UNREAL ENGINE **RENDERING PIPELINE**

BASEPASS

Static Meshes · Instanced Staticmeshes · Skeletal Meshes · Landscapes · Procedural Meshes · Geometry Collection

HLOD

Only for regular meshes

Drawcalls
The drawcalls are commands that make up the frame - coming from different sources

Dynamic Instancing
Automatic drawcall batching, reduced drawcalls

Basepass Materials
Part of the rendering and shading is handled already in the basepass

Lightmaps
Using the Lightmaps to do the initial shading

Static · Dynamic

STATIC LIGHTING / SHADOWS

Volumentric Lightmaps
Precalculated indirect lighting to light dynamic actors
Higher quality - standard

Volume Lighting Samples
The cheaper and less powerful but faster version of VolumetricLM
Cheaper

Which one depends one settings

Static Light Actors as Placed
An actor marked as Static (or Stationary) in the world

Lightmass
Stand alone application, with support to act as a system to calculate and bake the static lighting

Lightmass Importance Volume
Identifies where to prioritize light calculations. Higher quality area

Global Illumination / Radiosity
Lightmass does the lighting with full GI and Radiosity support

REFLECTIONS

Reflections Captures
Store reflections locally per probe. Static, fast, and provides the foundation

Planar Reflections
Useful for flat and highly reflective surfaces

Screen Space Reflections
SSR is fast, real time but does not reflect everything

Raytraced Reflections
Precise and accurate raytraced reflections

POST PROCESSING

Etc

Bloom #3 · Bloom #2 · Bloom #1

Standard
Convolution

Burley SSSSS
Gaussian · Bokeh · Circle Cinematic

Chromatic Aberration · Vignette · Lensflares · Grain · Dirt Mask

PP Materials

Tonemapper · Bloom · SSAO · SSSSS · SSGI · Depth of Field · Exposure · Blendables · Camera Effects

VISIBILITY

Ahead of Rendering
Some parts related to rendering have to be run ahead of the actual render process. Visibility most notably

All Logic
Catch all, for all logic related work gameplay, animations etc

Occlusion / Visibility Processes
Determines what's visible and should be included in the frame

Start of Rendering

Hardware Occusion · Software Occusion · Mesh LODs

Visibility Culling
Occlusion culling of all rendering actors

Not always used

Precomputed Visibility
Optional - Use precomputed visibility data stored in cells spread over the world

Frustrum Culling
Standard frustum culling

Distance Culling
The standard, most common, and Cull actors if further than X from the camera perspective.

Early Z Pass
Prepass to reduce pixel overdraw. Also Scene Depth what it needs and starts to render

Basepass
The major (executed) stage handles geometry and some of the material rendering

GBuffer
A set of images (one per buffer) pass for the deferred

Scan Depth
Scene Depth Texture. Used for various later parts of the deferred rendering pipeline

Buffer A · Buffer B · Buffer C · Buffer D · Buffer E

DYNAMIC LIGHTING / SHADOWS

Dyn Lighting / Shadows
Various methods for dynamic lighting and shadows.

Direct · Indirect

Light · Shadow · Light · Shadow

IES Profiles
Alters the projection and intensity of light sources - also works for static lighting

Light Functions
Blends a material on top of a light to create effects - like water caustics or cloud shadows

Material

Light Propagation
Older real-time Global Illumination system

Raytraced GI
Fully raytraced Global Illumination

Capsule Shadows
Simplified shadows for use with characters - when scale or performance is critical

DFAO
Ambient Occlusion using Distance Field Meshes

Raytraced AO
Accurate raytraced Ambient Occlusion

Distance Field Meshes

Dynamic Shadows
Regular dynamic shadows as used for for example overnights

Shadow Caching

Inset Shadows
"Higher" quality shadows - see Per Object

Optionally supports soft shadowing when using DF

Distance Field Meshes

Cascaded Shadow Maps
Shadow maps from environments - cascades different quality shadows maps up to a certain range

Contact Shadows
Small detail shadows for when two objects are close to each other

Distance Field Shadows
Usefor outdoor lighting - using DF for shadows speeds up rendering

Per Object Shadows
Simpler shadow technique that casts a limited scale ShadowMap

Raytraced Shadows
Full on raytraced shadows including soft shadowing

Reflections
All types of reflections and related shading work

Additional
Several additional things highlighting the less mainstream and used here

Post Processing
It is possible to have many different passes here

Final Frame
The image as seen by the viewer

ADDITIONAL

Atmospherics
All items of sky, fog and volumetrics

Translucency
All types of translucency

Materials

Optionally via a material

Volumetric Fog
Height Fog can be enhanced and it would use the volumetric fog system along side Lightmass using other features also

Lighting Mode
Sets different ways of shading and rendering translucent surfaces

Refraction
Refraction / Distortion as caused by translucent surfaces

Physically Based Sky Atmosphere
Land sky support for dynamic time of day

Distance Fog
Height or Atmospheric Fog

Volumetric Materials
Materials applied on volume Materials, applied via a material

Volumetric NonDir · Vertex NonDir
Volumetric Dir · Vertex Dir
Translucency Volume · Forward Shading
Raytraced

PERFORMANCE

Scalability
Scalability affecting quality, performance visible in platform

GPU Profiler
GPU rendering performance expense overview

Stats
Displays real time detailed information about performance

View Modes
Various modes for optimization of things like textures, shader detail, etc

CVars

SCALABILITY EXAMPLE

PC / Editor

Console → Etc...
Mobile → Android → Adreno 2000 · Etc...
Mobile → Etc...

High end deferred

Adreno 2000 → Forward Shading → Force Mesh LODs → Force Material Quality → Force Particle LOD → View Distance Multiplier → Foliage Density Multiplier → Material Fully Rough → 1000+ More Settings