



# 3D ray tracing simple scalability case study

Threading in OpenMP\*, Intel® Threading Building Blocks and Intel® Cilk Plus

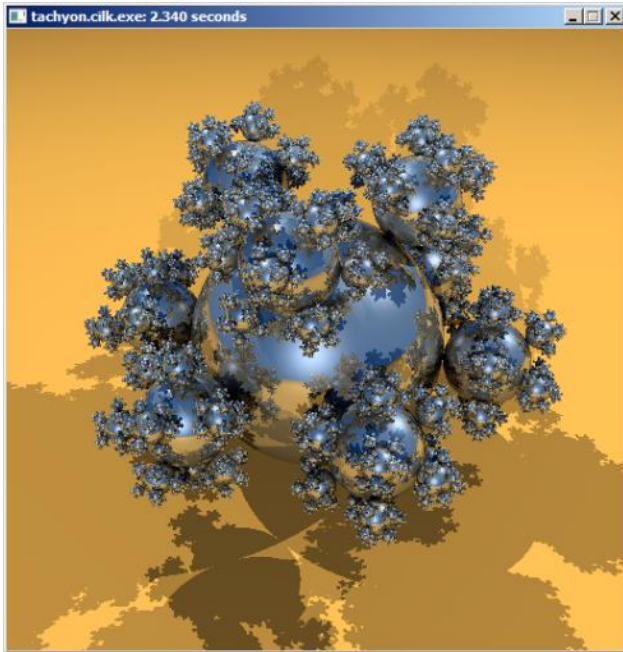
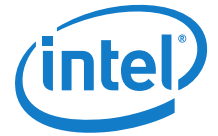
Based on Intel TBB tachyon package example

Vladimir Polin

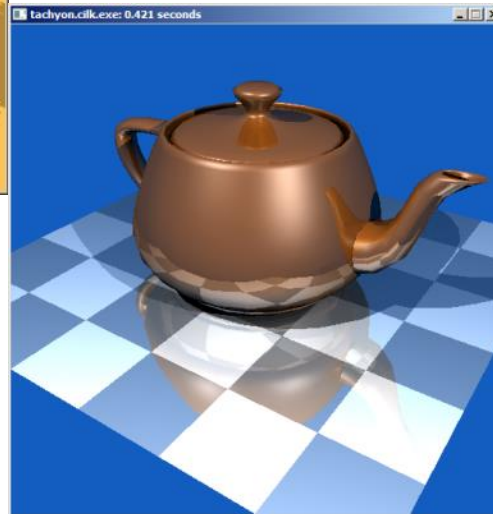
Threading Runtimes Engineering Manager

Rock your code.

# Tachyon Parallel / Multiprocessor 3D Ray Tracing System



- 3D ray tracing
- Open Source
- Part of the Intel TBB package
- Important:



- Demo only
- Vivid pictures
- Easy to reproduce

Full 3D ray tracer is available at <http://jedi.ks.uiuc.edu/~johns/raytracer/>

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# Basic Threading Runtimes Difference



```
#if RUNTIME == RUNTIME_OPENMP
#include <omp.h>
#elif (RUNTIME == RUNTIME_TBB)
#include <tbb/tbb.h>
#endif

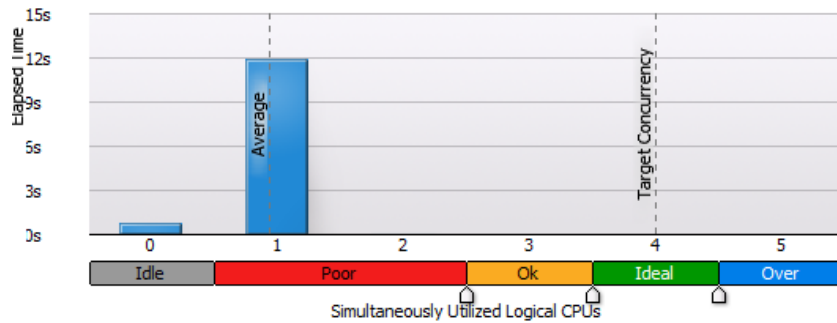
static void parallel_thread(void)
{
    unsigned int mboxsize = sizeof(unsigned int)*(max_objectid()+20);
    #if RUNTIME == RUNTIME_SERIAL
        for (int y = starty; y < stopy; y++)
    #elif RUNTIME == RUNTIME_OPENMP
        #pragma omp parallel
        #pragma omp for schedule(dynamic, 32)
        for (int y = starty; y < stopy; y++)
    #elif RUNTIME == RUNTIME_CILK
        _Cilk_for(int y = starty; y < stopy; y++)
    #elif RUNTIME == RUNTIME_TBB
        tbb::parallel_for(starty, stopy, [mboxsize](int y)
    #endif
        {
            unsigned int serial = 1;
            unsigned int local_mbox[mboxsize];
            memset(local_mbox, 0, mboxsize);
            drawing_area_drawing(startx, totaly - y, stopx - startx, 1);
            for (int x = startx; x < stopx; x++) {
                color_t c = render_one_pixel(x, y, local_mbox, serial, startx, stopx, starty, stopy);
                drawing.put_pixel(c);
            }
            video->next_frame();
        }
    #if RUNTIME == RUNTIME_TBB
        );
    #endif
}
```

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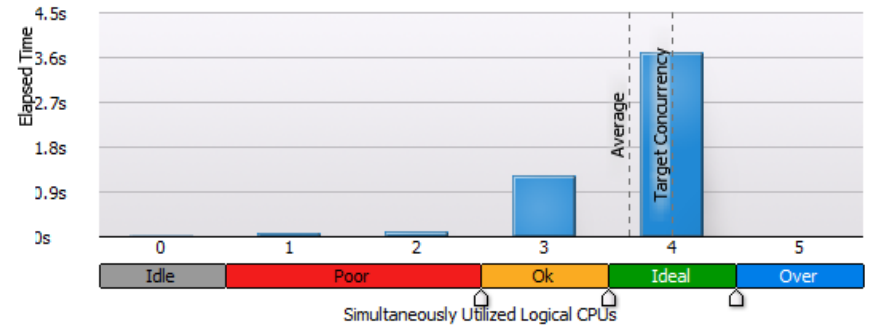
# Results



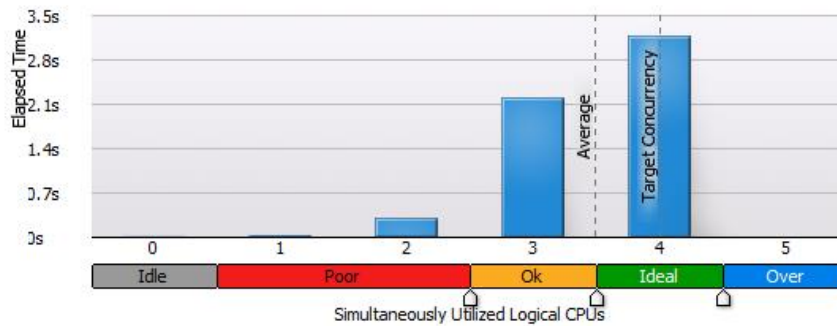
## Serial



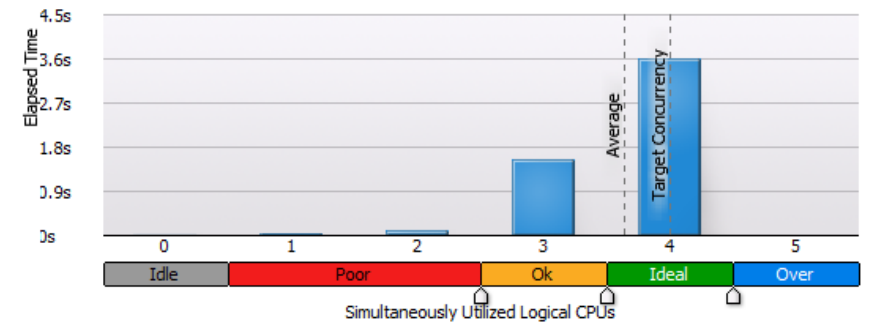
## OpenMP



## Intel Cilk Plus



## Intel TBB



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# Results (Serial)



Advanced Hotspots Hotspots viewpoint (change) ? Intel VTune Amplifier XE 2015

Analysis Target Analysis Type Collection Log Summary Bottom-up Caller/Callee Top-down Tree Tasks and Frames

Grouping: Module / Function / Call Stack

Module / Function / Call Stack	CPU Time				Instructions Retired	CPI Rate	CPU Frequency Ratio	Mod ...	Function (Full)	Source File	
	Effective Time by Utilization	Spin Time	Ove ... Time								
tachyon.all_id.exe	11.487s	0s	0s		42,907,800,000	0.852	1.226		grid_intersect	c:\users\vp...	
+ grid_intersect	6.713s	0s	0s		23,878,400,000	0.896	1.228	tach ...	grid_intersect	grid.cpp	
+ sphere_intersect	4.226s	0s	0s		17,258,800,000	0.785	1.235	tach ...	sphere_intersect	sphere.cpp	
+ shader	0.181s	0s	0s		499,200,000	1.214	1.289	tach ...	shader	shade.cpp	
+ tri_intersect	0.134s	0s	0s		663,000,000	0.467	0.889	tach ...	tri_intersect	triangle.cpp	
+ trace	0.073s	0s	0s		119,600,000	1.565	0.985	tach ...	trace	trace_rest.cpp	
+ render_one_pixel	0.059s	0s	0s		169,000,000	1.323	1.471	tach ...	render_one_pixel	trace.all.cpp	
+ light_intersect	0.049s	0s	0s		143,000,000	0.909	1.032	tach ...	light_intersect	light.cpp	
+ tri_normal	0.018s	0s	0s		80,600,000	0.645	1.130	tach ...	tri_normal	triangle.cpp	
+ parallel_thread	0.009s	0s	0s		20,800,000	1.250	1.083	tach ...	parallel_thread	trace.all.cpp	
+ light_normal	0.008s	0s	0s		33,800,000	1.154	1.773	tach ...	light_normal	vector.cpp	
+ cbkctk	0.005s	0s	0s		0	0.000	0.371	tach ...	cbkctk	cbkctk.asm	
Highlighted 51 row(s):				11.821s	0.002s	0s					

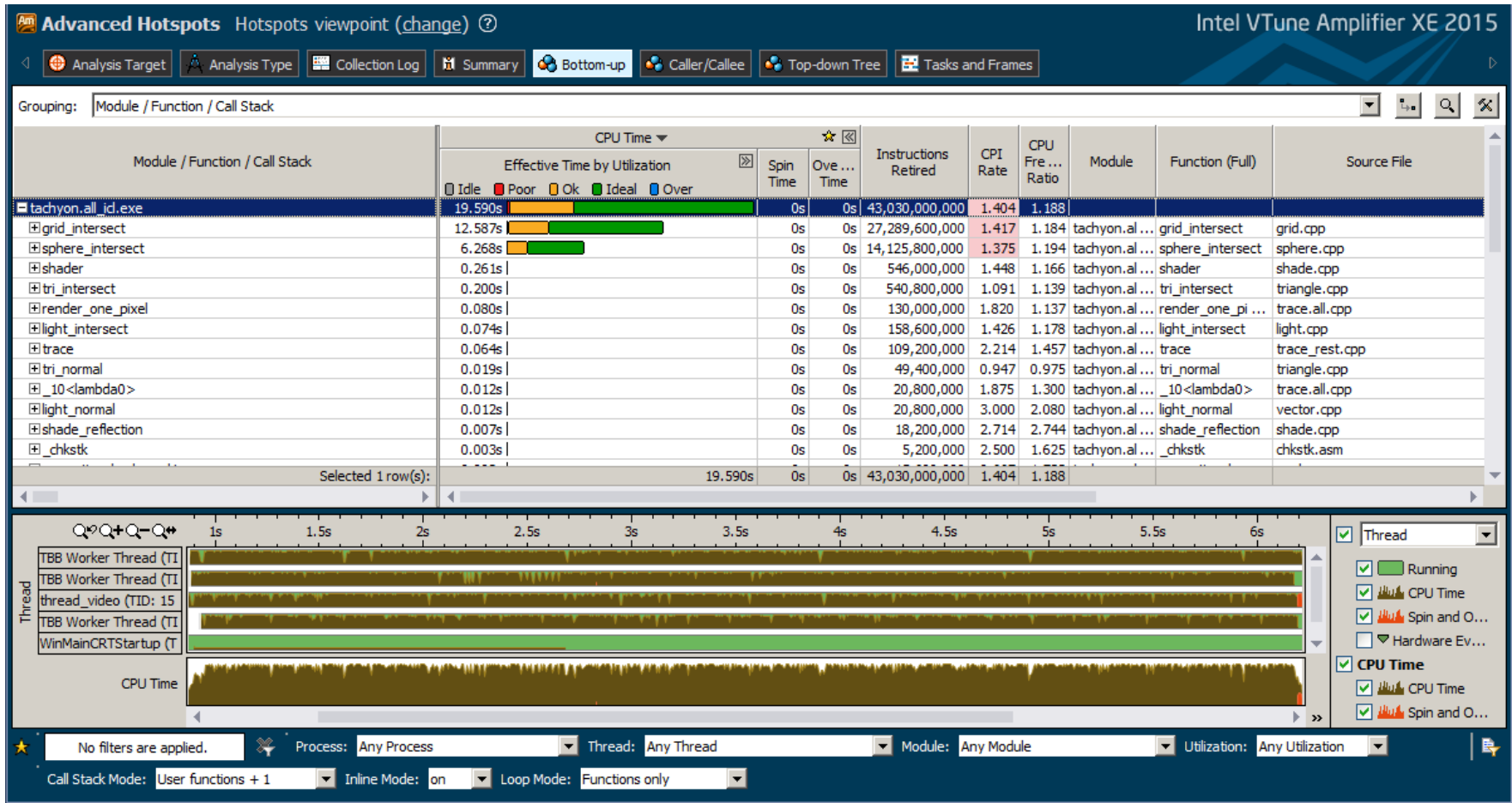
Thread: thread\_video (TID: 12424), WinMainCRTStartup (TID: ...), Thread (TID: 10364), Thread (TID: 13864), Thread (TID: 16900), Thread (TID: 15664), Thread (TID: 13984)

Filter: 99.2% is shown Process: Any Process Thread: Any Thread Module: Any Module Utilization: Any Utilization

Call Stack Mode: User functions + 1 Inline Mode: on Loop Mode: Functions only

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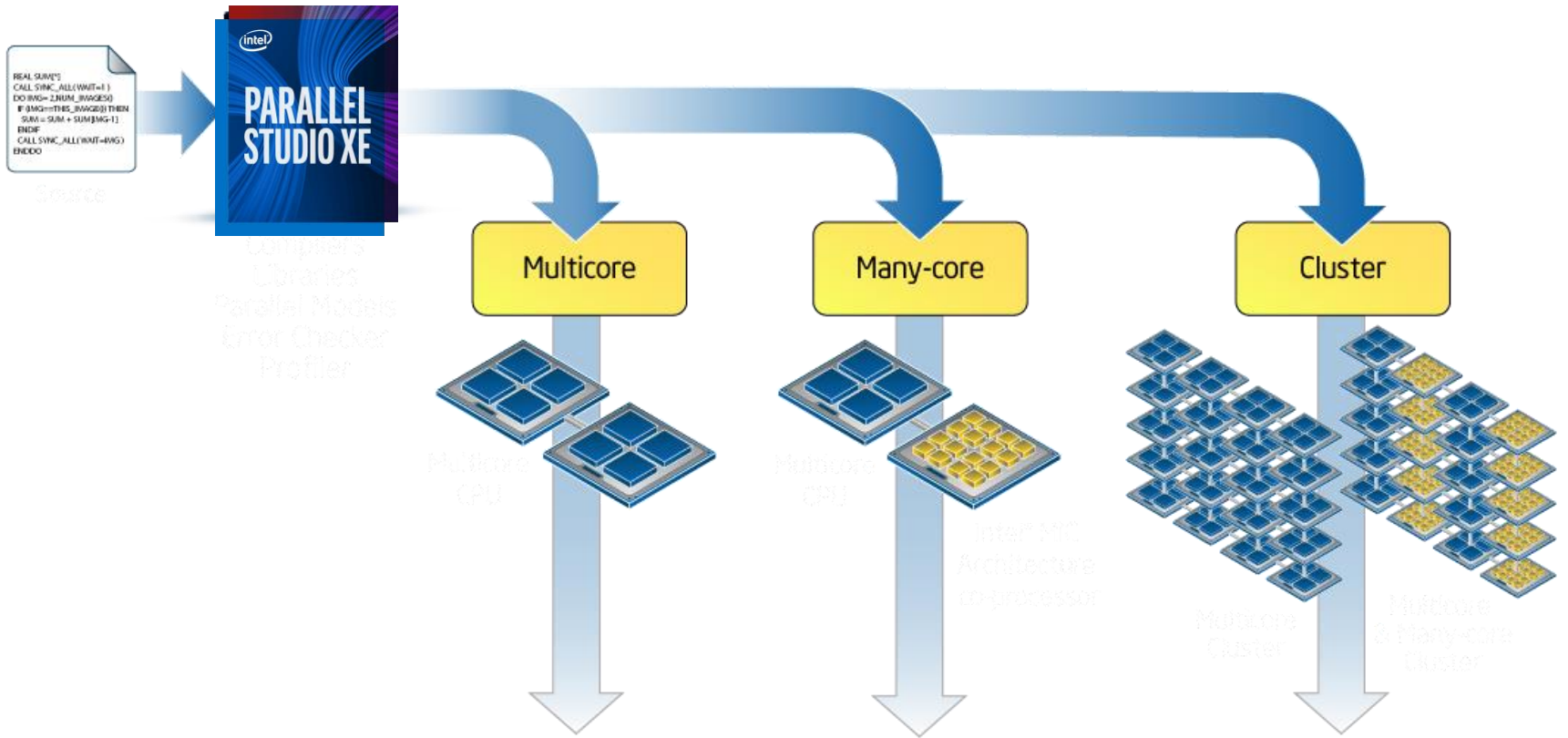
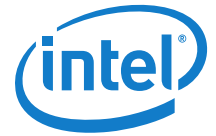
# Results (Intel TBB)



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# Tomorrow?

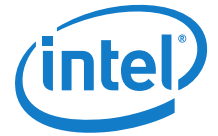


Can you application utilize all resource efficiently?



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# Conclusion



## **Scale productive**

Tune and debug for more cores and nodes

## **Scale effectively**

Keep performance

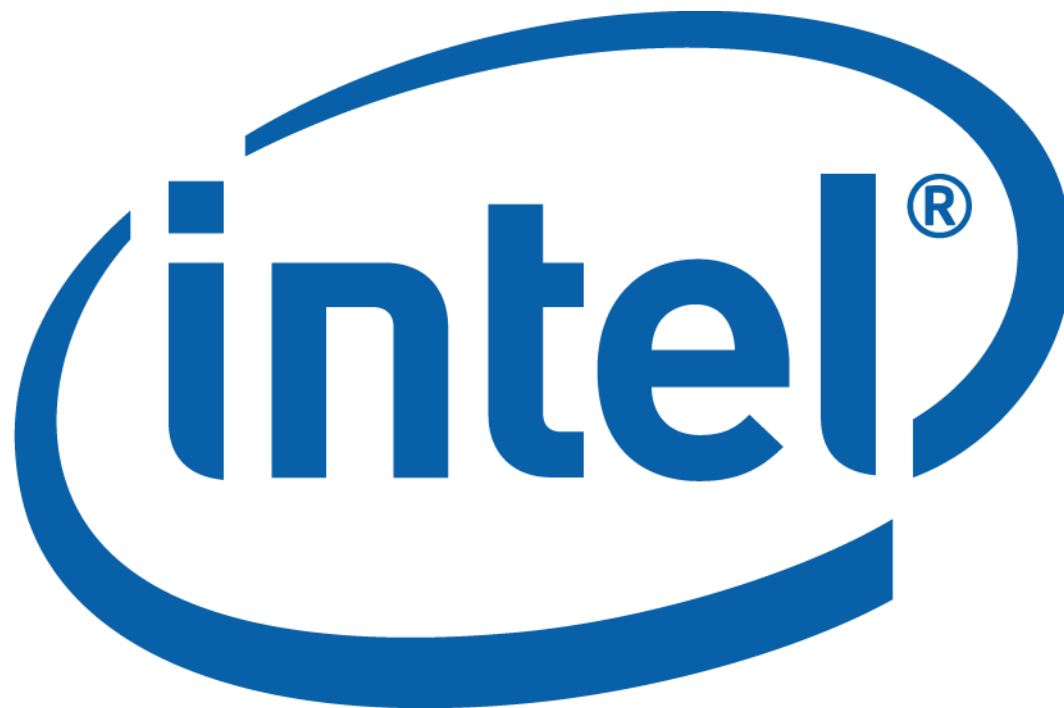
## **Scale for the future**

Multicore today, Many-core tomorrow

**Intel® Parallel Studio XE:** The Suite for developing of applications for shared and distributed memory models

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# Software

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Уведомление, редакция № 20110804

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