

Debugging IE Performance Issues xperf, ETW & NavigationTiming

Nic Jansma
@NicJ
//nicj.net

Who am I?

Nic Jansma

Microsoft Sr. Developer (2005-2011)

Windows 7 & IE 9/10 Performance Teams

Founding member of W3C WebPerf WG

Back to GR / founded Wolverine Digital

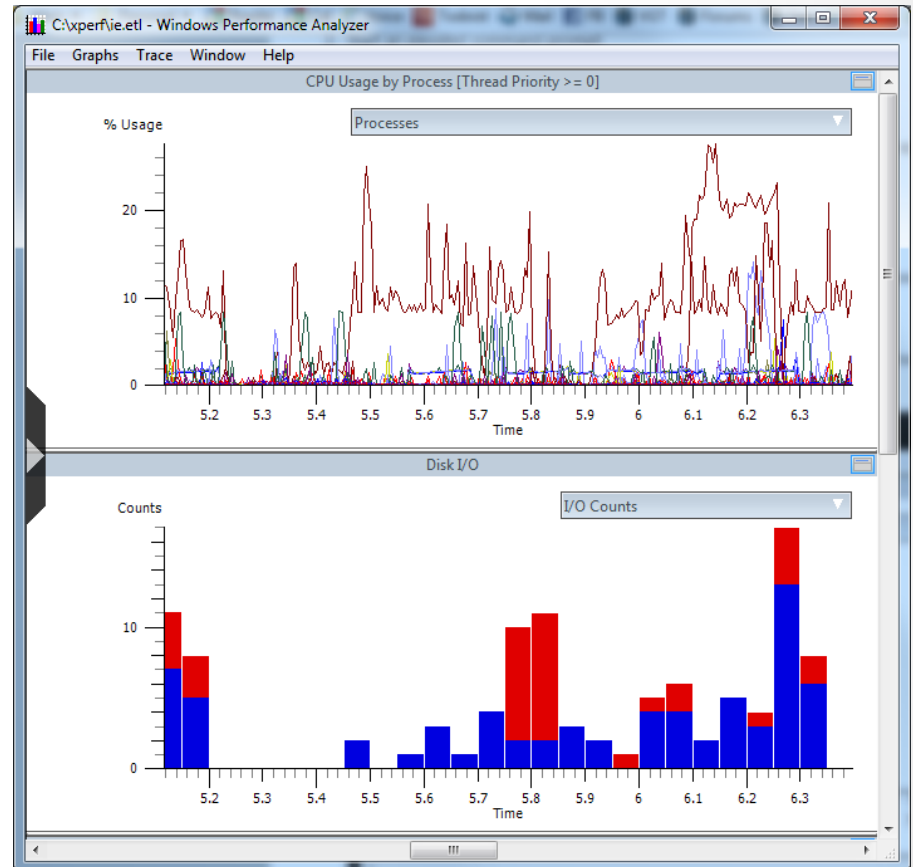
Developing high-performance websites and apps



nic@nicj.net @NicJ <http://nicj.net>
<http://github.com/nicjansma>

What is ETW/xperf?

- Event Tracing for Windows (ETW) enables the OS/apps to efficiently generate runtime tracing events
 - Windows XP+
 - CPU usage
 - Disk usage
 - Hard faults
 - DPCs/ISRs
 - TCP
 - Profiling
 - Custom app events (incl IE7+)
 - Stacks on most of the above
- xperf is a toolset used to trace/view ETW events
- Use ETW/xperf to trace page loads of browsers



IE9 load of cnn.com

Getting WPT (xperf)

- Windows Performance Toolkit (WPT)
- Free!
- From the Windows SDK
 - WPT home
 - <http://msdn.microsoft.com/en-us/performance/cc825801.aspx>
 - Windows 7 SDK
 - <http://www.microsoft.com/en-us/download/details.aspx?id=8279>
 - Windows 8 SDK
 - <http://msdn.microsoft.com/en-us/windows/hardware/hh852363>

Getting a Trace

From an elevated command prompt:

- Simple trace of system events

- `xperf.exe -on latency`
- `[run scenario]`
- `xperf.exe -stop -d myscenario.etl`

(latency = PROC_THREAD+LOADER+DISK_IO+HARD_FAULTS+DPC+INTERRUPT+CSWITCH+PROFILE)

- Stack-Walking on sample profiling events

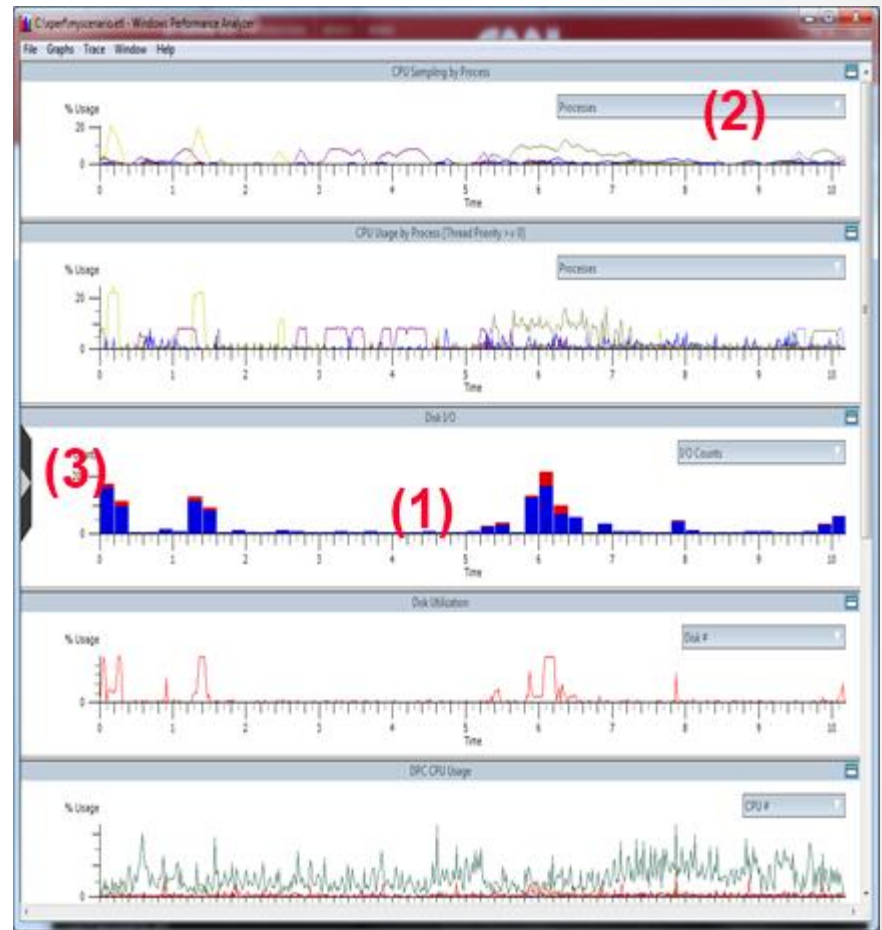
- `xperf.exe -on latency -stackwalk profile -setprofint 1224`
- `[run scenario]`
- `xperf.exe -stop -d myscenario.etl`

- IE events

- `xperf.exe -on latency -start ie -on Microsoft-IE+Microsoft-IEFRAME+Microsoft-Windows-WinINet+PerfTrack`
- `[run scenario]`
- `xperf.exe -stop -stop ie -d myscenario.etl`

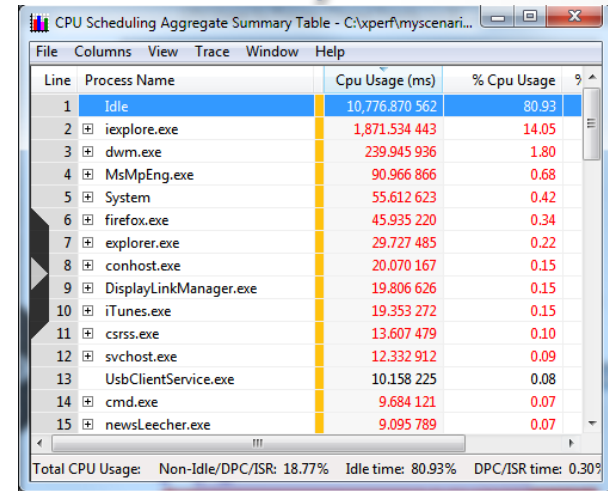
xperfview

- xperfview gives you a timeline view of the events in the .etl (1)
- Use the drop-downs to filter out specific processes (2)
- Use the left fly-out to see different graphs (3)



xperfview - Summary Tables

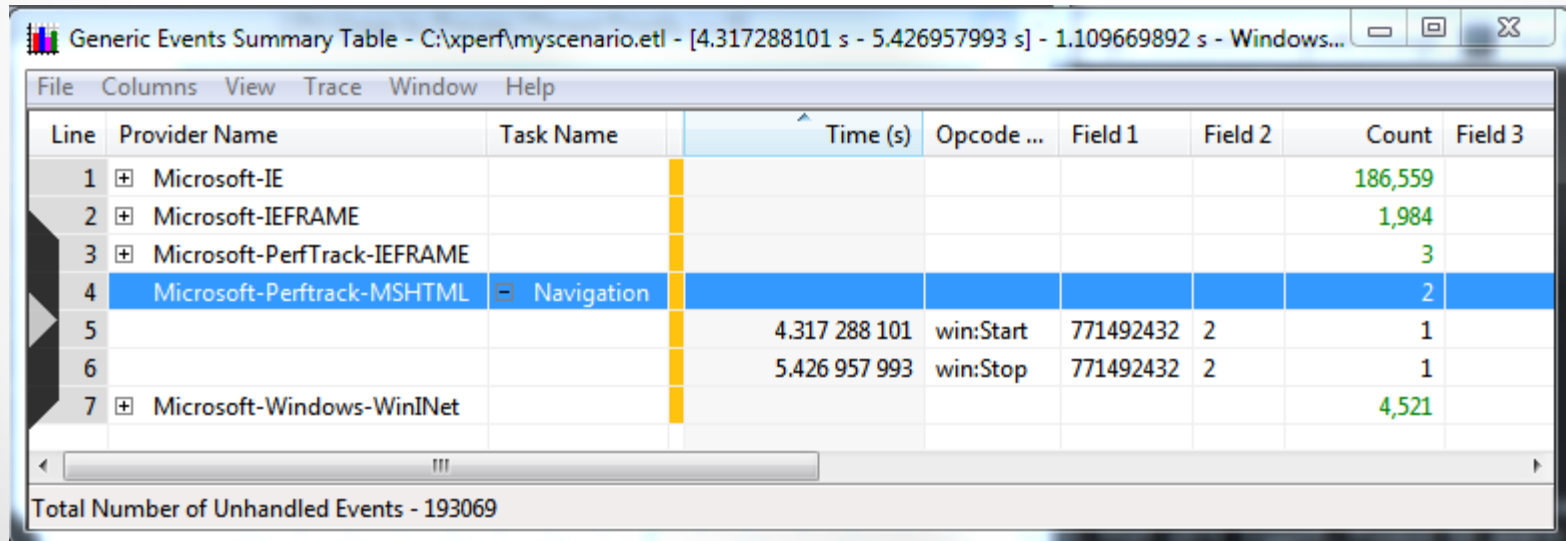
- All of the graphs can be interacted with - zoom, popups, right-clicked
- Summary Tables show data in tabular form



CPU Scheduling Aggregate Summary Table - C:\xperf\myscenari...

Line	Process Name	Cpu Usage (ms)	% Cpu Usage
1	Idle	10,776.870 562	80.93
2	ieexplore.exe	1,871.534 443	14.05
3	dwm.exe	239.945 936	1.80
4	MsMpEng.exe	90.966 866	0.68
5	System	55.612 623	0.42
6	firefox.exe	45.935 220	0.34
7	explorer.exe	29.727 485	0.22
8	conhost.exe	20.070 167	0.15
9	DisplayLinkManager.exe	19.806 626	0.15
10	iTunes.exe	19.353 272	0.15
11	csrss.exe	13.607 479	0.10
12	svchost.exe	12.332 912	0.09
13	UsbClientService.exe	10.158 225	0.08
14	cmd.exe	9.684 121	0.07
15	newsLeecher.exe	9.095 789	0.07

Total CPU Usage: Non-Idle/DPC/ISR: 18.77% Idle time: 80.93% DPC/ISR time: 0.30%



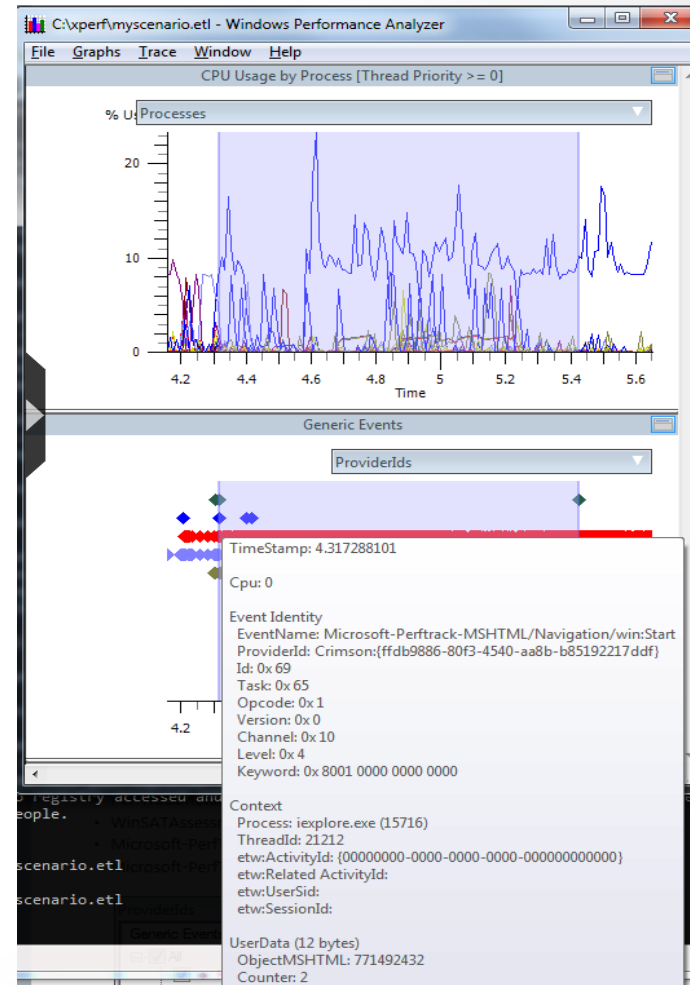
Generic Events Summary Table - C:\xperf\myscenario.etl - [4.317288101 s - 5.426957993 s] - 1.109669892 s - Windows...

Line	Provider Name	Task Name	Time (s)	Opcode ...	Field 1	Field 2	Count	Field 3
1	Microsoft-IE						186,559	
2	Microsoft-IEFRAME						1,984	
3	Microsoft-PerfTrack-IEFRAME						3	
4	Microsoft-Perftrack-MSHTML	Navigation					2	
5			4.317 288 101	win:Start	771492432	2	1	
6			5.426 957 993	win:Stop	771492432	2	1	
7	Microsoft-Windows-WinINet						4,521	

Total Number of Unhandled Events - 193069

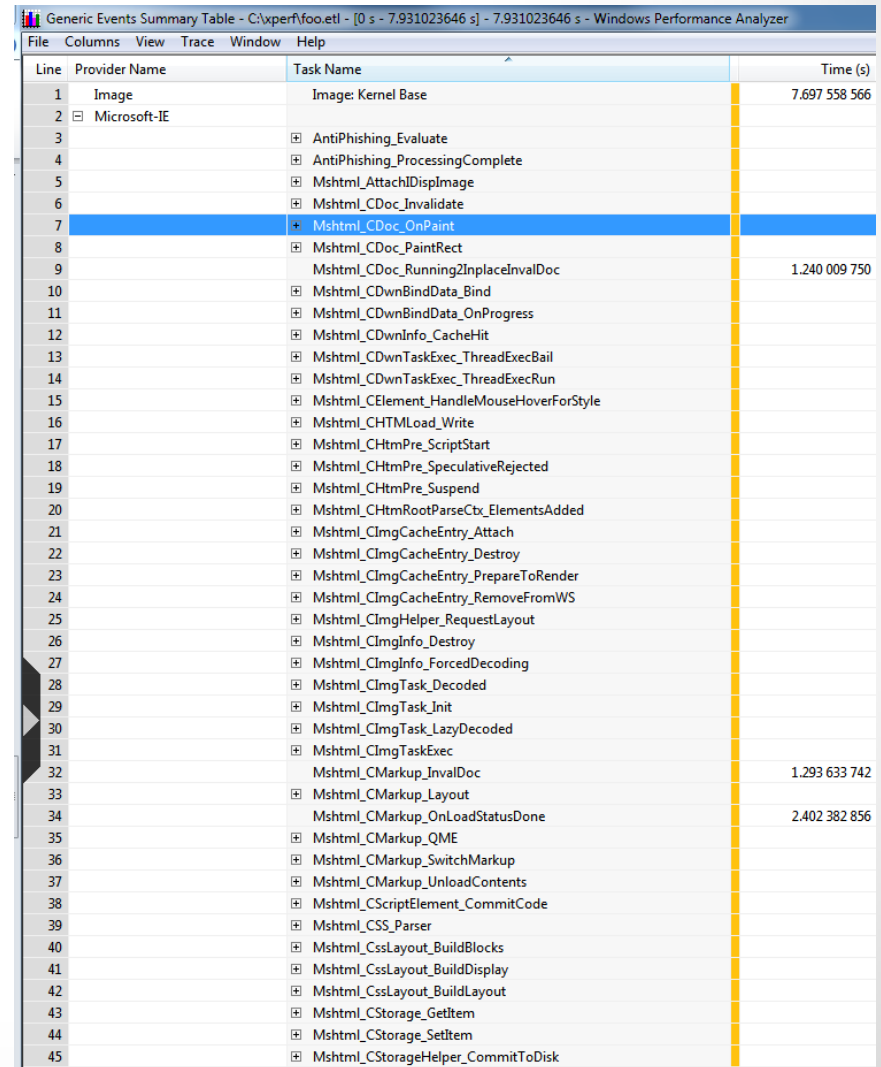
xperfview - Generic Events

- Events without associated graphs show up in Generic Events
- Look for Microsoft-IE* and Microsoft-PerfTrack* events



xperfview - IE events

- Microsoft-IE events
 - CMarkup_OnLoadStatusDone: Page load is complete
 - CDoc_OnPaint: Paints
 - CDwnBindData_Bind: Downloads
 - + 100s more
- Microsoft-IEFRAME
 - Frame events such as tab creation, navigation start, history queries, extension loading
- Microsoft-PerfTrack-*
 - -MSHTML-Navigation - End-to-end page load time



Generic Events Summary Table - C:\xperf\foo.etl - [0 s - 7.931023646 s] - 7.931023646 s - Windows Performance Analyzer

Line	Provider Name	Task Name	Time (s)
1	Image	Image: Kernel Base	7.697 558 566
2	Microsoft-IE		
3		AntiPhishing_Evaluate	
4		AntiPhishing_ProcessingComplete	
5		Mshtml_AttachDispImage	
6		Mshtml_CDoc_Invalidate	
7		Mshtml_CDoc_OnPaint	
8		Mshtml_CDoc_PaintRect	
9		Mshtml_CDoc_RunningZInplaceInvalDoc	1.240 009 750
10		Mshtml_CDwnBindData_Bind	
11		Mshtml_CDwnBindData_OnProgress	
12		Mshtml_CDwnInfo_CacheHit	
13		Mshtml_CDwnTaskExec_ThreadExecBail	
14		Mshtml_CDwnTaskExec_ThreadExecRun	
15		Mshtml_CElement_HandleMouseHoverForStyle	
16		Mshtml_CHTMLoad_Write	
17		Mshtml_CHtmlPre_ScriptStart	
18		Mshtml_CHtmlPre_SpeculativeRejected	
19		Mshtml_CHtmlPre_Suspend	
20		Mshtml_CHtmlRootParseCtx_ElementsAdded	
21		Mshtml_CImgCacheEntry_Attach	
22		Mshtml_CImgCacheEntry_Destroy	
23		Mshtml_CImgCacheEntry_PrepareToRender	
24		Mshtml_CImgCacheEntry_RemoveFromWS	
25		Mshtml_CImgHelper_RequestLayout	
26		Mshtml_CImgInfo_Destroy	
27		Mshtml_CImgInfo_ForcedDecoding	
28		Mshtml_CImgTask_Decoded	
29		Mshtml_CImgTask_Init	
30		Mshtml_CImgTask_LazyDecoded	
31		Mshtml_CImgTaskExec	
32		Mshtml_CMarkup_InvalDoc	1.293 633 742
33		Mshtml_CMarkup_Layout	
34		Mshtml_CMarkup_OnLoadStatusDone	2.402 382 856
35		Mshtml_CMarkup_QME	
36		Mshtml_CMarkup_SwitchMarkup	
37		Mshtml_CMarkup_UnloadContents	
38		Mshtml_CScriptElement_CommitCode	
39		Mshtml_CSS_Parser	
40		Mshtml_CssLayout_BuildBlocks	
41		Mshtml_CssLayout_BuildDisplay	
42		Mshtml_CssLayout_BuildLayout	
43		Mshtml_CStorage_GetItem	
44		Mshtml_CStorage_SetItem	
45		Mshtml_CStorageHelper_CommitToDisk	

xperfview - Stacks

- By using the -StackWalk tag, you can enable stacks on many events
- Public symbol servers:
 - <http://msdl.microsoft.com/download/symbols>
 - <http://symbols.mozilla.org/firefox>
 - <http://chromium-browser-symsrv.com/mondatastorage.googleapis.com>

Line	Process	Stack	Weight
1	Idle (0)		14,723,751,199
2	explorer.exe (15716)		1,757,963,644
3		[Root]	1,746,964,721
4		- ntddll.dll!_RtlUserThreadStart	1,450,969,689
5		ntddll.dll!_RtlUserThreadStart	1,450,969,689
6		kernel32.dll!BaseThreadInitThunk	1,450,969,689
7		IEFFRAME.DLL!Detour_DefWindowProcA	1,292,986,077
8		IEFFRAME.DLL!CISOscope:RegisterThread	1,017,006,326
9		IEFFRAME.DLL!CIETab_ThreadProc	1,017,006,326
10		IEFFRAME.DLL!CIETabWindow:_TabWindowThreadProc	1,017,006,326
11		user32.dll!DispatchMessageW	999,009,359
12		user32.dll!DispatchMessageWorker	898,008,691
13		user32.dll!UserCallWinProcCheckWow	898,008,691
14		user32.dll!InternalCallWinProc	898,008,691
15		MSHTML.DLL!GlobalWndProc	734,010,341
16		MSHTML.DLL!GlobalWndOnMethodCall	734,010,341
17		MSHTML.DLL:View:EnsureViewCallback	315,005,625
18		MSHTML.DLL:View:EnsureView	314,005,404
19		MSHTML.DLL:CTreeNodes:DisplayNone	1,000,221
20		MSHTML.DLL:CDwnChan:OnMethodCall	209,002,886
21		MSHTML.DLL:CPaintBeat:OnVSyncMethodCall	117,001,658
22		MSHTML.DLL:CProgSink:OnMethodCall	41,000,463
23		MSHTML.DLL:XMLHttpRequest:DeferredFire_onreadystatechange	18,000,795
24		MSHTML.DLL:Markup:AnchorVisitedCheckCallback	9,000,081
25		MSHTML.DLL:ScriptElement:FireOnReadyStateChange	7,998,579
26		MSHTML.DLL:CDoc:OnUrlImgCbDeferredDownload	5,999,732
27		MSHTML.DLL:Markup:ProcessPeerTasks	5,000,150

Line	Process	Stack	Weight
1	Idle (0)		223,389,926,693
2	firefox.exe (32544)		3,316,777,954
3		[Root]	3,311,781,633
4		- xul.dll!nsDisplayList:PaintForFrame	182,989,152
5		xul.dll!mozilla:layers:LayerManagerD3D10:EndTransaction	147,993,208
6		xul.dll!mozilla:layers:LayerManagerD3D10:Render	147,993,208
7		xul.dll!mozilla:layers:ContainerLayerD3D10:Validate	103,003,343
8		xul.dll!mozilla:layers:ContainerLayerD3D10:Validate	68,000,380
9		xul.dll!mozilla:layers:ThebesLayerD3D10:Validate	66,000,895
10		xul.dll!cairo_d2d_flush	51,001,085
11		d2d1.dll!D2DRenderTargetBase<ID2D1RenderTarget>:EndDraw	50,000,864
12		d2d1.dll!DrawingContext:EndDraw	50,000,864
13		d2d1.dll!DrawingContext:Flush	50,000,864
14		d2d1.dll!DrawingContext:FlushBatch	50,000,864
15		d2d1.dll!CBatchSerializer:FlushInternal	46,001,892
16		d2d1.dll!CChwSurfaceRenderTarget:ProcessBatch	34,001,786
17		d2d1.dll!CCommand_DrawGlyphRun:Execute	14,000,547
18		d2d1.dll!CChwSurfaceRenderTarget:DrawGlyphRunInternal	14,000,547
19		d2d1.dll!GlyphRunRealizer:Init	7,999,538
20		DWrite.dll!DWriteFactory:CreateGlyphRunAnalysis	5,999,413
21		DWrite.dll!GlyphRunAnalysis:GlyphRunAnalysis	5,999,413
22		DWrite.dll!GetGlyphBitmaps	5,999,413

Configure Symbol Paths

_NT_SYMBOL_PATH:

srv*c:\xperf\symbols*http://msdl.microsoft.com/download/symbols;srv*c:\xperf\symbols*http://symbols.mozilla.org/firefox;srv*c:\xperf\symbols*http://chromium-browser-symsrv.com/mondatastorage.googleapis.com

_NT_SYMCACHE_PATH:

C:\xperf\symcache

OK Cancel

Custom Web Events

- JavaScript ETW events

```
<SCRIPT type="text/javascript">  
    if (msWriteProfilerMark) {  
        msWriteProfilerMark("Mark1");  
    }  
</SCRIPT>
```

- Comes in as:
 - Microsoft-IE\Mshtml_DOM_CustomSiteEvent

What Can You Do?

- Slow page load performance? Take a trace!
- See page load from a system-wide perspective
 - Isolate page-load from interference due to other CPU/disk/network activity
- Compare IE/FF/Chrome browser page-load times and resource usage
- Examine browser CPU usage hot-spots from sampled profile stacks
- Automated page-load regression testing of browsers via command-line tools
 - Integrate page load time / cpu usage metrics into your build system

ETW/xperf is great, but...

- Your development machine isn't your customer's machine
- How does your website behave in the real world?
- Enter...

W3C WebPerf WG

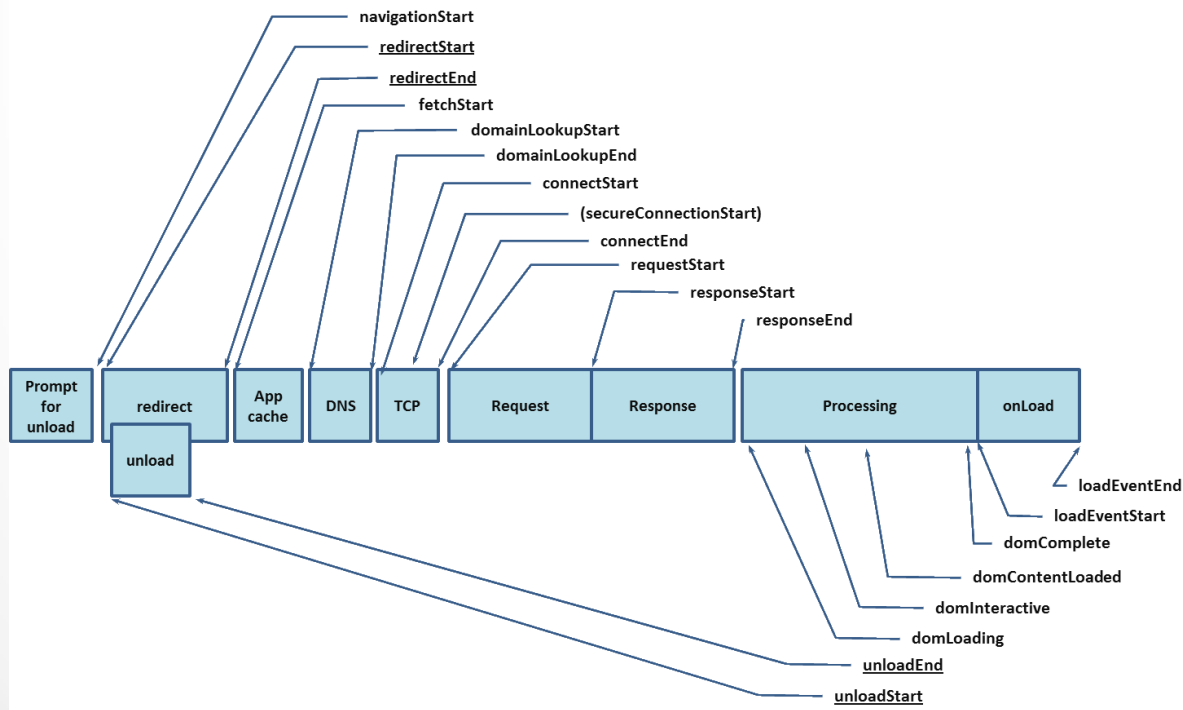
Navigation Timing, User Timing, Resource Timing
Performance Timeline, Page Visibility, High Resolution Time

W3C WebPerf

- Founded in 2010 to give developers the ability to assess and understand performance characteristics of their applications
- Specs:
 - Navigation Timing: Page load timings
 - User Timing: Custom site events and measurements
 - Resource Timing: Resource / download times
 - Page Visibility: Get visibility state
 - High Resolution Time: Better than `Date.now()` - sub-millisecond resolution, monotonically non-decreasing timestamps

Navigation Timing

- <http://www.w3.org/TR/navigation-timing/>
- Page load timings
- Implemented in IE9+, FF7+, C6+, Android 4+



Navigation Timing

- API available from the DOM (window.performance.timing)
- Get real-world page-load timings from your users via JavaScript

```
<script type="text/javascript">
window.addEventListener("load", loadTime, false);
function loadTime() {
    var now = new Date().getTime();
    var pageLoadTime = now - performance.timing.navigationStart;
}
</script>
```

- Many other sub-timings (DNS, connect, request, response, redirects, DOM events, load event)
- Demo
 - <http://ie.microsoft.com/testdrive/Performance/msPerformance/Default.html>

Navigation Timing

How to Use

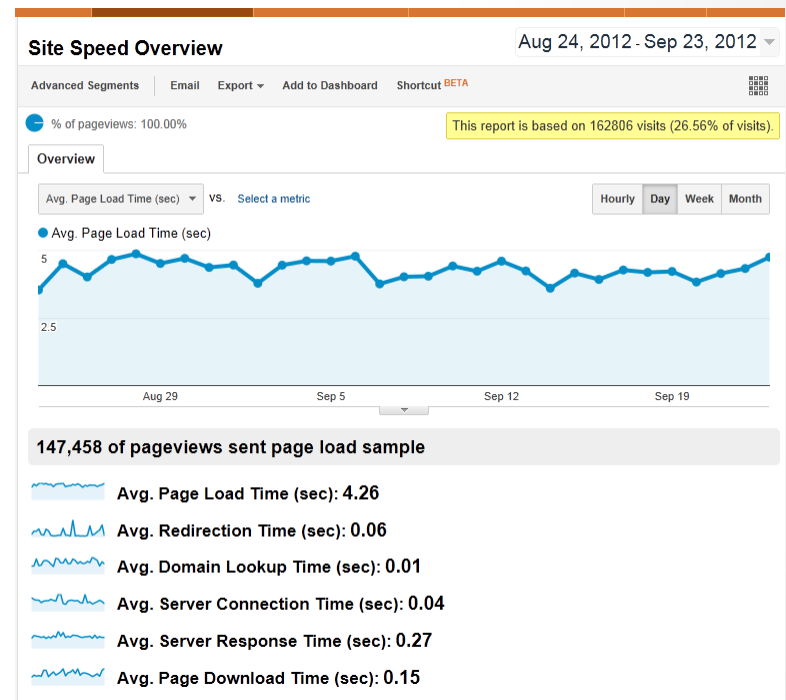
- Sample real-world page load times
- XHR back to mothership

`JSON.stringify(window.performance):`

```
"{"timing":{"navigationStart":0,"unloadEventStart":0,"unloadEventEnd":0,"redirectStart":0,"redirectEnd":0,"fetchStart":1348506842513,"domainLookupStart":1348506842513,"domainLookupEnd":1348506842513,"connectStart":1348506842513,"connectEnd":1348506842513,"requestStart":1348506842513,"responseStart":1348506842595,"responseEnd":1348506842791,"domLoading":1348506842597,"domInteractive":1348506842616,"domContentLoadedEventStart":1348506842795,"domContentLoadedEventEnd":1348506842795,"domComplete":1348506842795,"loadEventStart":1348506842900,"loadEventEnd":1348506842900,"msFirstPaint":1348506842707},"navigation":{"redirectCount":1,"type":0}}"
```

Used by:

- Google Analytics' Site Speed
- [Boomerang](#)



Links

Xperf/ETW

- <http://msdn.microsoft.com/en-us/performance/cc825801.aspx>
- <http://blogs.msdn.com/b/ie/archive/2010/06/21/measuring-browser-performance-with-the-windows-performance-tools.aspx>

W3C WebPerf

- <http://www.w3.org/2010/webperf/>
- http://www.w3.org/wiki/Web_Performance/Publications
- <http://w3c-test.org/webperf/specs/NavigationTiming/>

Questions?

- @NicJ
- nic@nicj.net