

# 3-Dimensional (3-D) Spatial-Temporal Video Noise Reduction (VNR)

— For Mobile Phones —



## Latency-Free 1-Previous-Buffered-Frame VNR Filter

Precoad's next-generation 3-Dimensional (3-D) spatial-temporal video noise reduction (VNR) solutions [significantly improve](#) and are complementary to mobile phone video camera and display, as well as LCD TV, Blu-ray player and production, digital video camera, video camcorder, sensor, and industrial applications. A key advantage is Precoad's 3-D spatial-temporal VNR solutions can be implemented as a [live, real-time, latency-free](#) 1-previous-buffered-video-frame VNR filter. This visibly and significantly reduces critical temporal noise, whilst preserving video picture features. This innovative patented [anisotropic-diffusion-based spatial-temporal](#) solution is starkly [different](#) from the onerous and burdensome IIR and adaptive filter types of approaches, as can be clearly seen from pixel-by-pixel comparisons of results. Implementations can be in either [software](#) or hardware.

Precoad's groundbreaking, [visibly superior](#), [lowest implementation-cost](#) family of 3-D VNR solutions for video provides the following feature set:

- [Complementary](#) -- also removes video content noise (caused for example by camera-capture device hardware, poor lighting, film grain noise, video reproduction) that is NOT removed by other algorithms and/or hardware device
- Reduces various ***DIFFERENT*** types of spatial-temporal noise contamination
  - including both "external" noise and "internal" noise
- Can be [integrated in combination with any other existing NR \(such as 2-D spatial only\)](#), or as stand-alone independently
- Improves NR performance for [visibly superior](#) video picture quality, and preserves and does not destroy nor lose video picture features
- Lowest complexity for [lowest-cost](#) implementation
- Without tailing nor ghosting effects
- [No additional latency — NO future frames](#)
- Needs only **1 previous buffered video frame**, but [NO future frames](#)
- Rapid product integration
- [Software](#) or hardware implementations

The "game changing" market opportunity enabled by Precoad's 3-D VNR is [higher product-quality levels](#) at [lower product-cost levels](#) in the fiercely picture-quality competitive video landscape -- from the sensor level to the camera level to the display level to the IC level. The critical differentiating key is our highly sought "latency-free" advantage, without compromising video picture-quality, without onerous implementation complexity and cost.

Precoad 3-D VNR results for video test sequences for major chip manufacturers are quite dramatic. These tests are commonly used patterns in video test and measurement systems. Their purpose is to stress the system and observe system behavior under controlled conditions. The VNR must be capable of recognizing noise and noticeably reducing noise level without unacceptable or visible degradation in the original video pattern.

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# System Specifications

## 3-D Spatial-Temporal VNR

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<b>General</b>	
VNR algorithm type:	Anisotropic-diffusion-based, 3-D (spatial-temporal)
Patent information:	U.S. Patent No. 7,570,832, Hong Kong Patent No. HK1111494, International Patent Application No. PCT/US2005/021099, Japanese Patent Application No. 2007-527809, Chinese Patent Application No. 200580026770.2.
Algorithm complexity:	Very low. Easy to implement.
Video picture quality:	Superior to prevalent VNR algorithms.
Latency:	None. No future frames used.
Memory requirement:	Low. Only one previous frame used.
Implementations:	Software, or hardware.
<b>Input Formats</b>	
Video Resolutions:	800 x 480, 720 x 480, 640 x 480, 480 x 320, 320 x 240
Raw Video Formats:	YUV, RGB
Other Video Formats:	H.264, AVC, MPEG-4, MPEG-2 (with separate decoder)
Color Support:	Color, B/W
<b>Hardware requirement for VNR</b>	
CPU speed:	Display resolution dependent. 800 MHz or above, for 640x480 raw video input, 30fps
Memory Size:	4 MB
Hardware Accelerator:	2x: CPU requirement reduces to half 3x: CPU requirement reduces to 1/3
VNR Processing:	Parallel processing recommended
<b>Platform Supported</b>	
CPU Architecture::	ARM series, or other RISC.
Mobile OS's:	Windows Mobile 5.0 or above (implemented and tested). Symbian, Android, Apple Mobile OS (to be supported).



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