HDR contents via IIIF

Next steps

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Introduction: What is HDR?

Incomplete and greatly simplified

- ☞ HDR images using tone mapping are around since 3 decades
  - ☞ Composed of different exposure levels
  - ☞ Images for display still have 8 bit colours (they are tone mapped)
- ☞ We are talking about HDR display using a 10 bit colour space
  - ☞ Tone mapping might be still applied
  - ☞ Generated either by HDR capable imaging sensors, composed or artificial.

Introduction: Current status

High level (user / consumer) view

- HDR video
  - Currently best known and supported in the browser - for example on YouTube
  - Supported by TV sets
  - Can be created by mobile phones
- HDR images
  - Can be created by modern mobile phones
  - Supported by some browsers
  - Different level of support by different formats
- HDR images as Textures (for 3D models)
  - Supported by modern game engines
  - Browser support experimental (Three.js)

Introduction: Limitations

Soft- and hardware (as of November 2024)

- ☞ You need a HDR-capable monitor / screen
- ☞ Operating system level support inconsistent
  - ☞ Mac OS is certainly best
  - ☞ Windows support need to be enabled explicitly (but it's solid enough for gaming)
  - ☞ Linux support currently experimental
- ☞ Browser support (~95% for HDR images)
  - ☞ Firefox only has partial support for HDR video
  - ☞ Chromium-based browsers might need additional flag for all features (see demo)
- ☞ OSS support in development / experimental
  - ☞ VIPS, ImageMagick etc.

Use cases

See https://christianmahnke.de/en/post/iiif-online-meeting-2024-slides

- ☞ Presenting artefact's with enhanced colours
  - ☞ Immersive effects
- ☞ Image analysis
- ☞ Mixing different channels (wave lengths) as gain maps
- ☞ Scientific visualisation
  - ☞ Like bioluminescence, multispectral / false colour images etc.
- ☞ Highlighting / contrast enhancements (as optional image operations) in VREs
- ☞ Not necessarily limited to web browsers

Technical Background

Not all browsers support all possibilities yet!

- ☞ Different technical methods depending on media type (image, video, 3D)
- ☞ Currently focused on Images, but shouldn't be limited
- ☞ Currently advanced browser settings might be required

Technical Background: Image formats (gain maps)

These formats offer a fallback by storing the lighting information separately

- ☞ Separation between SDR and HDR components
- ☞ Gain map holds „differences“ to create HDR image
- ☞ HDR gain map saved in image metadata
- ☞ Available for JPEG, AVIF, JXL and HEIF - specification (ISO 21496-1) currently settling, multiple vendors have implementations (November 2024)
- ☞ Benefits
  - ☞ Fallback for SDR-only soft- and hardware
  - ☞ Efficient storage by subsampled gain map

Technical Background: Videos

Limited only to browser based presentation

- ☞ Well know from sites like YouTube (since November 2016!)
- ☞ Works in Chrome
- ☞ Works on Firefox for Mac since May 2022
  - ☞ Complete Windows and Linux support still missing
- ☞ Provided via HDR10(+), Advanced HDR or Dolby Vision - 10Bit (or more) colour spaces
- ☞ Encoded in H.264, H.265, AV1, VP9
- ☞ Usually encapsulated in MP4 (others possible)

Technical Background: 3D Models

Limited only to browser based presentation

- ☞ Currently only textures are supported, since those are just images
- ☞ „Real“ HDR rendering not yet supported by browsers, if there is any lighting calculation tone mapping will be applied

Open questions I

Short summary of the discussion in IIIF/api#2312

- ☞ Started as a discussion on Image API
- ☞ Indication of HDR using `supports`
- ☞ Maybe add another `format` like `ultrahdr` or `jpg+hdr`
- ☞ But there are other HDR capable image formats, should everyone get its own `format` or a `+hdr` suffix?
- ☞ Should colour spaces / bit depth be covered / included?
  - ☞ Might require additional metadata fields
- ☞ `quality` can be considered as an abstraction of colour spaces (like `color`, `gray`, `bitonal`), so `extraQualities` might be a good fit - favoured in the discussion
- ☞ How generic should it be? Presentation API (for 3D) as well?
- ☞ Presentation API: Provide metadata as part of the `service`

Open questions II (high level)

What should a HDR related API change achieve?

- ☞ Indicate HDR content to an agent (viewer) to be able to check / hint technical requirements / possibilities
- ☞ Might cover the complete range of possible contents
- ☞ Image API related
  - ☞ Would HDR be client side pull or server push?
  - ☞ Should it be legal to supply HDR image as `format jpg`?
  - ☞ Or should the user be required to explicitly require HDR (as additional `format`)?
- ☞ Presentation API related
  - ☞ Might be necessary for other HDR capable media, like Video or 3D

Proposal (Short term)

More usage convention than specification

- ☞ HDR images as `format jpg` (and `quality color`) should be considered legal if there is a transparent SDR fallback, for backwards compatibility.
  - ☞ Provide a URI as `supports` hint
- ☞ No API change required, as a first shot, just register the URI and let viewer implementations handle required steps

Proposal (long term)

Next major revision of involved APIs

- ☞ Image API
  - ☞ Address the question on bit depth / colour spaces
  - ☞ Define `extraQualities` - not only limited to HDR use cases
- ☞ Presentation API
  - ☞ Add an indication for HDR contents - independent of specific media type
  - ☞ Can this be done using a `profile` technical property?
  - ☞ Should a dedicated technical property be added?

Discussion

Please comment at IIIF/api#2312

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