

# Automatic Problem Localization via Multi-dimensional Metric Profiling

## 1 Addendum to Appendix

Tables 1 show the list of metric types that we analyzed, grouped by layer. Notice that the list is not the *number* of metrics that we actually analyzed because some metrics types have multiple instances. For example, the `data_source_numActive` is the number of active connections per database. The StationsStat system has two databases so it has two instances of this metric. The same occurs for Java servlets, containers and server metrics—a server can have multiple containers and database connections while each container can have multiple servlets. The OS metrics are based on statistics of a Linux process—if a Java server only creates one Linux process, it would have only one instance of each of the OS metrics.

Table 1: Metrics descriptions.

Operating System Metrics		Hardware Metrics	
Metric	Description	Metric	Description
minor_faults	minor page faults	L1_DCM	Level 1 data cache misses
major_faults	major page faults	L2_DCM	Level 1 instruction cache misses
utime	user-level CPU time	L2_JCM	Level 2 data cache misses
stime	system-level CPU time	L1_TCM	Level 1 total cache misses
num_threads	number of threads	L2_TCM	Level 2 total cache misses
vsize	virtual memory size	CA_SHR	Requests for exclusive access to shared cache line
rss	RAM memory	CA_CLN	Requests for exclusive access to clean cache line
processor	CPU number last executed on	CA_ITV	Requests for cache line intervention
stack_size	size of the stack	TLB_DM	Data translation lookaside buffer misses
rchar	read characters from disk	TLB_IM	Instruction translation lookaside buffer misses
wchar	written characters to disk	L1_LDM	Level 1 load misses
read_bytes	read bytes from disk	L1_STM	Level 1 store misses
write_bytes	written bytes to disk	L2_LDM	Level 2 load misses
canceled_write_bytes	canceled written bytes to disk	L2_STM	Level 2 store misses
num_file_desc	open file descriptors	HW_INT	Hardware interrupts
nicRcvBytes	received bytes from NIC	BR_CN	Conditional branch instructions
nicRcvPkts	received packets from NIC	BR_TKN	Conditional branch instructions taken
nicSentBytes	sent bytes from NIC	BR_NTK	Conditional branch instructions not taken
nicSentPkts	sent packets from NIC	BR_MSP	Conditional branch instructions mispredicted
IPInTruncatedPkts	truncated IP packets	BR_PRC	Conditional branch instructions correctly predicted
IPInOctets	received IP octets	TOT_IIS	Instructions issued
IPOutOctets	sent IP octets	TOT_INS	Instructions completed
Application Metrics		FP_INS	Floating point instructions
Metric	Description	LD_INS	Load instructions
servlet_processingTime	processing time (per servlet)	SR_INS	Store instructions
servlet_maxTime	max processing time (per servlet)	BR_INS	Branch instructions
servlet_requestCount	requests (per servlet)	VEC_INS	Vector/SIMD instructions
servlet_errorCount	errors (per servlet)	RES_STL	Cycles stalled on any resource
datasource_maxWait	max waiting time (per database)	TOT_CYC	Total cycles
datasource_numIdle	idle connections (per database)	L1_DCH	Level 1 data cache hits
datasource_maxActive	max active time (per database)	L1_DCA	Level 1 data cache accesses
datasource_numActive	active connections (per database)	L2_DCA	Level 2 data cache accesses
Middleware Metrics		L2_DCR	Level 2 data cache reads
Metric	Description	L2_DCW	Level 2 data cache writes
request_handler_bytesSent	bytes sent (per container)	L1_JCH	Level 1 instruction cache hits
request_handler_bytesReceived	bytes received (per container)	L2_JCH	Level 2 instruction cache hits
request_handler_requestCount	requests(per container)	L1_JCA	Level 1 instruction cache accesses
request_handler_maxTime	max processing time (per container)	L2_JCA	Level 2 instruction cache accesses
request_handler_processingTime	processing time (per container)	L2_TCH	Level 2 total cache hits
request_handler_errorCount	errors (per container)	L1_TCA	Level 1 total cache accesses
cache_hits	cache hits (per server)	L2_TCA	Level 2 total cache accesses
cache_accesses	cache accesses (per server)	L2_TCR	Level 2 total cache reads
number_threads	active threads (per thread pool)	L2_TCW	Level 2 total cache writes
		FML_INS	Floating point multiply instructions
		FDV_INS	Floating point divide instructions
		FP_OPS	Floating point operations
		SP_OPS	Optimized single precession Floating point ops
		DP_OPS	Optimized double precession Floating point ops
		VEC_SP	Single precision vector/SIMD instructions
		VEC_DP	Double precision vector/SIMD instructions