UltraGrid Updates

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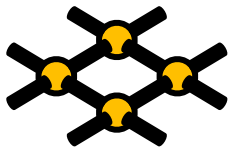
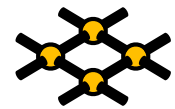


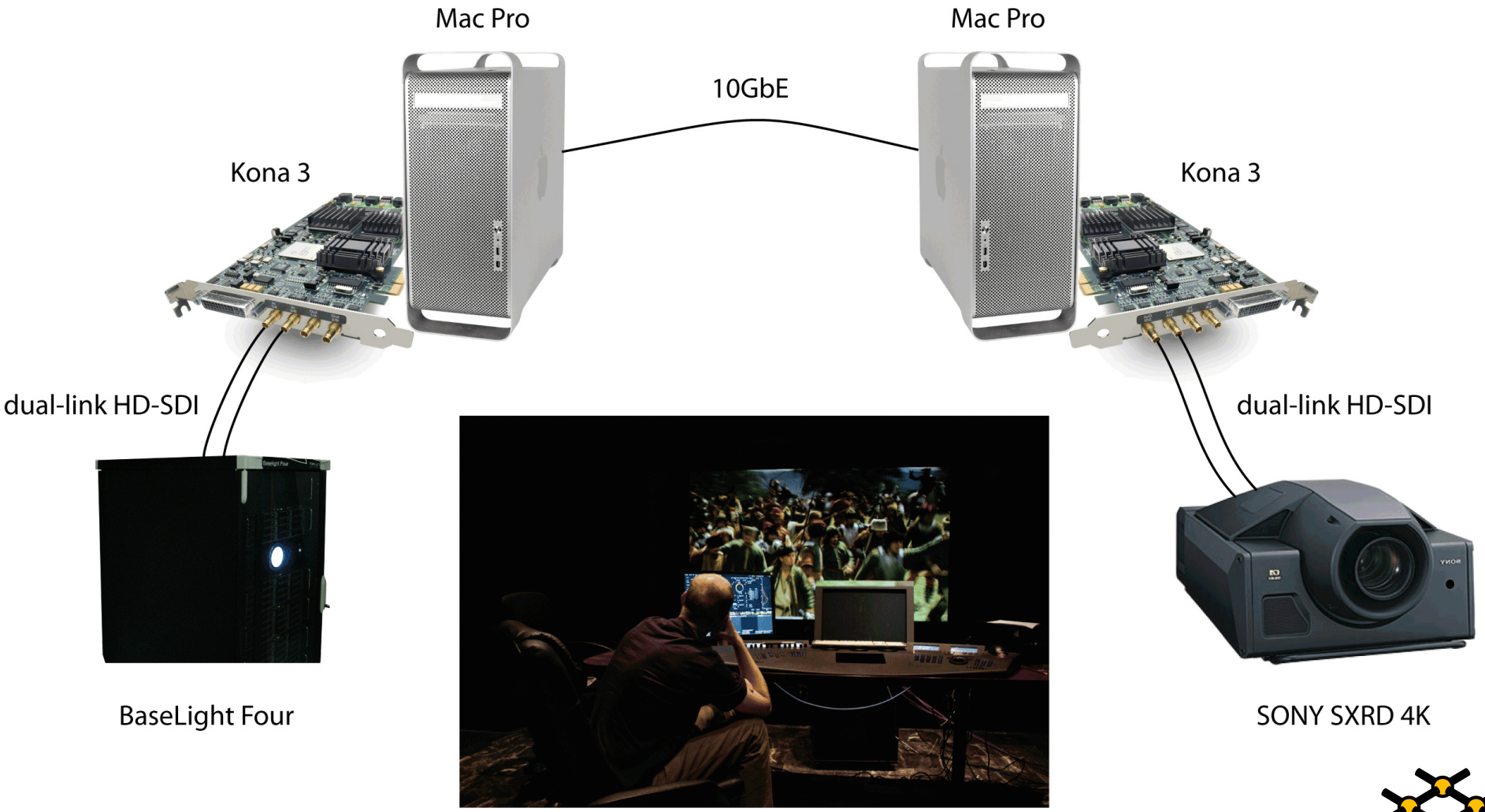
Internet2 Spring Member Meeting 2012
Washington DC, 2012–04–25



Goals

- Technology
  - affordable platform for high-quality interactive image transmissions
  - use of commodity hardware
    - Linux PC and Mac platforms
    - commodity video capture cards
    - commodity GPU cards
    - 10GE is a plus but not necessary
  - as low latency as possible on commodity hardware
  - open-source software
- Applications
  - medicine
  - cinematography
  - education

Goals


Mac Pro
Mac Pro
10GbE
Kona 3
Kona 3
dual-link HD-SDI
dual-link HD-SDI
BaseLight Four
SONY SXRD 4K

Goals

SC'11 Demos

Goals

SC'11 Demos

Current State

UltraGrid 1.1-RC3

- "Old" features
  - HD/2K video support (4:2:2, 4:4:4)
  - tiled SuperHD (4K) video support (with Linsys Quad/i and DeckLink Quad)
  - SuperHD/4K playout (with Kona 3G)
  - SAGE tiled screen support
  - full audio support (PortAudio, Jack, embedded in HD-SDI)
  - support for mono-audio (e.g., echo-canceling mics)
  - pure GL rendering for Mac (no SDL dependencies anymore!)
  - full-duplex operation (both sender & receiver)
  - fixed packetization for arbitrary packet length
  - bugfixing, completely revised and documented code

Current State

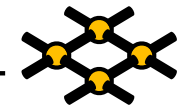
UltraGrid 1.1-RC3

- Supported platforms:
  - Linux
    - tested distributions: Ubuntu, Fedora, Debian, OpenSUSE
  - MacOS X 10.5, 10.6
- Source and binary distributions

Current State

UltraGrid 1.1-RC3

- New features
  - native 4K (single tile)
  - 4K transmissions tested with real 4K source/display
  - better stereoscopic video support
  - CUDA-based GPU JPEG compression/compression up to 4K
  - GLSL-based GPU DXT compression up to 4K
  - ALSA audio support on Linux
  - CoreAudio audio support on MacOS X
  - new generic RTP-packet format
  - FEC based on interleaved multiplication or XOR-based parity
  - user-settable double and triple buffering for GL and SDL
  - a simple GUI with persistent parameter storage



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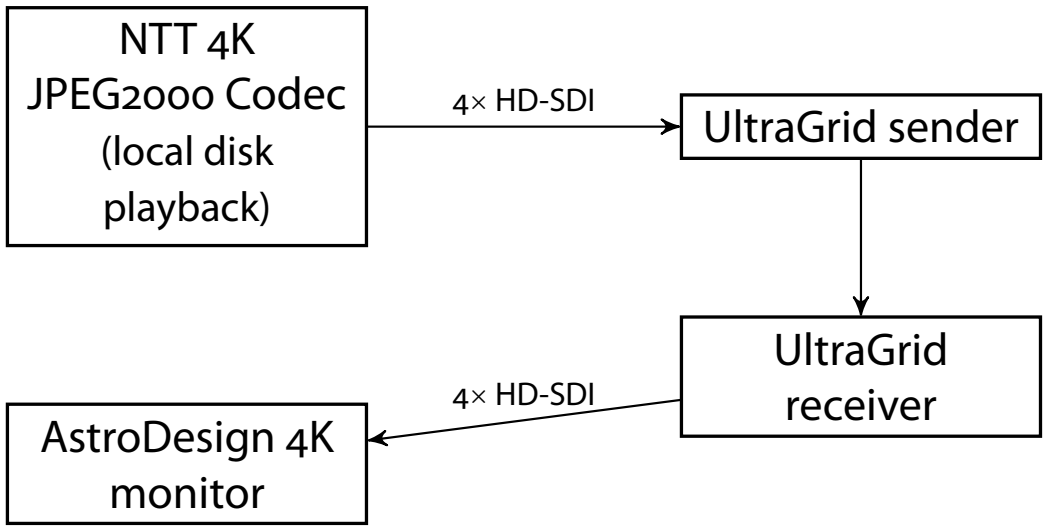
Current State

UltraGrid 1.1-RC3

- 4K transmissions tested
  - we're still waiting for Decklink 4K or equivalent…
  - …but Kona3G and Decklink Quad work with some limitations



Current State

UltraGrid 1.1-RC3

- 4K transmissions tested
  - limitations:
    - Kona3G works only up to 25 fps
    - Decklink Quad doesn't work with 2K/4K modes (2048/4096 horizontal pixels), only 1080p/2160p (2160p means 3840×2160)
    - Decklink Quad requires external clock to get the inputs in sync (verified with AJA GEN)
    - no 60p mode support (8× HD-SDI, but we have some idea for future...)

Notes on Compression

as of UltraGrid 1.1-RC3

- DXT vs. JPEG
  - performance vs. portability trade-off
  - DXT has relatively simple fixed compression-ratio
    $\Longrightarrow$ can be implemented relatively easily using GLSL
  - JPEG requires more power and optimizations
    $\Longrightarrow$ opted for CUDA (we know this platform rather well)

Notes on Compression

as of UltraGrid 1.1-RC3

- DXT performance
  - DXT1 has 1:6 ratio, DXT5 has 1:3 ratio
  - DXT1 on CPU: visible artifacts, esp. posterization of long slow gradients and noise on edges
  - DXT1 on GPU: floating point arithmetic removes gradient posterization and noise on edges is also lower
  - DXT5 YCoCg on GPU: hard to distinguish from uncompressed video, but there is some noise added on edges
  - up to 798 Mpix/s for DXT1 and 593 Mpix/s for DXT5 on NVidia GTX 580

Notes on Compression

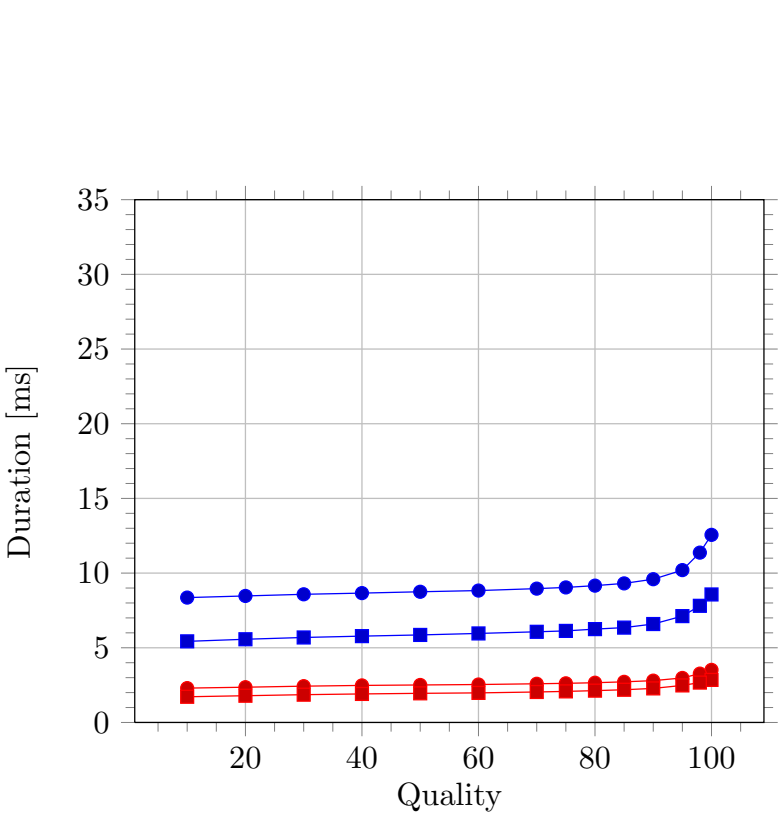
as of UltraGrid 1.1-RC3

- JPEG performance
  - JPEG Q=50 to Q=90: depending on target application
  - JPEG Q>90: hard to impossible to distinguish from uncompressed video
  - throughput depends: (1) on Q settings, (2) on image type
  - compression: 810–1.460 Mpix/s for Q=60, 646–1.196 Mpix/s for Q=95
  - decompression: 905–1.521 Mpix/s for Q=60, 428–770 Mpix/s for Q=95
  - all measured on NVidia GTX 580

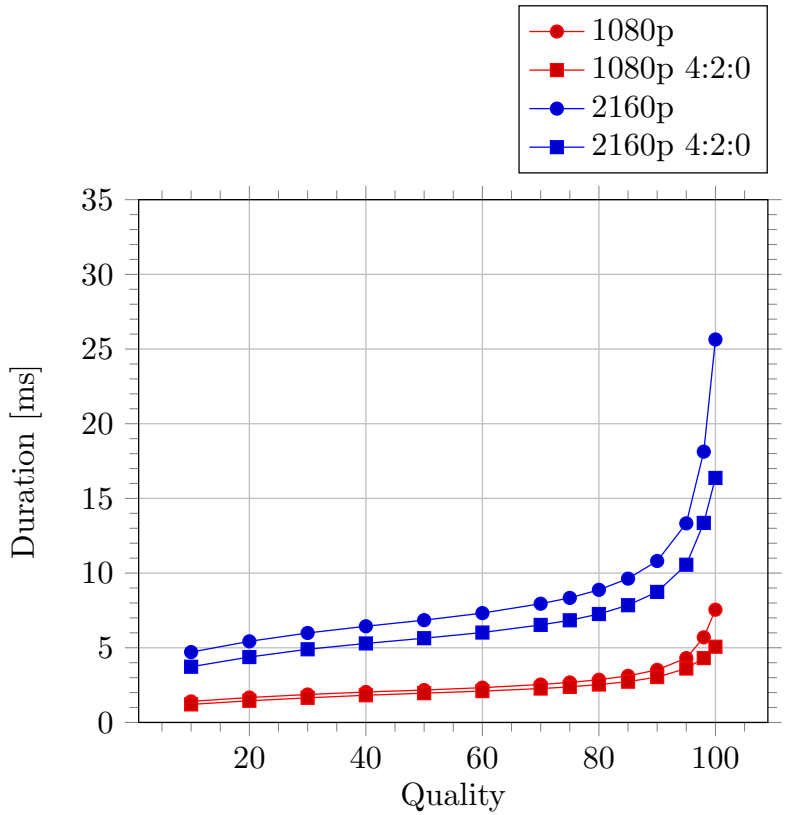
Notes on Compression

as of UltraGrid 1.1-RC3

- JPEG performance



(a) Encoder performance (only GPU)

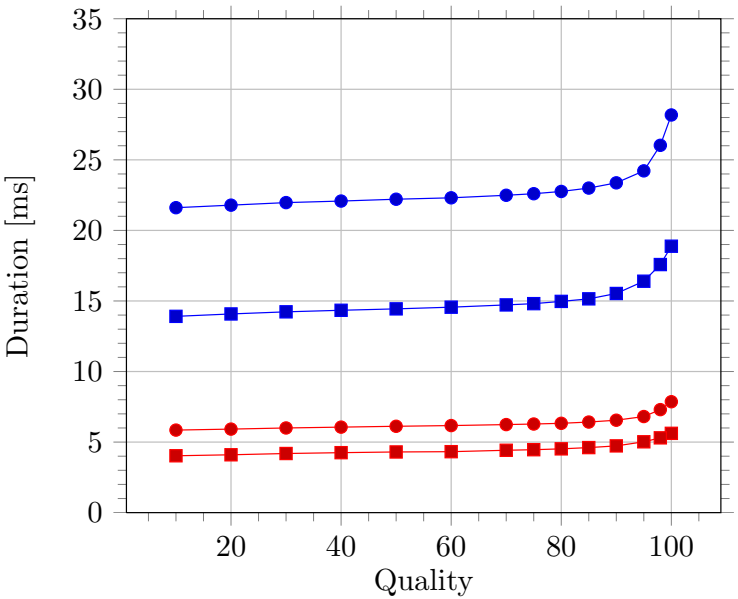


(b) Decoder performance (only GPU)

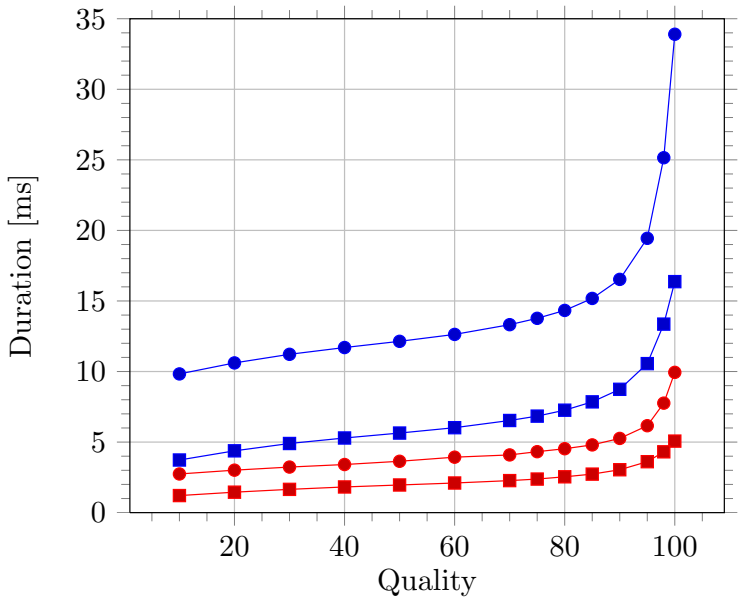
Notes on Compression

as of UltraGrid 1.1-RC3

- JPEG performance



(c) Encoder performance (both CPU and GPU)

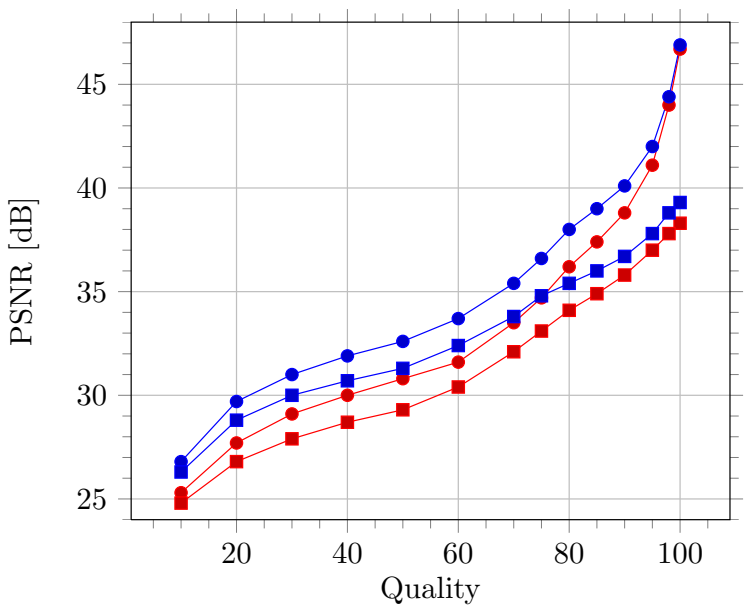


(d) Decoder performance (both CPU and GPU)

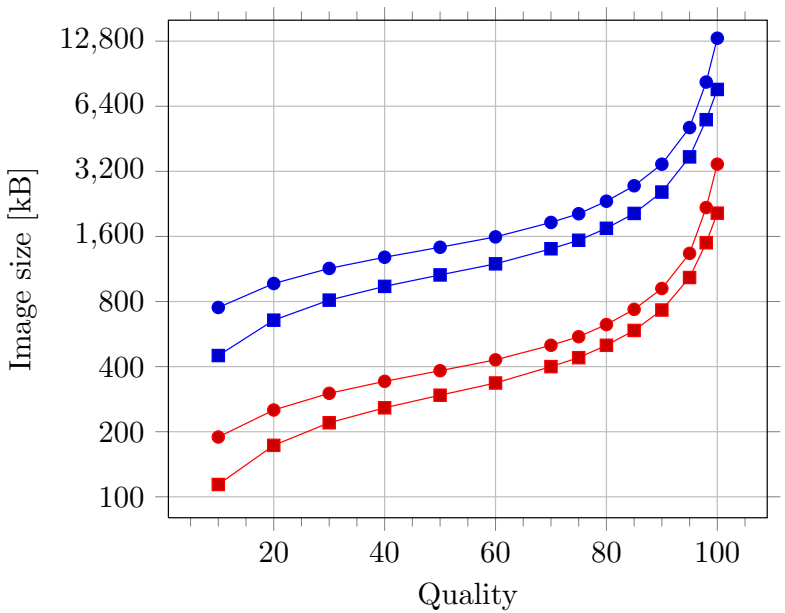
Notes on Compression

as of UltraGrid 1.1-RC3

- JPEG performance



(e) Quality of reconstruction

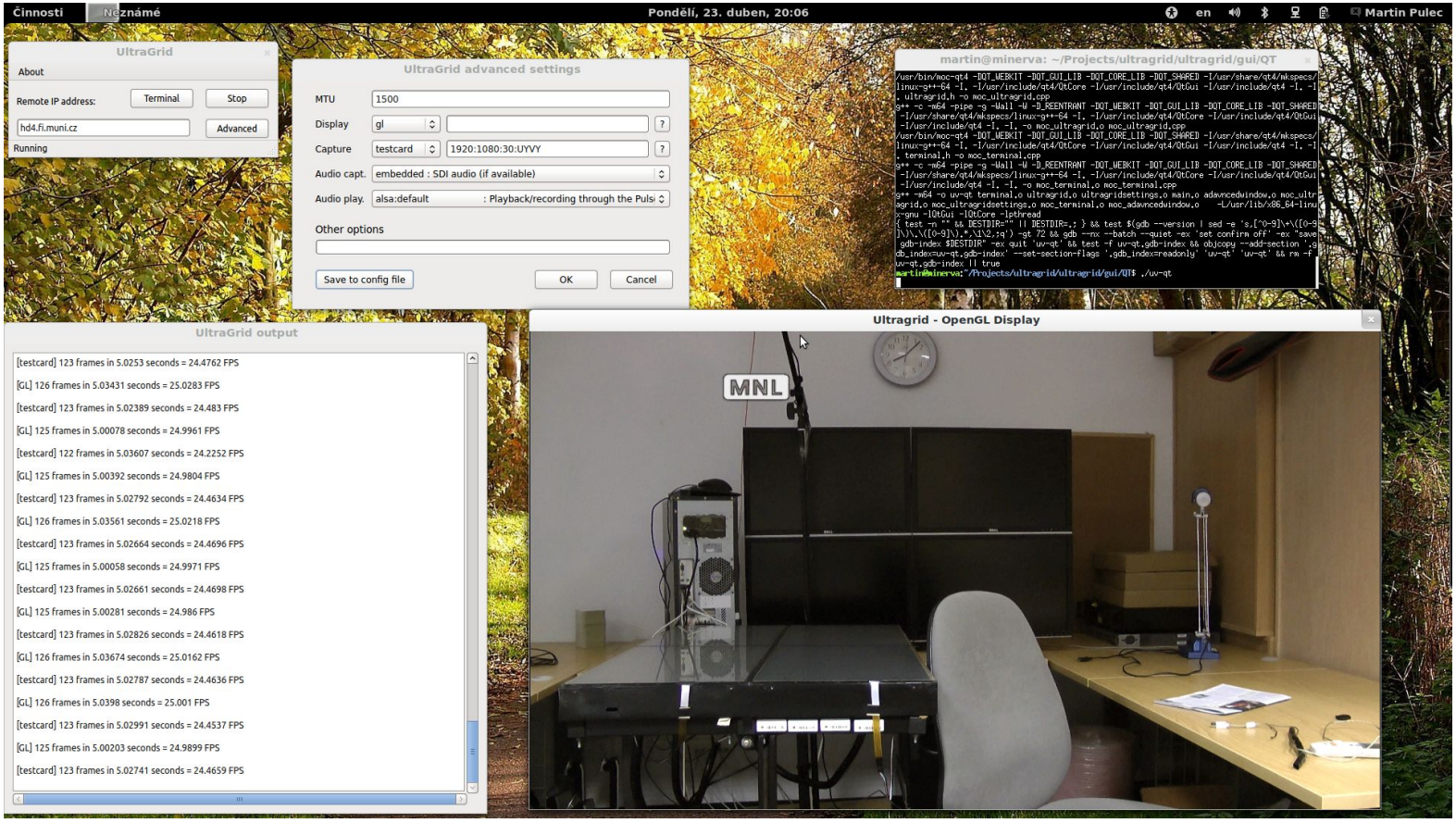


(f) Compressed image size

GUI

as of UltraGrid 1.1-RC3

- A simple GUI with persistent parameter storage
- Works both on Linux and Mac



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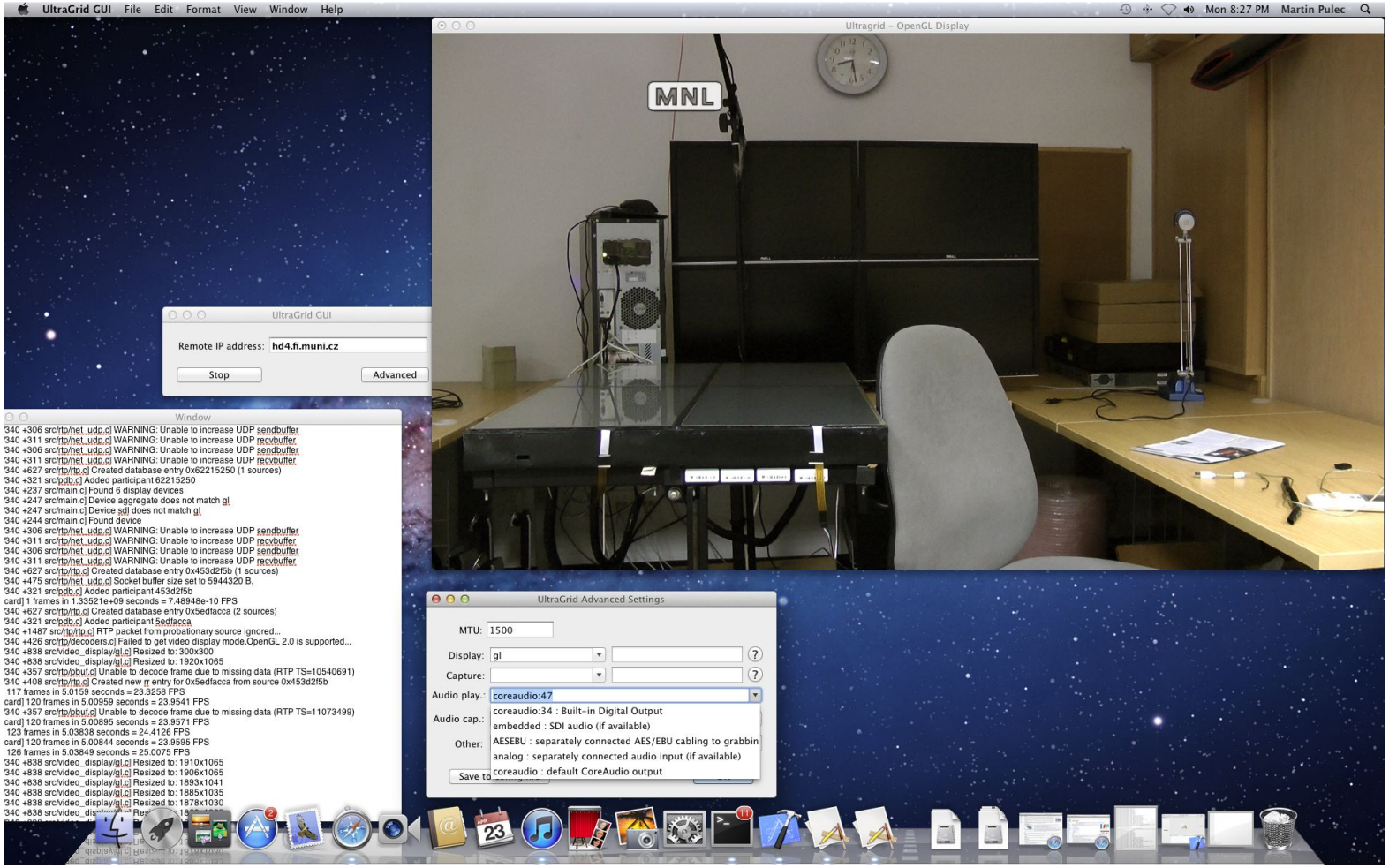
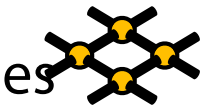


Notes on Stereocopic Video

as of UltraGrid 1.1-RC3

- Traditional operation:
  - 2× cameras → 2× capture cards
  - two projectors with polarized projection
- UltraGrid support Blackmagic Decklink 3D Extreme
  - HDMI 1.4a support direct transmission of sterescopic video
  - support should be in there, but we can't guarantee functionality as of now
  - we need somebody, who has HDMI 1.4a equipment, to test it for us :)
- For Planar displays
  - GLSL-based merging of even/odd lines from both images



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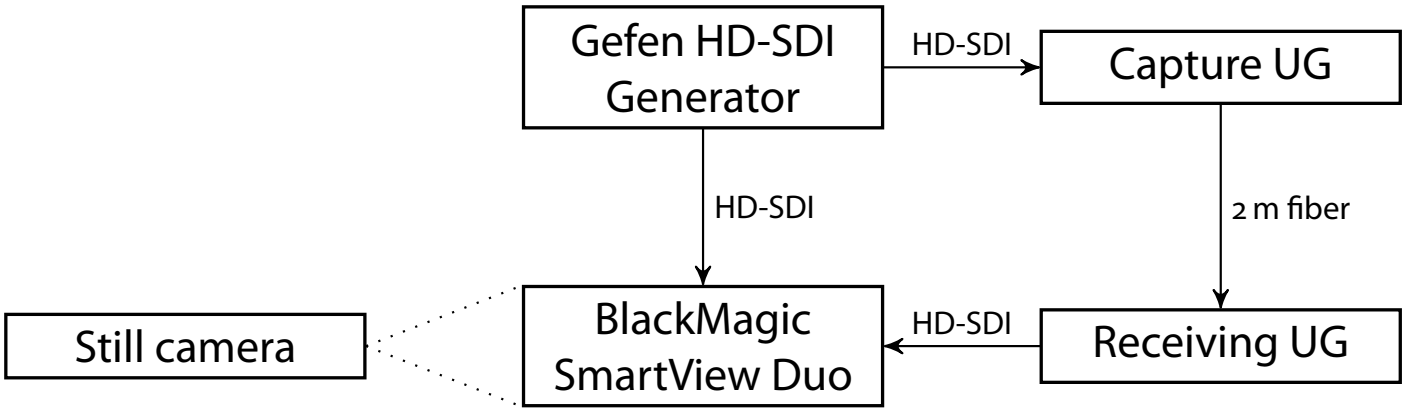
Latency Measurements

- Methodology



- Uncompressed
  - 2 frames (67 ms, DeckLink HD → Kona 3G)
- Impact of compressions
  - 2.5 frames (83 ms) for DXT1/5
  - 3.5 frames (117 ms) for JPEG

Hardware Matters

- Supported noteworthy HW:
  - BlackMagic Intensity (Linux & Mac)
  - BlackMagic DeckLink HD (Linux & Mac)
  - BlackMagic DeckLink Quad (Linux & Mac)
  - BlackMagic DeckLink 3D Extreme (Linux & Mac)
  - BlackMagic MultiBridge (Linux & Mac)
  - AJA Kona & Kona 3G (Mac)
  - DVS Centaurus & Centaurus II (Linux)
  - Linsys Quad/i (Linux)
  - ClearOne Chat 150 (echocancelling mic)

Hardware Matters

- How cheap can we get?
  - a machine worth $500 (Core i5-based PC)
  - a GPU worth $500 (NVidia GTX 580)
  - … CineGrid saw this setup working for 4K decompression!
  - HD-SDI/HDMI capture cards worth $200-$300 (Blackmagic)
  - not-so-lousy camera worth $1.000 (e.g., Panasonic TM-900)

Hardware Matters

- How small can we get?
  - currently building a prototype machine on Mini-ITX platform

Until End of 2012

- Features to be expected
  - multi-receiver (aka iHDTV tiled mode, but more flexible)
  - joint release with CoUniverse
    - support for automatic setup of multi-point distribution trees
    - adaptive compression
    - automatic allocation of on-demand networks (e.g., Internet2 ION or NSI-enabled nets)
- Would you be interested in some other functionality?

How to get it

- BSD-lincesed software
- Available from
  `http://ultragrid.sitola.cz/`
- UltraGrid is now also part of SAGE toolkit
  `http://www.sagecommons.org/`

- Please, help us with testing 1.1-RC3 so that 1.1-RELEASE is as stable as possible!

Thank you for your attention!

This effort is supported by LM2010005 project.