



**PCaPAC Workshop 2006 at Jefferson Lab**

# **EPICS SCA Clients on the .net x64 platform**

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# Control experts don't care 64-bit.

Control systems are fine on 32-bit!

However, some of us are already on 64.

Scientific Computing.

Server-side Computing.

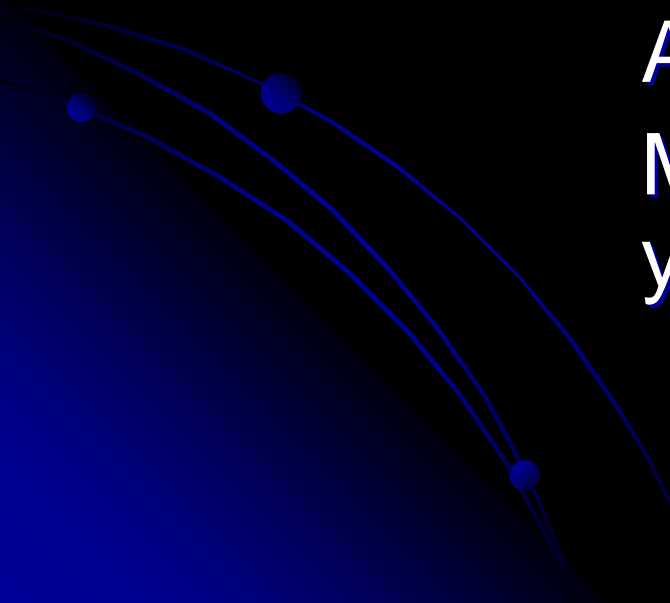
Computer Games.

64-bit PC is not expensive.

# Moving to 64-bit!

- Merits
  - Wider Memory Space
  - Faster Execution Speed

Accelerator physicists do  
Model-based controls using  
your system!



# Scientific Computing on .NET

- **C# provides reasonable performance**
  - H. Nishimura and T. Scarvie .  
“Particle Tracking and Simulation on the .NET Framework”, EPAC 2006

## Performance of Particle Tracking on AMD Athlon 4800+

Compiler	Test1	Test2	Test3
C++ /32	0.263 sec	0.294 sec	0.197 sec
C++/64	0.247 sec	0.223 sec	0.145 sec
C#	0.220 sec	0.386 sec	0.153 sec

Test 1. 10,000 turns of a particle in 5-dim phase space.

Test 2. 1,000 turns of a particle in 6-dim phase space.

Test 3. 100 turns of a linear DA map.

# EPICS must support 64-bit

- It is difficult to mix 32-bit and 64-bit routines on 64-bit PCs.

*64-bit apps cannot call 32-bit routines without using a kind of IPC.*

- **64-bit EPICS access makes sense!**

# Porting CA to 64

- CA is a Portable C++ Library
  - Only a little work required on Windows to recompile for 64-bit by using Visual C++
- Athlon Dual Core gave a Timing Problem
  - Trouble posted on a web.
  - Posted as a patch for gamers by AMD!

**Gamers have power on the market.**

**CA.dll for 64-bit Windows is ready!**

# SCA.NET for 64-bit

- There was absolutely nothing to do!  
**SCA.NET for 32-bit also works for 64-bit.**
- The Secret is “**Any CPU**” build option.

**Binaries built for “Any CPU”  
run natively on Any CPU.**

Prepare

32-bit CA.dll on 32-bit Windows

64-bit CA.dll on 64-bit Windows

# Inside SCA.NET

```
[DllImport("ca.dll")]
```

```
unsafe public static extern
```

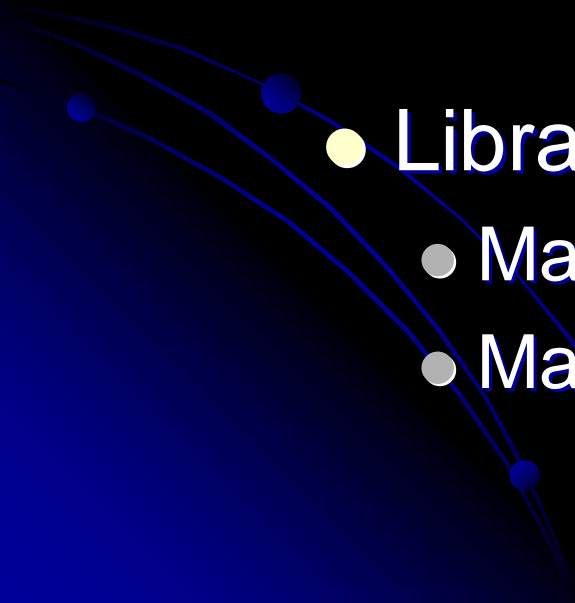
```
char * ca_message(uint ca_status);
```

The CPU is not explicitly assigned.

ca.dll can be 32-bit, 64-bit,  
or even ca.so on Linux!



# EPICS .NET Apps are Portable!

- An SCA.NET client on .NET runs on both 32-bit and 64-bit Windows if built for “Any CPU”.
  - EPICS CA itself is CPU dependent.
  - Libraries from third parties
    - May be for “Any CPU”
    - May be CPU-dependent.
- 

# Third Party Libraries

- Many Commercial Libraries and Tools
- Many Open-Source Libraries and Tools
  - Source Forge
  - CodePlex at [www.codeplex.com](http://www.codeplex.com)
- Our Favorites
  - ZedGraph for Plot/Chart, [ZedGraph.org](http://ZedGraph.org)
  - SourceGrid for string grids, [www.devage.com](http://www.devage.com)
- We have not yet chosen any instrumentation component library.

# Example

SRMagNet in C#															
<b>Bend</b>	<b>AC</b>	<b>AM</b>	<b>QF</b>	<b>AC</b>	<b>AM</b>	<b>QD</b>	<b>AC</b>	<b>AM</b>	<b>Sqew</b>	<b>AC</b>	<b>AM</b>	<b>ChicH</b>	<b>AC</b>	<b>AM</b>	
SR01C B	896.815	897.470	SR01C QF1	92.810	92.888	SR01C QD1	103.071	103.160	SR01C SQSF1	-1.915	-1.906	SR04V HCM1	-47.750	-47.919	
SR04C BSC P	296.551	296.385	SR01C QF2	92.638	92.705	SR01C QD2	102.820	102.932	SR02C SQSD1	-1.773	-1.779	SR04V HCM2	-1.832	-1.779	
SR08C BSC P	298.597	298.431	SR02C QF1	92.472	92.350	SR02C QD1	102.377	102.443	SR03C SQSD1	2.982	2.987	SR04V HCM3	-47.750	-47.821	
SR12C BSC P	298.459	298.238	SR02C QF2	92.687	92.632	SR02C QD2	102.897	102.982	SR03C SQSF1	-4.495	-4.491	SR06V HCM1	23.875	23.809	
<b>QFA</b>	<b>AC</b>	<b>AM</b>	SR03C QF1	92.643	92.680	SR03C QD1	103.051	103.087	SR03C SQSF2	-4.668	-4.672	SR06V HCM2	-10.169	-10.366	
SR01C QFA	517.604	517.016	SR03C QF2	91.929	91.999	SR03C QD2	101.287	101.327	SR03C SQSD2	3.938	3.944	SR11V HCM2	6.511	11.725	
SR04C QFA	525.436	525.525	SR04C QF1	92.208	92.144	SR04C QD1	103.586	103.565	SR04C SQSD1	-2.039	-2.031	<b>ChicV</b>	<b>AC</b>	<b>AM</b>	
SR08C QFA	522.711	523.016	SR04C QF2	92.292	92.227	SR04C QD2	102.824	102.845	SR05C SQSD1	3.608	3.615	SR04V VCM1	0.000	-0.042	
SR12C QFA	519.448	519.897	SR05C QF1	92.534	92.576	SR05C QD1	104.854	104.918	SR05C SQSF1	0.000	-0.002	SR04V VCM2	1.122	1.587	
<b>QDA</b>	<b>AC</b>	<b>AM</b>	SR05C QF2	92.476	92.509	SR05C QD2	102.591	102.653	SR05C SQSF2	0.056	0.060	SR04V VCM3	0.000	-0.039	
SR04C QDA1	77.655	77.656	SR06C QF1	92.486	92.418	SR06C QD1	102.796	102.784	SR05C SQSD2	-2.846	-2.853	SR06V VCM2	-1.591	-1.856	
SR04C QDA2	83.047	83.040	SR06C QF2	92.991	92.926	SR06C QD2	103.778	103.769	SR06C SQSD1	-2.958	-2.971	SR11V VCM2	3.238	2.887	
SR08C QDA1	81.694	81.745	SR07C QF1	92.483	92.512	SR07C QD1	103.155	103.223	SR06C SQSF1	0.000	-0.011	<b>ChicV</b>	<b>AC</b>	<b>AM</b>	
SR08C QDA2	74.813	74.854	SR07C QF2	92.743	92.788	SR07C QD2	102.320	102.330	SR06C SQSF2	-1.129	-1.133	SR04V HCM2M	24.210	24.210	
SR12C QDA1	77.221	77.249	SR08C QF1	91.602	91.636	SR08C QD1	100.742	100.819	SR06C SQSD2	0.495	0.505	SR04V HCM2M	5.010	5.010	
SR12C QDA2	81.533	81.604	SR08C QF2	91.995	92.071	SR08C QD2	102.588	102.651	SR07C SQSD1	-0.473	-0.482	SR04V HCM2M	0.000	0.000	
<b>Sext</b>	<b>AC</b>	<b>AM</b>	SR09C QF1	92.451	92.375	SR09C QD1	103.702	103.760	SR07C SQSF1	-0.061	-0.074	SR06V HCM2M	20.000	20.000	
SR01C SF	373.140	370.546	SR09C QF2	92.749	92.666	SR09C QD2	102.431	102.506	SR07C SQSF2	-19.735	-19.780	SR06V HCM2M	20.000	20.000	
SR01C SD	249.811	249.660	SR10C QF1	92.758	92.826	SR10C QD1	103.665	103.748	SR07C SQSD2	-3.425	-3.433				
<b>TrimQ</b>	<b>AC</b>	<b>AM</b>	SR10C QF2	92.384	92.462	SR10C QD2	102.291	102.377	SR08C SQSD1	-2.259	-2.259				
SR01C SF	373.140	370.546	SR11C QF1	92.298	92.342	SR11C QD1	102.696	102.759	SR09C SQSF1	1.667	1.674				
SR01C SD	249.811	249.660	SR11C QF2	92.636	92.692	SR11C QD2	102.543	102.608	SR10C SQSD1	1.924	1.931				
			SR12C QF1	91.446	91.939	SR12C QD1	101.321	101.270	SR11C SQSF1	-5.204	-5.223				
			SR12C QF2	91.910	91.922	SR12C QD2	101.486	101.422	SR12C SQSD1	-1.338	-1.343				

HCM	SR01	SR02	SR03	SR04	SR05	SR06	SR07	SR08	SR09	SR10	SR11	SR12
HCM1		0.219	1.074	-0.219	-2.088	18.985	-0.270	0.306	0.490	-0.581	-18.531	0.599
HCM2	0.191	-0.007	-0.089	-2.119	-1.129	0.149	0.995	1.487	-0.253	0.974	1.902	0.504
HCS1	0.032	0.348	0.588	0.346	11.584	0.808	-0.354	0.557	0.074	-0.693	-0.701	-0.722
HCSF1	0.287	0.578	0.534	0.496	-16.412	-11.741	0.357	-0.101	0.370	0.395	-0.166	-0.818
HCSF2	0.011	-0.531	0.521	0.689	-9.957	-0.784	0.238	-0.435	0.104	0.094	0.453	-1.371
HCS2	-0.070	-0.729	1.257	-0.223	-1.457	-0.831	0.139	0.073	0.543	-0.321	0.343	-1.105
HCM3	0.024	0.765	0.612	0.778	0.766	-1.037	-1.682	-0.065	0.008	-0.207	-0.857	0.704
HCM4	1.208	-0.499	0.374	1.056	1.882	1.067	1.556	-0.483	-0.024	-15.933	0.928	

VCM	SR01	SR02	SR03	SR04	SR05	SR06	SR07	SR08	SR09	SR10	SR11	SR12
VCM1		1.405	-2.195	0.126	-0.884	2.370	-2.002	-2.397	-0.327	-0.683	0.994	-0.536
VCM2	-0.043	-0.609	-1.069	0.709	0.147	-0.068	-2.587	-0.605	-0.731	-0.957	-0.683	0.198
VCS1	3.816	2.854	3.097	-0.154	1.888	2.330	2.009	1.151	1.218	3.573	2.347	-0.360
VCS2	2.401	0.820	1.023	2.587	3.055	3.565	1.508	1.318	1.988	1.456	3.299	2.515
VCM3	-0.209	-0.587	0.435	-1.120	-1.651	-1.245	0.142	0.030	-0.344	-0.256	-0.960	-2.599
VCM4	-0.012	-2.383	2.625	1.637	-0.390	-0.841	-1.879	1.149	0.550	0.190	-3.683	

# 32-bit Apps on 64-bit Windows

- 64-bit Windows has WOW64
  - 32-bit Apps can run seamlessly on WOW64
  - (16-bit apps don't run at all anymore)
  - CLR loads 32-bit DLLs for 32-bit apps (not 64-bit DLLs).
  - If system-oriented, it may not run.
- .NET Apps can be built for x86, x64, ia64..
  - If built for x86, it runs in 32-bit mode on 64.
  - If built for x64, it runs only on x64.

# .NET Today

- .NET 3.0 is coming
  - On top of .NET 2.0 as fancy options.
  - “Native” on Windows Vista
- Third Party Libraries
  - Becoming Managed
  - Becoming .NET 2.0 compatible.

*Therefore becoming portable!*

# Conclusion

- Controls systems must support 64-bit on the client side for scientists.

**By porting CA to 64-bit on Windows,  
SCA.NET client can run on 64  
without any change.**

