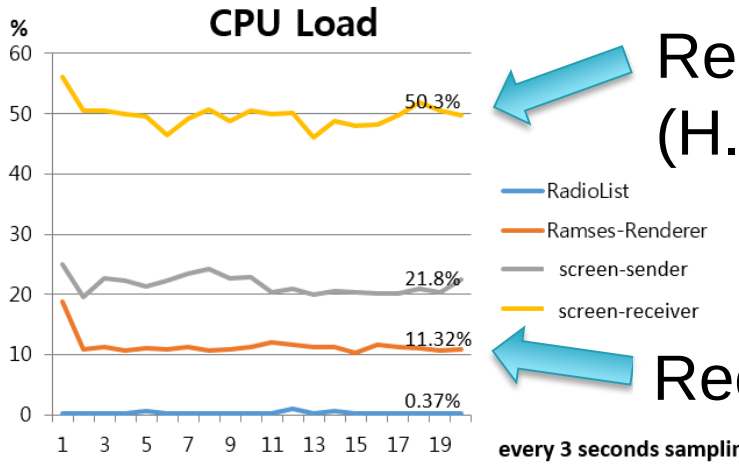




Please visit LG Electronics booth for full benchmark

Benchmarks by LG Electronics

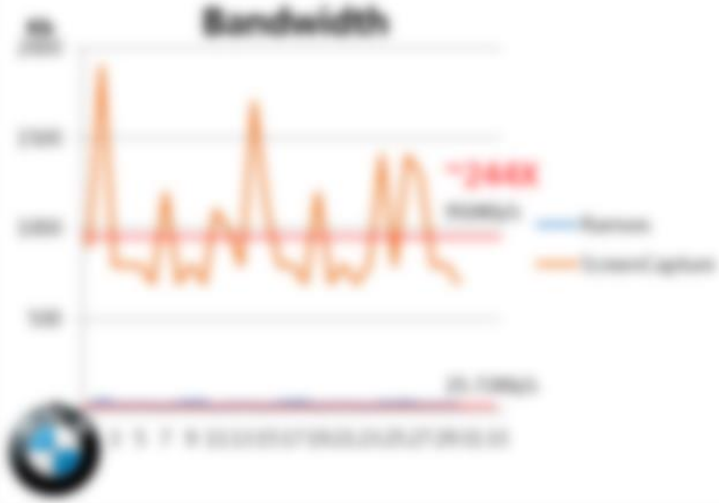
Compare the Performance of Radio List App



Receiver: Video transfer (H.264)

Receiver: RAMSES transfer

every 3 seconds sampling



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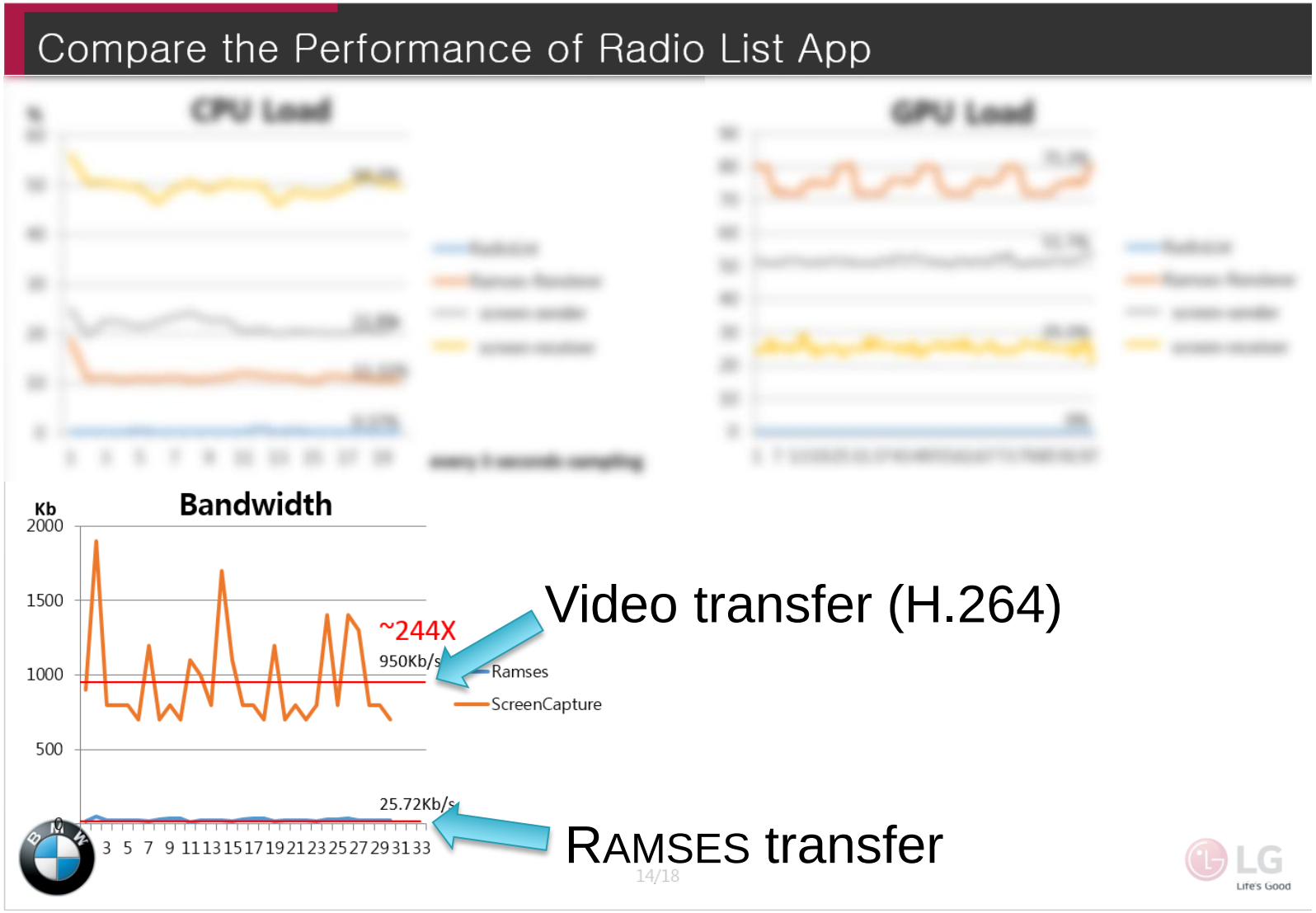
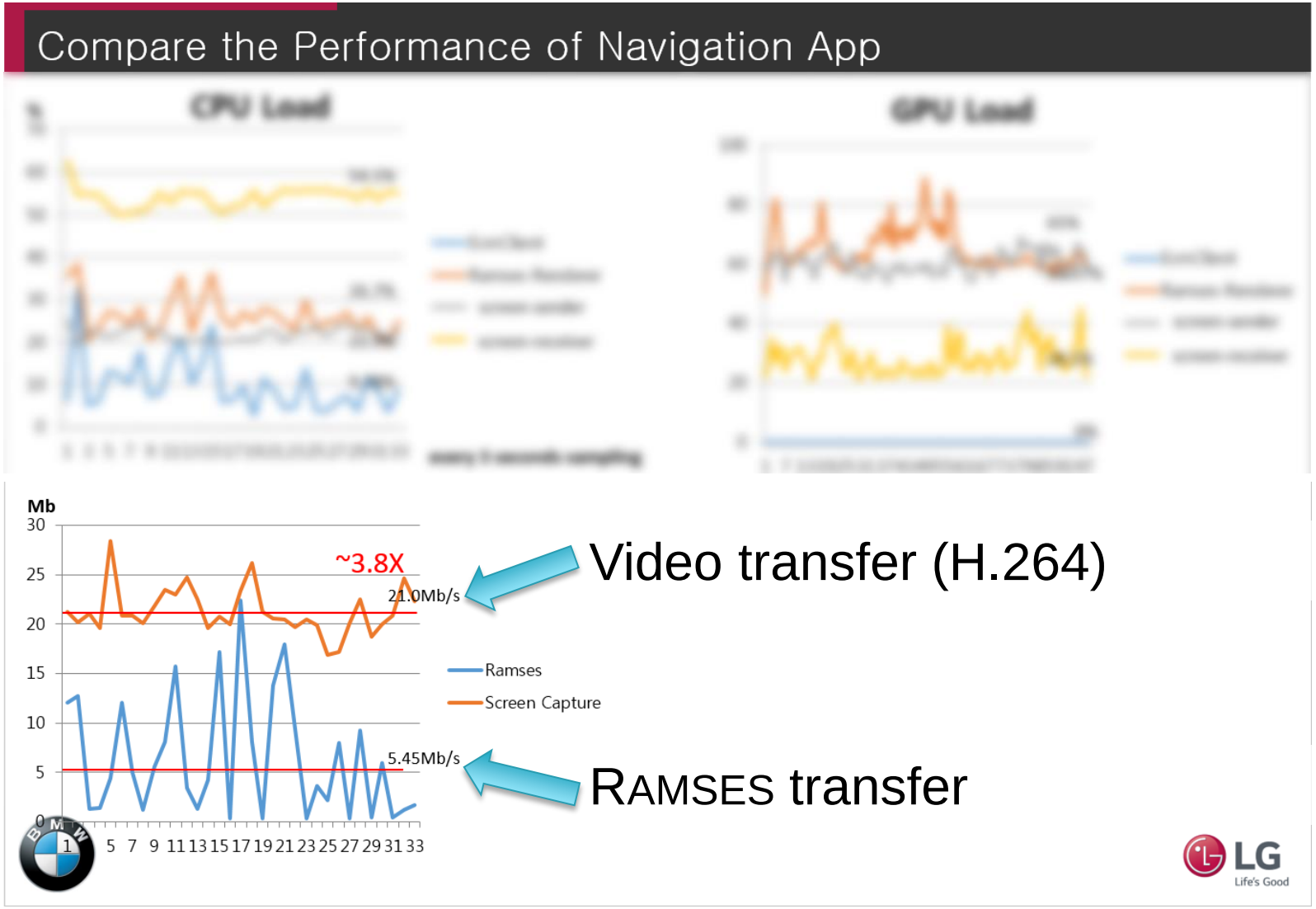


Benchmarks by LG Electronics (2)



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Wrap-up

- Applications (or underlying Widget framework) must be adapted to use RAMSES API

- More interaction of content than video allows seamless UI
- Graphical flexibility
- Low bandwidth

- **Will be open sourced in Q3 2018!**

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Questions?

Thank you!

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