

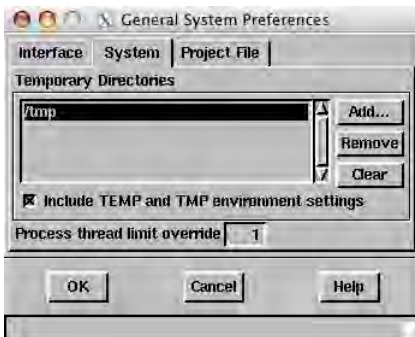
## System

# Multi-Threaded JPEG2000 Compression/Decompression

TNTmips can make extensive use of JPEG2000 compression for raster objects. JPEG2000 compression and decompression operations are multi-threaded in all TNT processes to allow simultaneous use of all of your computer's processor cores (2, 4, 8, or more). Multi-threading enables JPEG2000 operations to spread the processing workload across multiple cores, which provides particular speed benefits when the operation involves decompression and compression of large rasters, such as in import/export, extraction, or creating a mosaic. You can also start multiple processes in TNTmips, each of which uses JPEG2000 compression/decompression (e.g., 3 separate exports and/or mosaics into separate JP2 files). This multitasking will increase use of your cores by using multi-threading to very nearly 100% before delaying the time to complete any of these simultaneous processes.

Multi-threading to multiple cores offers considerable speed benefits in JPEG2000 operations in comparison to a single processing thread. Those speed benefits obviously depend on the number of cores, but also on other potentially limiting factors such as bus speed, hard drive speed, how many other concurrent processes are running, and whether or not the process is reading from and writing to different drives.

You can evaluate the impact of multi-threading in any TNT process involving JPEG2000 compression or decompression on your particular system by using the TNT General System Preferences to temporarily set the *Process thread limit override* (thread limit for any individual TNT process) to 1, which simulates the use of your multi-core computer as a single-core system. You can then increase this value to retest the process using additional threads (up to the number of cores available). Timing comparisons are provided here for a single process involving both decompression and compression:



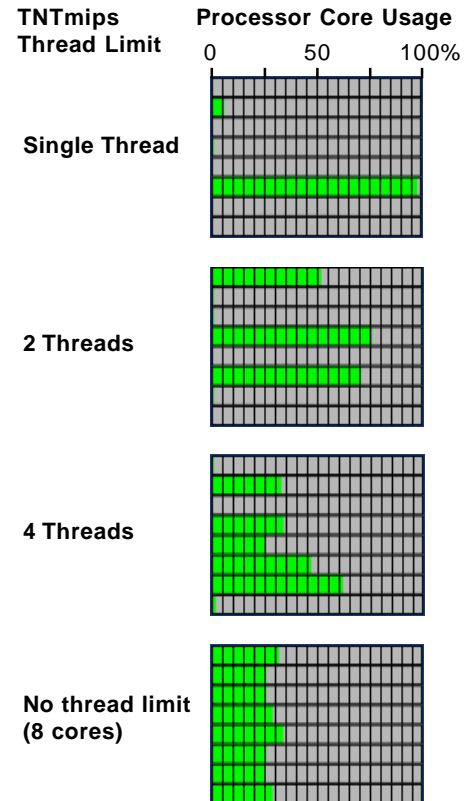
To test your multi-core system's TNT performance against a simulated single-core system, temporarily set the Process thread limit to 1 in the General System Preferences (Tools / System / Preferences). You must restart TNTmips in order for this change to take effect.

In the tests with 2 threads, multi-threading to 2 processor cores resulted in routine usage of 60 to 80% of each core's capacity and nearly halved processing times. Increasing the thread limit to 4 provided a further small reduction in processing time, but removing the thread limit to allow simultaneous use of all 8 cores provided little or no additional time reduction. As the graphs of CPU core usage in the illustration show, as the number of threads used by the process increases, the percentage of each core's processing capacity that is used falls from 30 to 60% with 4 threads to 25 to 40% with 8 cores, diluting the benefit of having the additional cores available for this multi-threading application.

exporting a large JPEG2000-compressed raster object from a Project File to a tiled set of lossy-compressed JP2 files. Tests were run on an 8-core Mac Pro computer with the TNT thread limit set to 1, 2, and 4 threads, and then with no limit (allowing all 8 cores to be used by the process).

Monitoring the CPU usage in the Mac Activity Monitor during the single-thread tests showed 95 to 100% CPU usage of a single core and provided benchmark times for the tests with higher

Timing Comparison, Multi-Thread versus Single Thread		
Task: Export JPEG2000-compressed raster to tiled set of lossy-compressed JP2 files on 8-Core, 3.0 GHz Mac Pro (2 Quad-Core Intel Xeon processors) with 8 GB RAM; read from / write to separate SATA hard drives.		
Source Raster	JP2 Tile Set	Processing Time
RGB composite, 48,203 columns x 35,612 lines, 500 MB compressed	945 tiles, each 1024 x 1024 cells, compressed to lossy 10:1	Single Thread: 21.2 min
		<b>Multi-Threaded</b>
		2 threads: 10.6 min 4 threads: 9.8 min 8 threads: 9.6 min
RGB composite, 115,000 columns x 145,000 lines 3.98 GB compressed	2,668 tiles, each 2500 x 2500 cells, compressed to lossy 12:1	Single Thread: 3 hr 6 min
		<b>Multi-Threaded</b>
		2 threads: 1 hr 33 min 4 threads: 1 hr 24 min 8 threads: 1 hr 27 min



Snapshots of processor core usage from the Mac Activity Monitor display during JPEG2000 decompression-compression tests. Each horizontal bar graphs the instantaneous use in percent of one processor core. Vertical lines mark 5% increments.