ChatGPT

Unity URP vs HDRP (Unity 2022 LTS) – Feature Comparison

Unity's **Universal Render Pipeline (URP)** and **High Definition Render Pipeline (HDRP)** are two Scriptable Render Pipelines tailored for different needs. URP is a **lightweight, performance-optimized pipeline** that runs on a wide range of devices (mobile, VR, console, WebGL) [1]. HDRP targets **high-end visuals on powerful hardware**, with cutting-edge graphics features but limited platform reach (no support for mobile, WebGL, or Switch) [2] [3]. Below is a side-by-side comparison of their graphics features in Unity 2022 LTS (the "Unity 6 LTS" mentioned), focusing on visual capabilities along with notes on performance and scalability.

Platform Support and Performance

- **URP – Broad Reach, Scalable Performance:** Designed to **scale across devices**, URP offers strong performance on low-end hardware and supports mobile, VR, and older consoles [1] [4]. It uses an efficient forward renderer (now with **Forward+** in 2022 LTS) to handle many lights via tiled lighting, enabling more real-time lights in a scene with minimal impact [5]. URP sacrifices some advanced visual fidelity to prioritize speed and flexibility [6]. This makes it ideal for projects targeting a wide audience or requiring 60+ FPS on modest GPUs. (For example, *Blade & Sorcery* switched to URP for better VR performance [7].) URP projects also tend to have smaller build sizes and shorter iteration times.

- **HDRP – High-End Only, Fidelity First:** HDRP is built for **"next-gen" graphics** – it **demands** more powerful GPUs and modern consoles to run well [8]. In exchange, it provides top-tier visual features (physically-based lighting, volumetrics, etc.) for photorealistic results [9]. HDRP has a higher base rendering overhead and is not suitable for low-end or mobile devices. While it includes some quality settings, its scalability downward is limited – it's optimized for **consistent high fidelity** rather than flexibly trading off quality for performance [8]. Developers using HDRP must budget for features like real-time global illumination and screen-space effects which can be expensive. (It's telling that HDRP-powered games often target PC/console only, e.g. *Sons of the Forest* on PC uses HDRP for its advanced visuals [10].) In summary, HDRP excels when maximum visual quality is the goal and the target hardware can support it, but it's ill-suited for anything less.

Graphics Feature Comparison (URP vs HDRP)

Below is a comparison of key **rendering features** in URP and HDRP under Unity 2022 LTS:

Lighting and Shadows: Both pipelines use physically-based lighting models, but HDRP offers more *advanced light types and controls*:

Lighting Feature	URP (2022 LTS)	HDRP (2022 LTS)
Main Light Types	Directional, Point, Spot lights (all supported) – standard PBR lighting and shadows. [11] [12]	Directional, Point, Spot lights (same as URP).
Area Lights	**No real-time area lights.** Rectangle and Disc lights are **baked only** (no real-time emissive area lighting) [13] .	**Yes – real-time Area Lights** (Rectangle and Tube shapes) with shadows, plus baked Disc lights [13] . Enables area emission for high realism.
Light Units & IES Profiles	Uses arbitrary light intensity units (non-physical). No built-in support for IES photometric profiles [14] [15] .	Uses **physical light units** (lumens, candelas, etc.) for accurate brightness [15] . Supports **IES profiles** for real-world light falloff patterns [14] .
Shadows	Supports hard and soft shadows on directional, spot, point lights. **Cascaded shadows** for directional light (up to 4 cascades) with adjustment in URP asset [16] . **No cascade blending** (transition between cascades can show a hard line) [17] . Only one directional light's shadows active at a time (additional directional lights won't cast shadows) [18] [19] .	Advanced shadow options. Cascaded directional shadows (1–4 cascades) with **smooth cascade blending** to hide transitions [20] [17] . One directional light can cast shadows (additional can be simulated via other lights) [19] . Supports **contact shadows** and other fine-tuning via Volume settings. Higher precision shadow filtering and control.
Other Light Features	**No real-time volumetric lighting** (lights do not produce volumetric fog rays by default). No built-in support for light cookies on area lights or tube lights (since those light types aren't real-time). Basic **light layers** available (via rendering layers) for culling lights per object.	**Volumetric lighting** supported (lights can emit volumetric scattering in fog [21]). Supports **advanced cookie** types (including colored cookies) and IES for lights. Offers **light layers (32 layers)** for fine control of light culling [22] . Also supports **light attenuation controls** and physically accurate falloff.

Global Illumination & Reflections: HDRP provides more ways to bounce and reflect light in real-time, whereas URP relies mainly on baked lighting and simple reflections:

GI/Reflection Feature	URP (2022 LTS)	HDRP (2022 LTS)
Baked Global Illumination	**Yes.** Supports baked lightmaps (using Progressive CPU/GPU lightmapper). Enlighten real-time GI is not supported/available in URP (Enlighten was deprecated for SRPs) [23] . Supports mixed lighting modes (baked indirect, shadowmask, etc.) like built-in [24] .	**Yes.** Supports baked GI via Progressive lightmapper. (Enlighten is also deprecated here.) Mixed lighting modes supported similarly [23] [24] . Both URP and HDRP can use **Realtime GI via Enlighten in legacy projects up to 2020**, but not in 2022 LTS.

GI/Reflection Feature	URP (2022 LTS)	HDRP (2022 LTS)
Realtime Global Illumination	**No.** URP has **no built-in realtime GI** solution in 2022 LTS. It relies on baked lighting or probes. There is **no Screen-Space GI** feature in URP [25]. (Artists may fake bounce lighting with Reflection Probes or custom shaders if needed.)	**Yes.** HDRP offers **Screen-Space Global Illumination (SSGI)** for approximate realtime bounce lighting [25]. It also supports **Ray-Traced Global Illumination** for more accurate real-time GI on ray tracing-capable hardware [26]. These allow dynamic indirect lighting in scenes (with performance cost).
Reflection Probes	**Yes.** Reflection probes (cube maps) are supported for environment reflections – both baked and runtime updated probes for dynamic reflections. Planar reflections require custom rendering (no built-in planar reflection component in URP).	**Yes.** Reflection probes (baked and realtime) are supported as well. Additionally, HDRP has a built-in **Planar Reflection** renderer for mirrors and water surfaces [27]. Reflections can be assigned to layers and handled in Volumes for quality.
Screen-Space Reflections	**No. SSR not available** in URP out-of-the-box [27]. Reflections rely on probes only. (Water or mirror effects must use planar probe hacks or custom passes.)	**Yes.** HDRP includes **Screen-Space Reflections** for real-time reflective surfaces [27]. It also features **transparent SSR** for materials like glass. These capture accurate real-time reflections of on-screen geometry.
Ray-Traced Reflections	**No.** (URP does not support DXR/ray-tracing in 2022.)	**Yes.** On hardware that supports ray tracing, HDRP can do **Ray-Traced Reflections** for highest-quality, accurate reflections beyond the screen view [28]. This is part of HDRP's ray tracing feature set (requires DX12 and suitable GPU).

Post-Processing and Visual Effects: Both pipelines use Unity's Volume framework for post-processing, but HDRP offers additional and higher-quality effects (often more physically-based). URP has caught up in some areas in 2022 LTS (e.g. added TAA), but still lacks certain advanced effects:

Post/FX Feature	URP (2022 LTS)	HDRP (2022 LTS)
Anti-Aliasing	**Multi-sample AA** (MSAA) supported (forward rendering only) [29] [30]. **Fast post-process AA** (FXAA/SMAA) available for deferred or as additional filtering. **NEW: Temporal AA (TAA)** added in 2022 LTS for better anti-aliasing with motion smoothing [31]. (TAA greatly improves image stability in URP now.)	**No MSAA** in deferred rendering (HDRP relies on post AA). Instead, **Temporal Anti-Aliasing** is the standard in HDRP (with cinematic quality). Also supports **advanced upscaling** like DLSS or FSR (on PC) to improve AA and performance (these are integrated as HDRP plugins).

Post/FX Feature	URP (2022 LTS)	HDRP (2022 LTS)
Depth of Field	**Yes**, via post-processing. URP offers basic Depth of Field (circle/bokeh blur) but **not a physically accurate aperture** model [30]. Suitable for background blur but less realistic focal controls.	**Yes**, with a **Physical Camera** model. HDRP's DoF simulates aperture, focal length, etc., giving **true cinematic bokeh** and focus effects [32]. More advanced and higher quality blur for large apertures.
Motion Blur	**Yes**, supports camera motion blur and per-object motion blur (optional). Uses post-processing effect – suitable for fast-moving games.	**Yes**, higher quality motion blur with more customization. HDRP can handle subtle blending for cinematics. (Both pipelines use similar algorithms here, but HDRP can trade more performance for quality.)
Bloom & Lens Effects	**Yes**, bloom, lens flares (via post-processing) and other glows are supported. URP's bloom is slightly simplified but still high quality. Lens Dirt and streaks are limited compared to HDRP.	**Yes**, HDRP provides bloom, lens flares, lens dirt, glare, and even diffraction effects with more realism. It has an enhanced **Lens Flare (SRP)** system for sun flares, etc., and more controls for cinematic bloom.
Volumetric Effects	**Fog**: URP supports exponential height fog and ambient haze. **No true volumetric fog or light shafts** in built-in URP. (You can approximate "God rays" with light cookies or custom shaders, but not full volumetric lighting.)	**Volumetrics**: HDRP has **Volumetric Fog and Lighting** out-of-the-box [21]. Lights can produce volumetric beams in fog. Supports **Volumetric Clouds** for sky realism and even local volumetric fog volumes [33]. These enable crepuscular rays ("God rays") and dense atmosphere effects for high realism.
Decals	**Yes**, URP supports projected **Decals** onto surfaces (e.g. bullet holes, splatters). In 2022 LTS URP gained **Decal Layers** for more control over which objects receive which decals [34]. URP decals affect albedo and normal by default but lack some HDRP material blending options.	**Yes**, HDRP has a robust **Decal Projector** system. Decals can affect smoothness, metalness, etc., and HDRP can use decal shaders for effects like graffiti, wet surfaces, etc. Decals can also receive lighting and be layered extensively (up to 4 blending layers by default).
Visual Effect Graph	**Yes**, fully supported. URP can render complex GPU particle systems via VFX Graph. Some advanced shader-based VFX (like volumetric smoke) may be less convincing without HDRP's lighting, but you can still use VFX Graph in URP for GPU-accelerated particles.	**Yes**, fully supported. HDRP's lighting enhances VFX Graph effects – e.g. particles can be lit by HDRP lights including volumetric fog lighting. HDRP also supports **Mesh VFX** and more complex particle shading (like refractive particles, distortion, etc.) more naturally. *(Example:* Hardspace: Shipbreaker *uses VFX Graph with HDRP to render thousands of sparks and debris with no performance lag* [35] *.)*

Summary of Visual Differences: In essence, **HDRP provides features aimed at realism and detail** – e.g. **real-time area lights, volumetric fog, screen-space/reflection and global illumination effects, physical camera effects, and ray-tracing** – which **URP lacks** [9] [21]. URP has narrowed the gap recently (adding things like TAA, Forward+ lighting, decal layers, etc. [5] [31]), but it still prioritizes performance and broad compatibility over maximum fidelity. If your project demands features like **dynamic global illumination, ray-traced reflections, high-end cinematic FX or volumetrics**, HDRP is the go-to. Otherwise, URP can deliver solid visuals (including PBR materials, shadows, post-processing, etc.) with much greater ease on various hardware.

Example Games Using URP vs HDRP

To put these pipelines in context, here are some real Unity games (especially ones with realistic or detailed graphics) and the pipeline they use:

- **Notable URP-powered games:** Several cross-platform titles and VR games leverage URP for its performance and scalability. For example, **Blade & Sorcery (PC VR)** uses URP (formerly LWRP) to render realistic melee combat scenes in VR with improved frame rates [7]. The indie city-builder **Timberborn** (2021) uses URP to handle its dynamic lighting and water simulation on mid-range PCs, balancing good graphics with performance. **DREDGE** (2023, stylized fishing adventure) runs on URP – it achieves striking lighting and weather effects (fog, night scenes) on both PC and Switch by using URP's features within a tight performance budget. These games show that URP can deliver high-quality visuals (including shadows, reflections, and post-FX) for realistic environments, as long as ultra-high-end effects are not required.

- **Notable HDRP-powered games:** HDRP is chosen for games pushing Unity's graphical fidelity on high-end platforms. For instance, **Hardspace: Shipbreaker** uses HDRP to achieve complex area lighting and volumetric effects in its sci-fi shipyard environments [36]. The adventure game **Syberia: The World Before** is built with HDRP, enabling its richly detailed European cityscapes and realistic character lighting [37]. The heavy-metal rhythm shooter **Metal: Hellsinger** also leveraged HDRP for its high-detail demons and environments, with the developers even using HDRP's advanced water and lighting systems in production [38]. A very recent example is **Sons of the Forest**, an open-world survival game noted for dense forests and dynamic lighting; it runs on Unity HDRP, which contributes to its impressive graphics (albeit at the cost of requiring powerful hardware) [10]. These titles demonstrate HDRP's strengths – delivering cutting-edge visuals (on par with many Unreal Engine games) when used by experienced teams on projects where top graphics are a priority.

Performance and Scalability in Practice:

In choosing URP vs HDRP, consider your **target hardware and desired visuals**. URP excels for games that need to run on varied or lower-end systems (or at high frame rates), while still offering modern graphics like PBR materials, shadows, and post-processing. HDRP is suited for projects aiming at "AAA" visuals on PC/console where you can afford the performance cost – it gives you more "dialed up" graphics out-of-the-box (from **realistic lighting and atmospherics to ray-traced effects**), but *only* makes sense if your audience has the hardware to enjoy it [6] [8]. Many studios start in URP for flexibility; moving to HDRP is worthwhile only if the game's artistic goals require those extra features. In summary, **URP vs HDRP is a trade-off** between **broader performance scalability vs. maximum visual fidelity** [6] [8]. Unity 2022 LTS has narrowed the feature gap somewhat, but the distinction remains: URP is the **universal** choice for most standard games, and HDRP is the **specialized** pipeline for bleeding-edge graphics on high-end hardware.

Sources: Unity official documentation and release notes [39] [40] [41] [33], Unity 2022 LTS features blog [42] [31], developer case studies and forum discussions [36] [10] [37] [7], as referenced above. Each pipeline's capabilities and limitations are summarized based on these sources.

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[1] [2] [3] [11] [12] [13] [14] [15] [16] [17] [18] [19] [20] [22] [23] [24] [25] [26] [27] [28] [29] [30] [32] [33] [39] [41] Unity - Manual: Render pipeline feature comparison
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