



Performance and Power Analysis Utilizing Intel® Performance Bottleneck Analyzer (PBA)

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Taking Advantage of Engineering Innovation Through Tools

Issue Identified by Hand



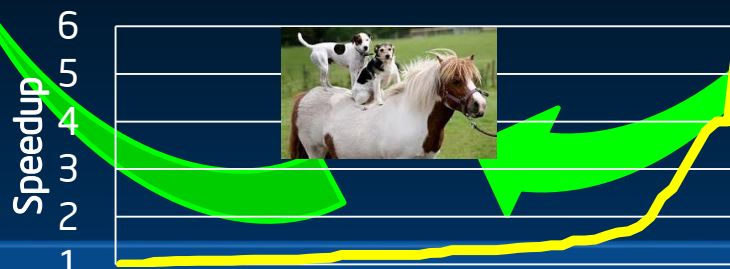
Innovation to Drive Automatic Identification

Automatic Identification



Capability is improved by other engineers

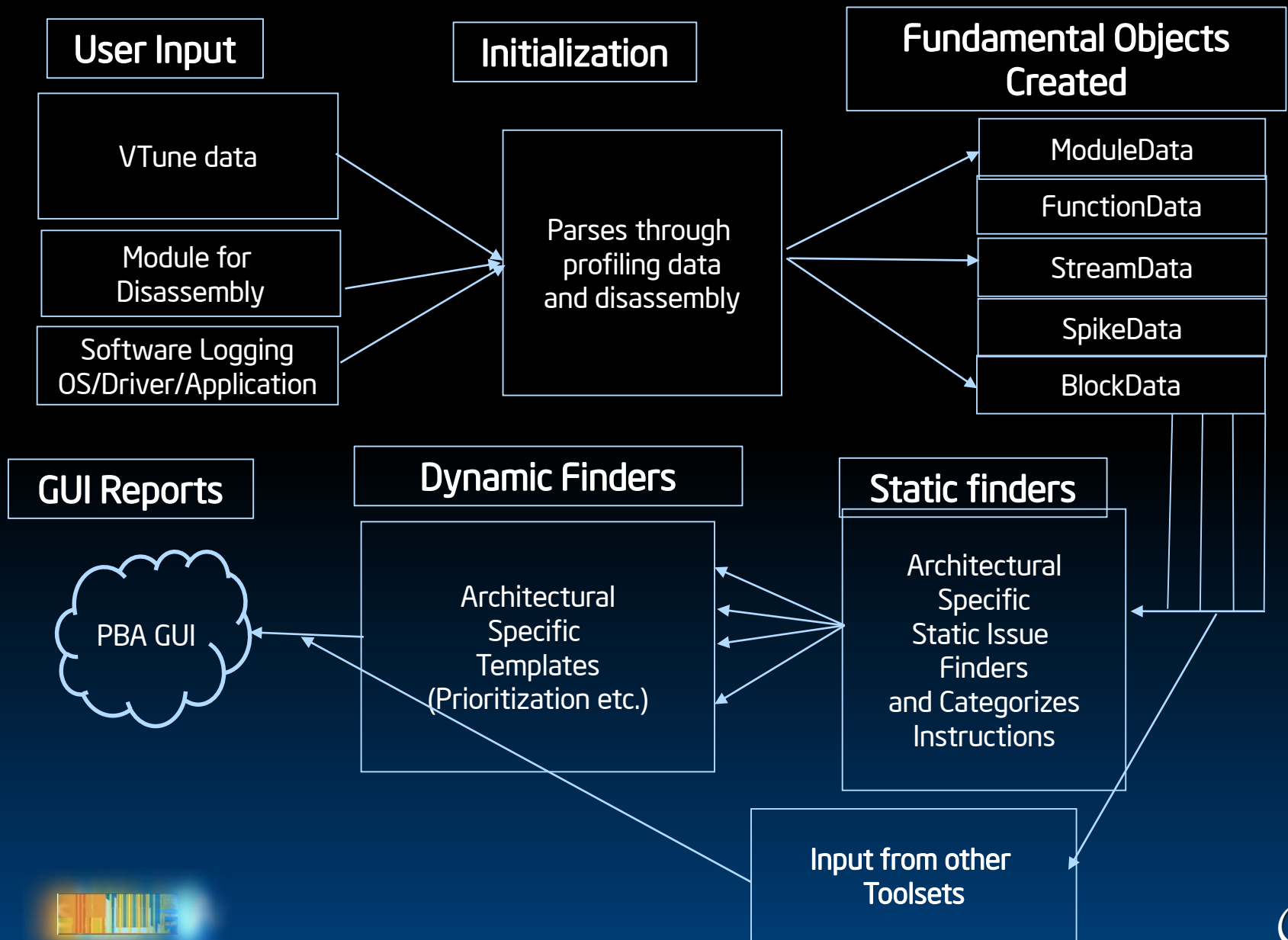
Workload Level Speedups Utilizing PBA



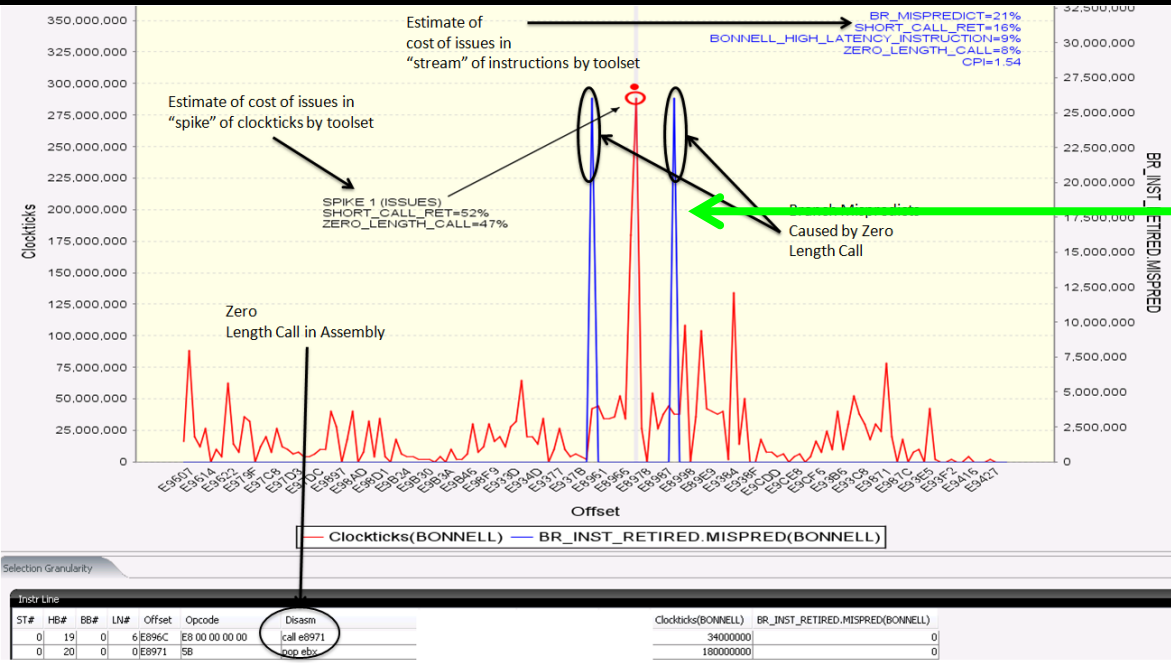
Automated capability used by other engineers

Extensible Tools Allow Engineers to Attack Difficult Problems as a Community

Intel® PBA Flow of Analysis

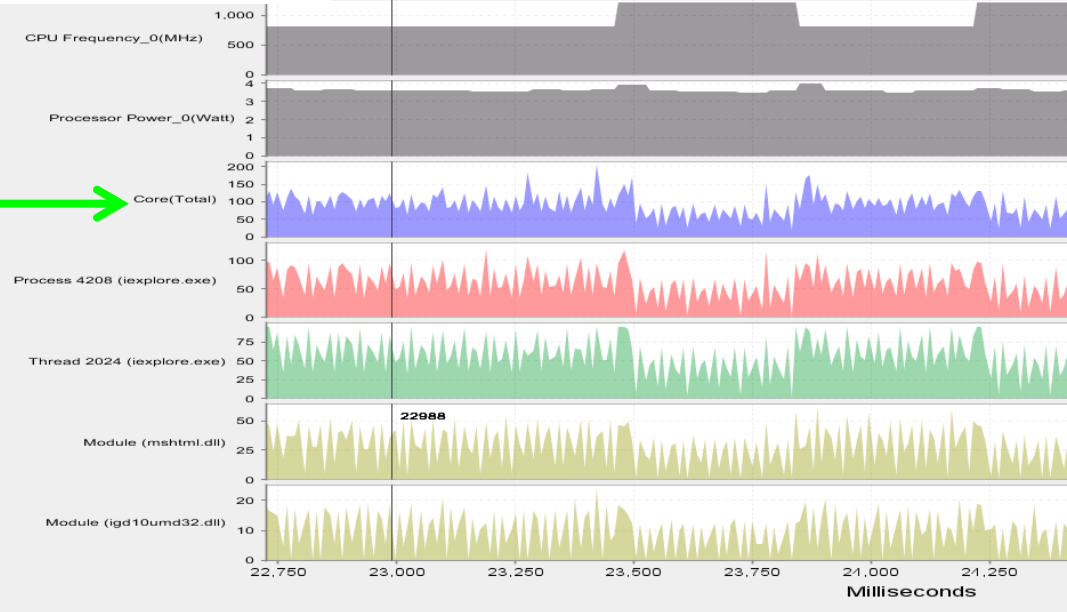


2 Primary Views of PBA: Replacing This



#1 Streams:
Recreate paths
of execution

#2 Overtime:
CPU, Process,
Module, Function
Frequency, Power, Sw Event,
etc.



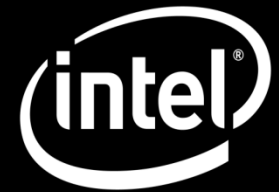
What is A Stream?

- Reconstructing the flow of basic blocks
- Shows flow of instructions as it ran on the core
- We pull all events along the stream for a “Poor-mans” pipe trace
- Find and reconstruct loops as a granularity
- Catches issues across branches

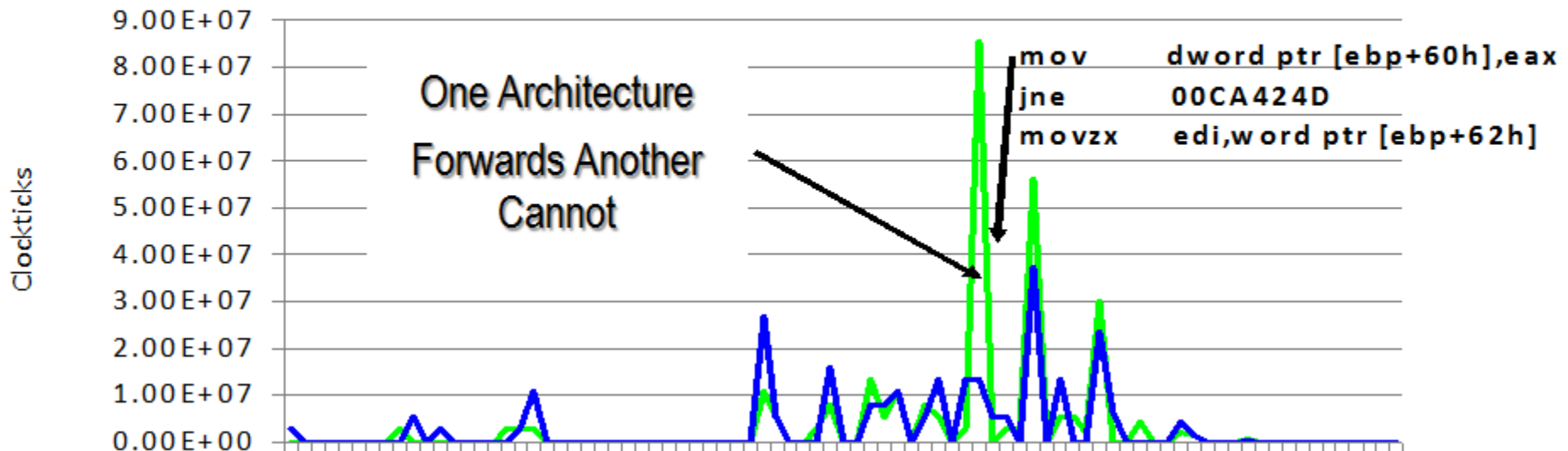
Address	Instruction
30AA668A	call 30AA63F7
30AA63F7	mov ecx, dword ptr [edi]
30AA63FF	sar ebx, 18h
30AA6403	mov esi, eax
30AA6405	js 30AA64D8
30AA640B	movzx eax, word ptr [edi+4]
30AA640F	cmp ax, 0FFFEh
30AA6413	je 30AA647B
30AA647B	movzx eax, word ptr [edi+4]



Comparing Architectures with Streams



Comparison between architectures to find issues



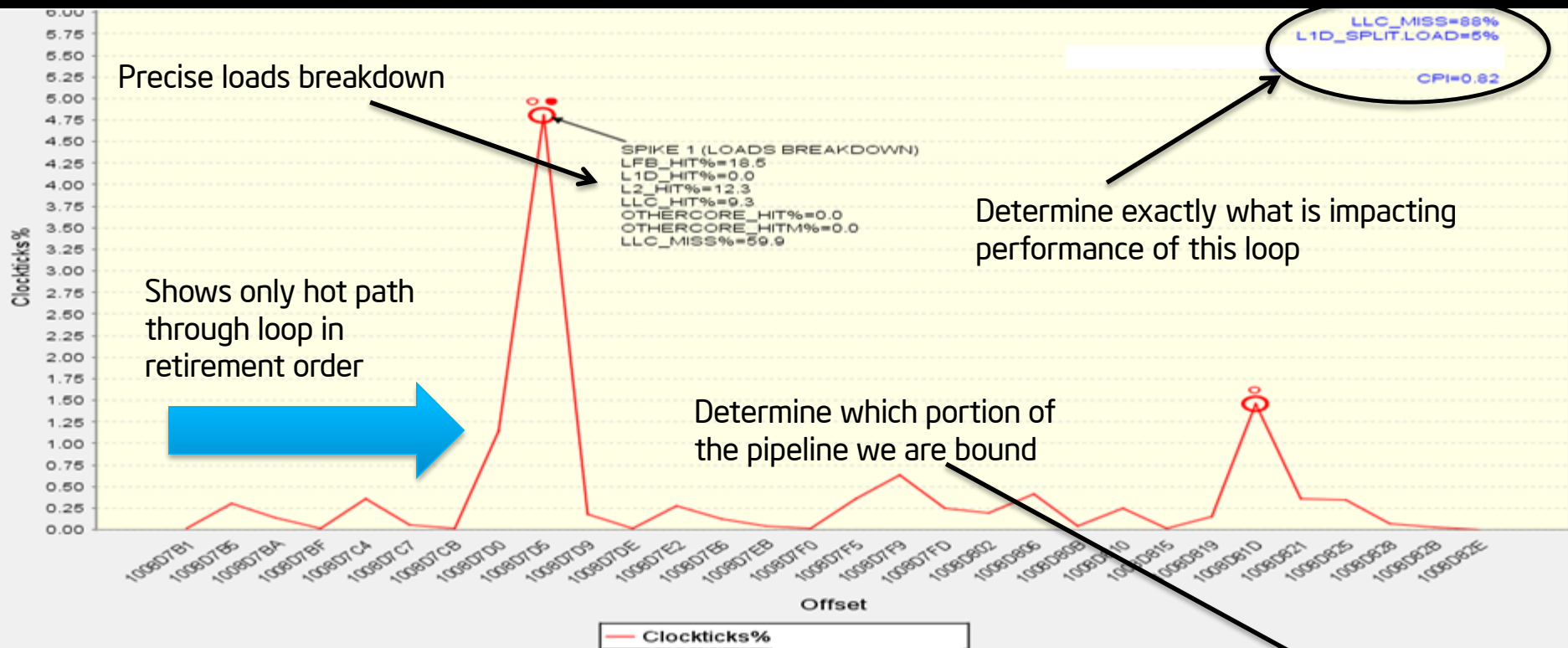
Streams Allow Us To Find Issues Across Branch Boundaries

DEMO #1 Streams:

“If you want micro-architectural issues fixed..make it easy”



Streams: Summary of Determining Issues in a Loop



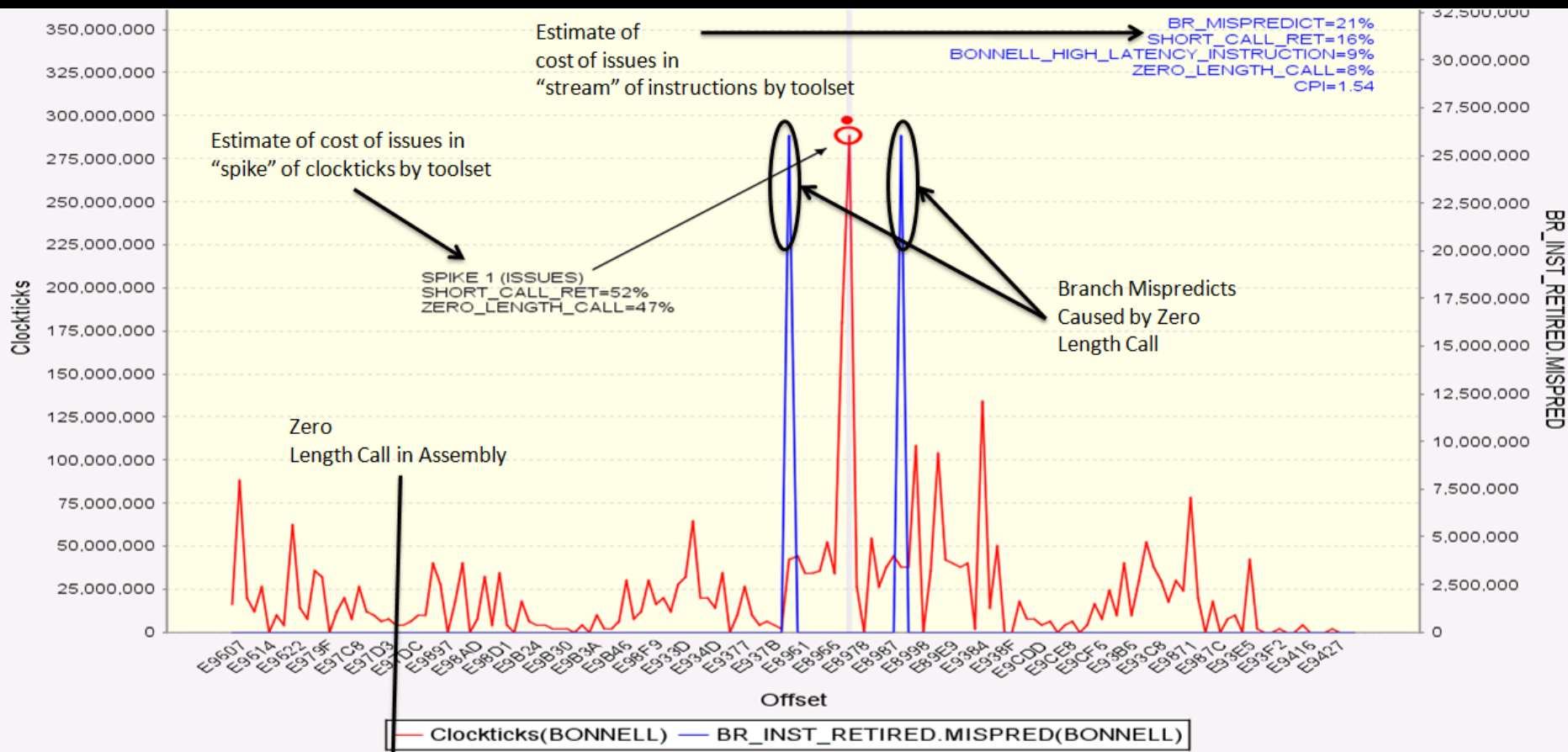
LoopStream

ST#	Offset	HitCount	Avg Trip Count	Clockticks...	FrontEnd%...	BadSpeculation%...	Retiring%...	BackEndBound%...
6	1008D7B1	167600000	12.0	12.11	0.95	0.00	31.74	67.31

Get accurate loop trip count
With no instrumentation using LBR



Streams: Correlating Static and Dynamic Identification

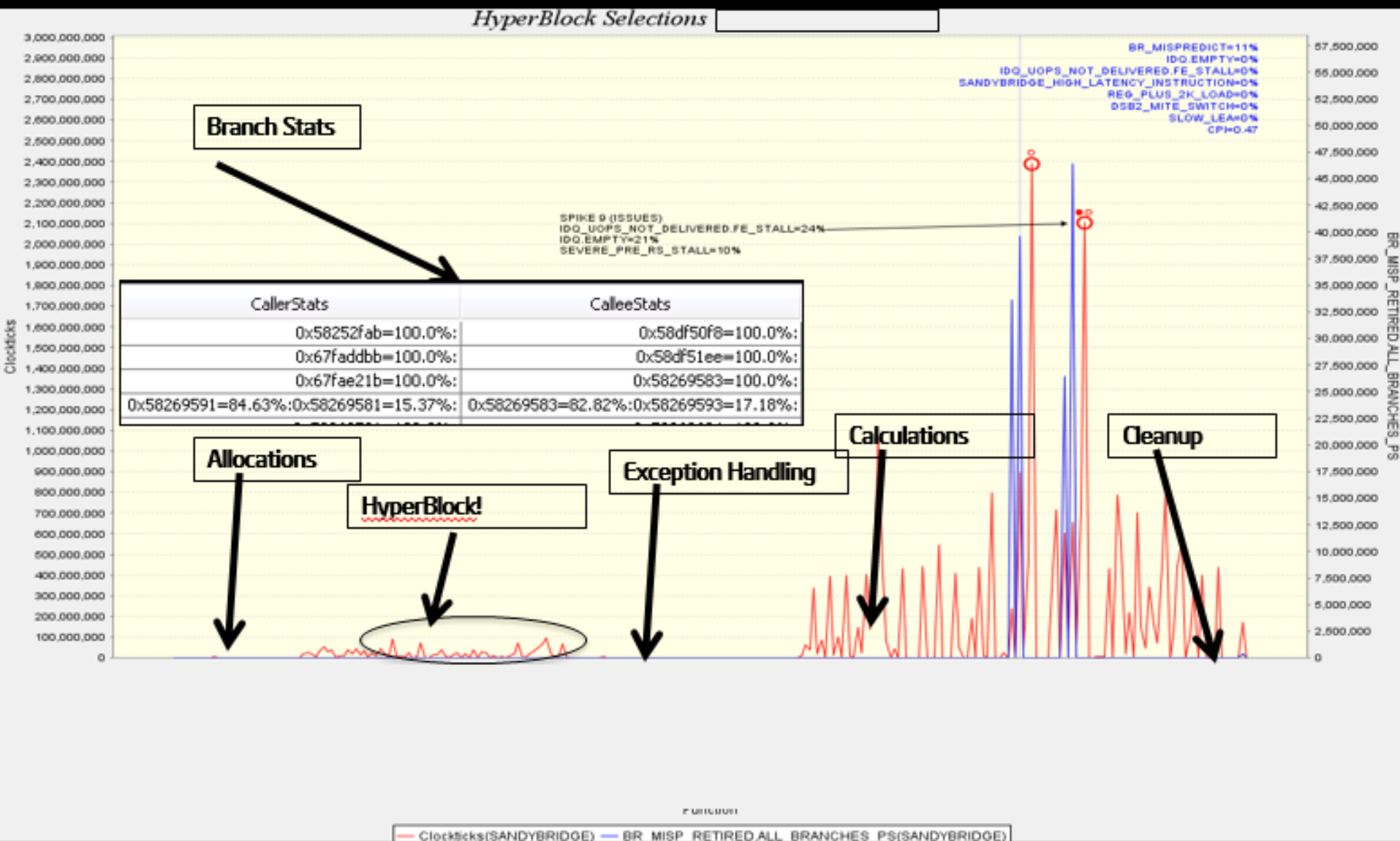


Selection Granularity

Instr Line	ST#	HB#	BB#	LN#	Offset	Opcode	Disasm	Clockticks(BONNELL)	BR_INST_RETIRED.MISPRED(BONNELL)	Static ASM Notes
	0	19	0	6	E896C	E8 00 00 00 00	call e8971	34000000	0	AGEN_STALL:ZERO_LENGTH_CALL
	0	20	0	0	E8971	5B	nop ebx	180000000	0	SHORT_CALL_RET

PBA Relates Static ASM with Events

Streams: Assist in Creating Larger and Larger Streams

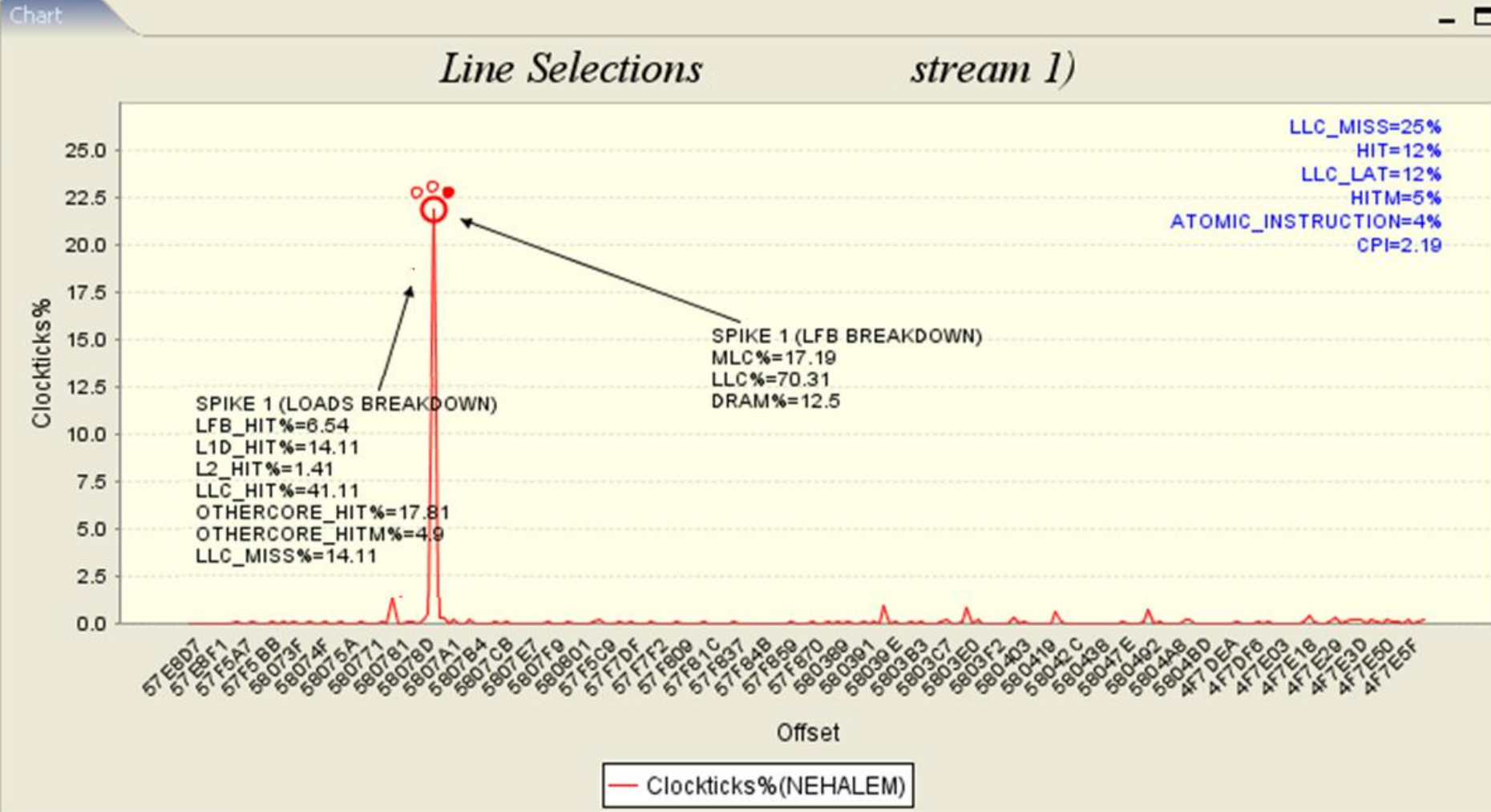


Streams Created with Last Branch Records Produce Greater Context

Streams: Loads and LFB Breakdown

xIF4 Analysis

Counters
+
-



PBA Displays Where Problematic Loads are Satisfied

Theme #2 JIT Explosion:
“Everyone is writing a JIT
Nowadays”



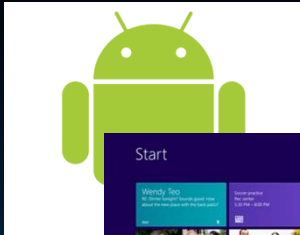
Vtune JIT APIs picked up by xIF

JIT Explosion

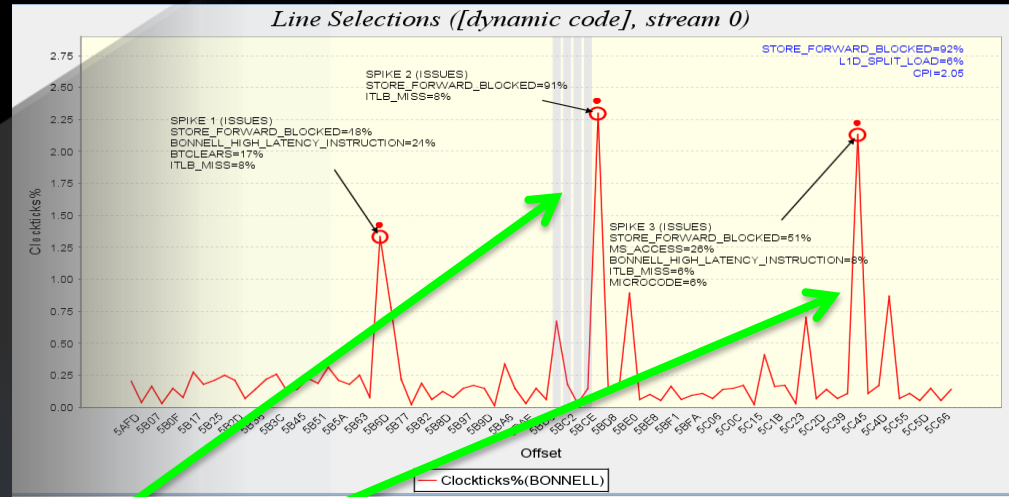
Javascript JITs



Win8 Apps, Dalvik



Automated Code Gen Analysis for JITs



xIF automatically identifying issues in JIT



Theme #2 Short Non-Steady State Workloads Becoming Critical “Debugging in the Millisecond Timeframe”



DEMO TOUCH DEBUG

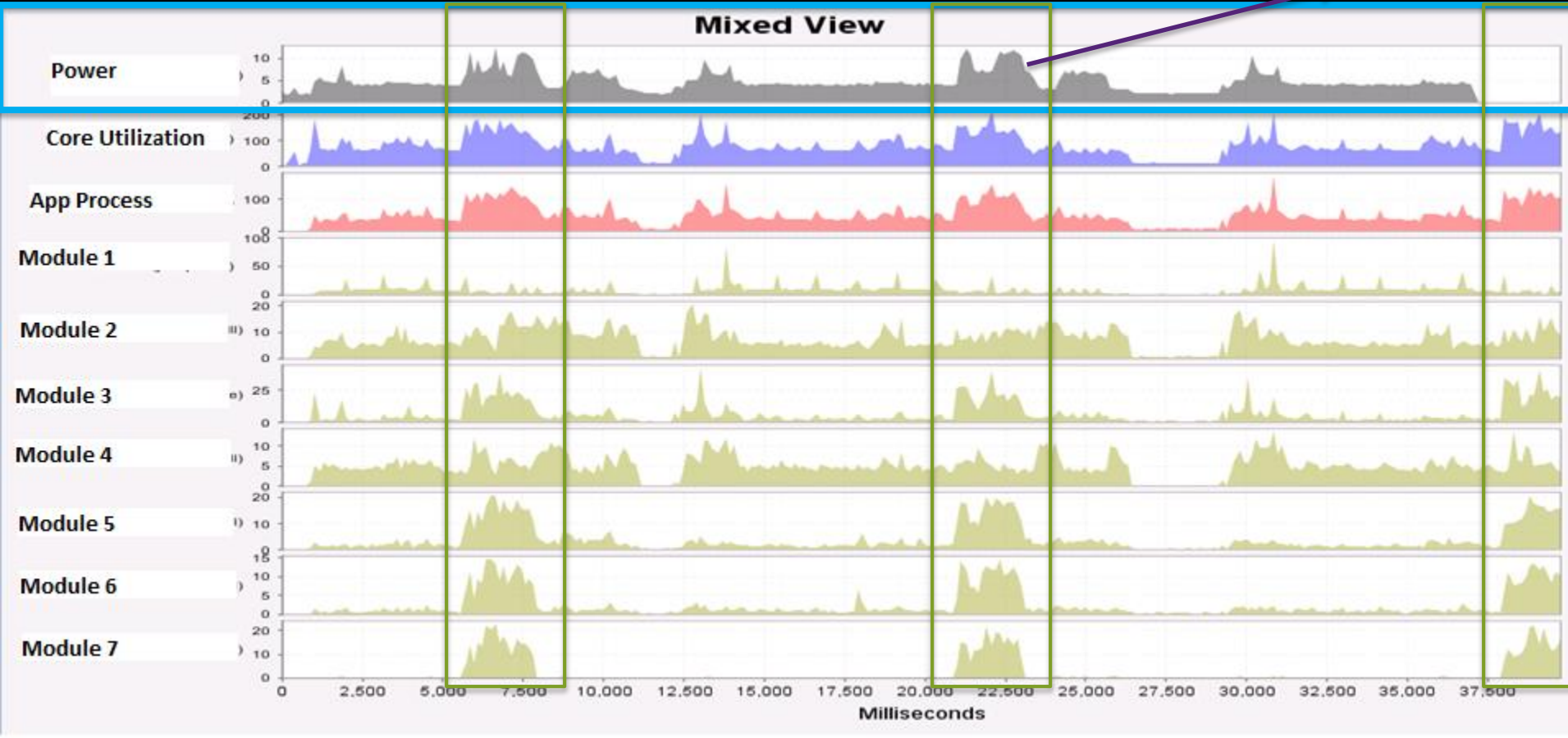


Theme #2 Power:
“Power and performance are
two sides of the same coin”



Power Correlation using Intel® PBA

Power Data



- Package power intermittently jumping high



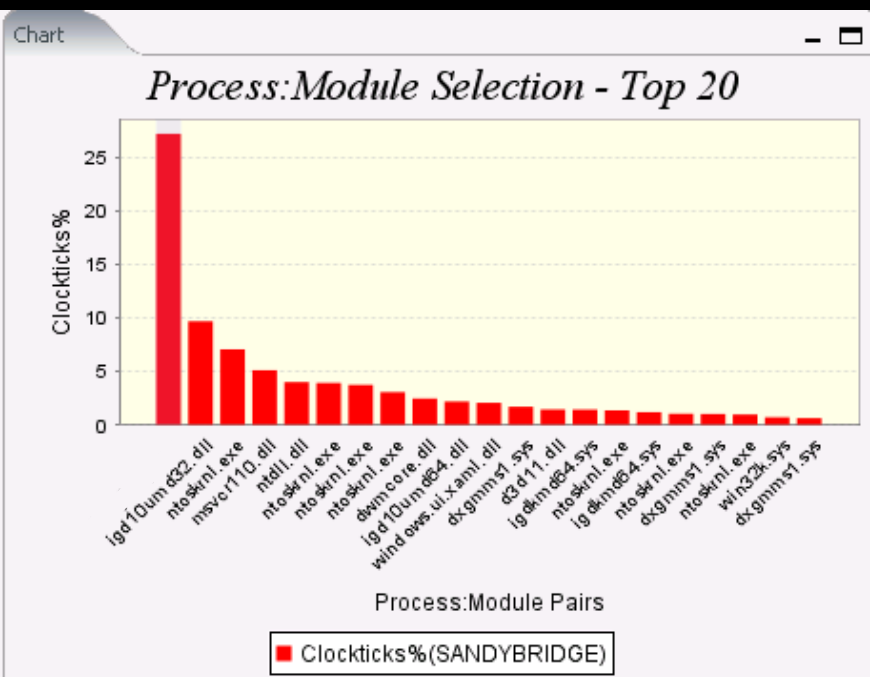
Automatically Determine Causes of High Power

Module_Name	Clocktick High Power%	Clockticks Low Power%
AppProcess:mshtml.dll	15.3	9.39
AppProcess:ntoskrnl.exe	10.64	5.12
AppProcess:ntdll.dll	7.92	2.5
AppProcess:oleaut32.dll	5.95	0.15
AppProcess:igd10umd64.dll	5.57	7.23
AppProcess:msvcrt.dll	4.89	1.3

Loading Library is Causing High Power

Shifting to Power Analysis

1 ms activities
wasting power!



Module Summary

Frequencies-O5(Thread)

Name	Frequency(Hz)	Period(ms)	#Samples	Samples%	Confidence
csrss.exe:532	1000.02	1.0	1263	1.5882797	0.5
csrss.exe:528	999.99	1.0	1621	2.038481	0.4
dwm.exe:896	999.99	1.0	1030	1.2952716	0.6
	299.96	3.33	4856	6.10664	0.5
ntoskrnl.exe:0	240.0	4.17	19091	24.007797	0.2
ntoskrnl.exe:0	240.0	4.17	19091	24.007797	0.2
Pid 0x0:0	240.0	4.17	19091	24.007797	0.2
Pid 0x0:0	240.0	4.17	19091	24.007797	0.2
	119.99	8.33	2246	2.8244467	1.
dwm.exe:748	119.99	8.33	4456	5.603622	0.9
svchost.exe:1020	107.42	9.31	579	0.7281187	0.4
Pid 0x4:3580	107.42	9.31	1066	1.3405433	0.7

Spikes Hyper Blocks Basic Blocks Issues Threads Functions Data Version Frequencies(Thread)

Frequencies(Process) **Frequencies-O5(Thread)** Frequencies-O5(Process)

Selection Granularity

Module

Export

ModuleName	ProcessName	Clockticks%(SANDYBRIDGE)
		27.18
		9.70

Calculating Frequency of Activities is Powerful for Performance

CERN Collider Proposal



Conclusion

- Intel® PBA post-processes data collected using Intel® VTune to automatically call out micro-architectural and SoC issues
- Issue identification capabilities increased by order of magnitude using streams
- PBA provides extensibility by specifying rules for various architectures in a configuration file
- Overtime views, UX and power analysis are new capabilities that augment existing functionalities

