

Loupe: ASPLOS'24 Supplemental Material

August 14, 2023

In these supplementary materials we first present the full support plans obtained with Loupe on our entire data set of 116 applications, for 11 OSes under development focusing on compatibility with Linux applications. We also provide a description of each application measured with Loupe referenced in the “Apps supported” column.

1 Full Support Plans

We present below the full support plans obtained with Loupe for 11 open-source OSes: Unikraft¹, Google Fuchsia², Kerla³, Google Zephyr⁴, HermiTux⁵, Google gVisor⁶, Graphene⁷, FreeBSD Linuxulator⁸, Browsix⁹, OSv¹⁰, and Linux’ nolibc¹¹.

¹<https://github.com/unikraft>

²<https://github.com/vsrinivas/fuchsia>

³<https://github.com/nuta/kerla>

⁴<https://github.com/zephyrproject-rtos/zephyr>

⁵<https://github.com/ssrg-vt/hermitux>

⁶<https://github.com/google/gvisor>

⁷<https://github.com/gramineproject/graphene>

⁸<https://github.com/freebsd/freebsd-src>

⁹<https://github.com/plasma-umass/browsix>

¹⁰<https://github.com/cloudius-systems/osv>

¹¹<https://github.com/torvalds/linux/tree/master/tools/include/nolibc>

Unikraft (commit 7d6707f, supports 174 syscalls)				
Step	Implement	Stub	Fake	Apps supported
0				(62 apps)
1	290	273, 186, 218, 332, 334	330	+ deno
2			332	+ rust-httpserver, nodejs
3	15	234		+ node-express, traefik
4		217, 230		+ dacapo
5		192, 191		+ vertx, openjdk8zulu, openjdkzulu9, caddy, busybox
6			218	+ rhino, golang-httpclient, openssl
7		283, 286, 319		+ derby, erlang
8	218	143, 144, 145, 146, 147		+ mono
9	217			+ h2o, kafka
10		67, 29, 149, 219, 221, 31	30	+ rust, gimp
11		203		+ aircrack-ng
12		314, 315		+ jetty, consul, embulk-example, akka, darktable
13		247		+ ocrmypdf, zookeeper, dropwizard-example, golang-netitrate
14	307			+ activemq, wrk
15	230			+ java-httpserver
16	186			+ blogbench, keydb
<i>continued on next page</i>				

Unikraft (commit 7d6707f, supports 174 syscalls)				
Step	Implement	Stub	Fake	Apps supported
17	247	326		+ golang-httpserver
18	219			+ golang-example
19	283	299		+ golang-pie-example, minecraft-server
20	27			+ mongodb
21	273, 334			+ linpack
22	149			+ jython, gnupg
23			221	+ gegl
24	221			+ libreoffice
25	26		151	+ cassandra
26	286, 319			+ elixir
27	203, 238		67, 29, 31	+ amg
28	67, 29, 30	237		+ gnuradio
29	64, 66, 220			+ dbench
30	208, 209, 206	207		+ aio-stress
31	237, 239			+ mysql
32	289, 277			+ fio

Fuchsia (commit 5d20758, supports 152 syscalls)				
Step	Implement	Stub	Fake	Apps supported
0				(78 apps)
1	302	99, 334, 143, 144, 273, 146, 147, 24		+ mono
2		58, 230		+ vertx, rhino
3		75		+ zookeeper
4		33, 74		+ derby
5			58	+ dropwizard-example
6		92		+ activemq
7		222, 223		+ haproxy
8	219			+ minecraft-server
9		280, 285, 326		+ golang-example
10	74			+ kafka
11	24	128, 237		+ octave
12	58	67, 140, 141, 270, 29, 149, 221, 31	332, 30	+ gimp
13	33	105		+ lighttpd
14	270		273	+ elixir
15	100			+ erlang, dhrystone
16	85	162		+ iozone
17	37			+ openssl
18	230			+ java-httpserver
19	280			+ golang-httpserver
20	162			+ golang-pie-example, blog- bench

continued on next page

Fuchsia (commit 5d20758, supports 152 syscalls)				
Step	Implement	Stub	Fake	Apps supported
21	128			+ pbzip2
22	273, 334			+ linpack
23	99			+ jython
24	27			+ mongodb
25	221		151	+ cassandra
26	149			+ gegl
27	86			+ gnupg
28	75			+ libreoffice
29	88			+ ocrmypdf
30	285, 238		67, 29, 31	+ amg
31	67, 29, 30			+ gnuradio
32	64, 66, 220			+ dbench
33	208, 209, 206	207		+ aio-stress
34	289, 277, 237			+ fio
35	105, 140, 141, 239			+ mysql

Kerla (commit 73a1873, supports 58 syscalls)				
Step 0	Implement	Stub	Fake	Apps supported (7 apps)
1	257, 262, 17	202, 11, 10, 204, 302, 334, 273, 21		+ npb-mg
2		99, 100, 102, 8, 137, 149, 87	204	+ uperf, gmic
3		157		+ imagemagick, blackscholes, ffmpeg
4		288, 289, 290, 40, 232, 105, 106, 107, 233, 18, 116, 53, 54, 213	56	+ python3, mruby, kong
5		192, 56, 332, 191		+ npb-ep, aobench, npb-bt, stream, busybox
6		131		+ npb-ua, lua, npb-sp, rust-pie- example
7		98		+ iperf3
8		95	8	+ npb-is, npb-lu, netperf, npb-ft, npb-cg, lzma
9		104, 108		+ rpm, groonga, python2, whet- stone, perlhello
10	8			+ postmark, npb-dc
11	10		302	+ tesseract-ocr
12		229, 77, 81, 24, 28		+ openjdk8zulu
13		138, 82, 280, 221, 314, 315, 285	120, 21, 118	+ inkscape
14		230		+ rawtherapee, openjdkzulu9
<i>continued on next page</i>				

Kerla (commit 73a1873, supports 58 syscalls)				
Step	Implement	Stub	Fake	Apps supported
15		281, 234, 35	291, 293	+ zstd, golang-pie-httpserver
16			25	+ iperf, rsvg, webassembly
17	302	143, 144, 145, 146, 147	77	+ mono
18			47	+ derby
19	307			+ wrk
20	24	128, 237		+ octave
21	202			+ dacapo
22		58		+ rhino
23	21	112, 203, 269		+ aircrack-ng
24		25, 75		+ darktable
25		32, 293		+ gccgo
26	293	263	32	+ rust
27			58	+ dropwizard-example
28	213			+ vertx
29	32			+ jetty
30		115, 84		+ embulk-example
31	100			+ dhrystone
32	85	162		+ iozone
33	290		232, 332	+ node-express
34	233			+ nodejs
35	232			+ zookeeper
36	54			+ redis
37	291			+ rust-httpserver
38	53	91, 93	330	+ deno
39	18	92	288	+ nginx
40	46		98	+ cryptsetup
41	56	292		+ httpd
42		222, 78, 223		+ akka, keydb, haproxy
43	11			+ weborf, lighttpd
44	288		102	+ h2o
45	131	97, 267		+ traefik
46		258		+ caddy
47	281			+ golang-httpclient
48	97	73, 47		+ consul
49	37			+ openssl
50	230			+ java-httpserver
51	87			+ sqlite
52	162			+ twmemproxy, blogbench
53	128			+ pbzip2
54	283, 219	299, 286		+ minecraft-server
55	273, 334			+ linpack
56	25, 58	67, 140, 141, 270, 29, 31	30	+ gimp
57	77, 47	27, 19		+ envoy
58	19, 270	319, 271	28	+ erlang
59	258, 292	247		+ golang-netiterate
continued on next page				

Kerla (commit 73a1873, supports 58 syscalls)				
Step	Implement	Stub	Fake	Apps supported
60	247	326		+ golang-example
61	280			+ golang-pie-example
62	28			+ golang-httpserver
63	81, 82			+ activemq
64	229, 157, 102			+ kafka
65	98, 149			+ gnupg
66	26, 221		151	+ cassandra
67	67, 29, 30			+ gnuradio
68	99, 73, 27		137	+ mongodb
69	137, 138			+ gegl
70	104, 107, 108			+ webfsd
71	204			+ jython
72	88, 263			+ ocrmypdf
73	208, 209, 206	207		+ aio-stress
74	112, 319, 286, 271			+ elixir
75	93, 75, 84, 269			+ libreoffice
76	64, 66, 220			+ dbench
77	289, 277, 237			+ fio
78	259, 267, 203, 238, 285		31	+ amg
79	105, 106, 140, 141, 239, 116, 95			+ mysql

Zephyr (commit 9d159ba, supports 55 syscalls)				
Step 0	Implement	Stub	Fake	Apps supported (6 apps)
1	59, 158	257, 262, 202, 10, 12, 13, 334, 17, 273, 21, 218, 231, 107, 108, 302, 318		+ perl
2	257, 262, 17	217, 204		+ npb-mg
3		99, 100, 39, 137, 149, 89, 186	218, 204	+ npb-dc, uperf, gmic
4		14		+ imagemagick
5		157		+ blackscholes, ffmpeg
6		131		+ python3, mruby, npb-ep, aobench, npb-bt, stream, npb-ua, lua, npb-sp, rust-pie-example
7		98, 63		+ iperf3
8		95		+ npb-is, npb-lu, netperf, npb-ft, npb-cg, lzma
9	10	28	98	+ rpm, groonga, python2, whetstone, perlhelloworld, postmark, cryptsetup
<i>continued on next page</i>				

Zephyr (commit 9d159ba, supports 55 syscalls)				
Step	Implement	Stub	Fake	Apps supported
10			302	+ zstd
11		138, 332, 221	318	+ iperf, rsvg
12			25	+ webassembly
13	231			+ tesseract-ocr
14		288, 233, 234, 15, 281	291, 293	+ golang-pie-httpserver
15	89	128, 237		+ octave
16		290, 110, 86, 280, 314, 315, 285	120, 21, 118	+ inkscape
17	5			+ rawtherapee
18	100			+ dhrystone
19	85			+ iozone
20	213	232		+ twmemproxy
21	56			+ weborf
22	128			+ pbzip2
23	290, 291	20		+ rust-httpserver
24	233	91, 93, 6	330	+ deno
25	293		232, 332	+ nodejs
26	232, 22			+ node-express, redis
27	186	230		+ keydb
28	302	80, 78	288	+ haproxy
29	218, 13	144, 145, 143		+ mono
30	15	81, 229		+ vtx
31		33, 18, 90	47	+ openjdk8zulu, openjdkzulu9, derby
32	202			+ dacapo
33	217			+ akka
34		32, 61	58	+ dropwizard-example
35	21	112, 203, 269		+ aircrack-ng
36		25, 75		+ darktable
37	90	58, 263	32	+ zookeeper, rust
38	32			+ jetty
39	47	27, 19	334	+ envoy
40	63	115, 84		+ embulk-example
41	318	289, 40, 105, 106, 116		+ kong
42	307			+ wrk
43	12	292		+ httpd
44	61	192, 191		+ sqlite, busybox
45	37			+ rhino, gccgo, openssl
46	230			+ java-httpserver
47	80			+ blogbench
48	288, 131	97, 267		+ traefik
49		258		+ caddy
50	20			+ h2o
51	18	92		+ nginx
52	281			+ golang-httpclient

continued on next page

Zephyr (commit 9d159ba, supports 55 syscalls)				
Step	Implement	Stub	Fake	Apps supported
53	97	73		+ consul
54	283, 219	299, 286		+ minecraft-server
55	273, 334			+ linpack
56	25, 58	67, 140, 141, 270, 121, 29, 62, 31	30	+ gimp
57	107, 108			+ webfsd
58	33, 14			+ lighttpd
59	19, 270	319, 271	28	+ erlang
60	258, 292	247		+ golang-netiterate
61	247	326		+ golang-example
62	280			+ golang-pie-example
63	28			+ golang-httpserver
64	81, 39			+ activemq
65	229, 157, 62			+ kafka
66	26, 221		151	+ cassandra
67	98, 149, 86			+ gnupg
68	67, 29, 30			+ gnuradio
69	99, 73, 27		137	+ mongodb
70	204, 110			+ jython
71	88, 263			+ ocrmypdf
72	137, 138			+ gegl
73	208, 209, 206	207		+ aio-stress
74	112, 319, 286, 271			+ elixir
75	93, 75, 84, 269			+ libreoffice
76	64, 66, 220			+ dbench
77	289, 277, 237			+ fio
78	259, 267, 203, 238, 285		109, 31	+ amg
79	105, 106, 140, 141, 239, 116, 95			+ mysql

Hermitux (commit cde4e84, supports 92 syscalls)				
Step	Implement	Stub	Fake	Apps supported (6 apps)
0				
1	59	14, 143, 144, 145, 146, 147, 334, 157, 318	77	+ mono
2		137, 100, 149		+ npb-mg, npb-dc, uperf, gmic
3		128, 237		+ octave
4		269		+ perl, imagemagick, blacksc-holes, ffmpeg, tesseract-ocr, aircrack-ng
5		116		+ python3, mruby, webfsd
6		290, 285, 138, 82, 86, 280, 314, 315, 221	120, 118	+ inkscape
<i>continued on next page</i>				

Hermitux (commit cde4e84, supports 92 syscalls)				
Step	Implement	Stub	Fake	Apps supported
7		77		+ rawtherapee, npb-ep, iozone
8		98		+ aobench, npb-bt, darktable
9		288, 233, 281, 15	291, 293	+ stream, npb-ua, lua, zstd, npb-sp, rust-pie-example, iperf3, sqlite, golang-pie-httpserver
10		55		+ npb-is, iperf
11		332	318	+ rsvg
12	15	81, 230		+ npb-lu, netperf, npb-ft, npb-cg, webassembly, weborf, lzma, rpm, groonga, python2, whetstone, perlhelloworld, postmark, dcapo
13		90, 53	47	+ openjdk8zulu, openjdkzulu9, derby
14	46		98	+ cryptsetup
15	213	232, 293		+ vertex
16	32			+ twmemproxy, jetty
17		115		+ embulk-example
18	318	291, 292, 61		+ httpd
19		289, 106, 105		+ kong
20	307			+ wrk
21	334			+ linpack
22	100			+ dhrystone
23	288	258, 267		+ caddy
24	293			+ traefik
25			58	+ dropwizard-example
26	90	58, 263		+ rust
27	58	67, 270, 121, 219, 29, 31	332, 30	+ gimp
28	61	192, 191		+ busybox
29	290		232	+ rhino, gccgo, node-express
30	291			+ rust-httpserver
31	233			+ nodejs
32	53	91, 93	330	+ deno
33	232			+ redis
34		92		+ nginx
35		222, 223		+ akka, h2o, zookeeper, keydb, haproxy
36	281	73, 47		+ consul
37	37			+ golang-httpclient, openssl
38	230			+ java-httpserver
39	128			+ blogbench, pbzip2
40	283, 219	299, 286		+ minecraft-server
41	73		137	+ mongodb
42	82, 157			+ kafka
43	77, 47			+ envoy

continued on next page

Hermitux (commit cde4e84, supports 92 syscalls)				
Step	Implement	Stub	Fake	Apps supported
44	270	319, 271		+ erlang
45	81			+ activemq
46	98		14	+ jython
47	14, 55			+ lighttpd
48	149, 86			+ gnupg
49	26, 221		151	+ cassandra
50	88, 263			+ ocrmypdf
51	258, 292	247		+ golang-netiterate
52	247	326		+ golang-example
53	280			+ golang-httpserver
54	137, 138			+ golang-pie-example, gegl
55	93, 269			+ libreoffice
56	319, 286, 271			+ elixir
57	67, 29, 30			+ gnradio
58	64, 66, 220			+ dbench
59	208, 209, 206	207		+ aio-stress
60	289, 277, 237			+ fio
61	267, 259, 285, 238		109, 31	+ amg
62	105, 106, 116, 239			+ mysql

gVisor (commit 6961f3e, supports 259 syscalls)				
Step	Implement	Stub	Fake	Apps supported
0				(All 116 apps)

Graphene (commit fb71e43, supports 161 syscalls)				
Step	Implement	Stub	Fake	Apps supported
0				(92 apps)
1	157	99, 334		+ kafka
2	334			+ linpack
3	25	67, 29, 149, 219, 221, 31	332, 30	+ gimp
4	100			+ dhystone
5	221		151	+ openssl, cassandra
6	219	98, 326, 73, 280, 285		+ golang-example
7	283	286		+ minecraft-server
8	280			+ golang-httpserver
9	162			+ golang-pie-example, blog-bench
10	286, 319			+ elixir
11	99, 149			+ libreoffice
12	73			+ gegl, mongodb
13	98			+ jython

continued on next page

Graphene (commit fb71e43, supports 161 syscalls)				
Step	Implement	Stub	Fake	Apps supported
14	86			+ gnupg
15	88			+ ocrmypdf
16	285, 238		67, 29, 31	+ amg
17	67, 29, 30			+ gnradio
18	64, 66, 220			+ dbench
19	208, 209, 206	207		+ aio-stress
20	239			+ mysql
21	289, 277			+ fio

FreeBSD Linuxulator (commit 07de869, supports 295 syscalls)				
Step	Implement	Stub	Fake	Apps supported
0				(113 apps)
1	238			+ amg
2	237, 239			+ mysql
3	289			+ fio

Browsix (commit 04f0830, supports 26 syscalls)				
Step	Implement	Stub	Fake	Apps supported
0				(6 apps)
1	9, 59, 158	262, 8, 72, 10, 11, 12, 13, 202, 334, 17, 273, 21, 218, 102, 104, 107, 108, 302, 318		+ perl
2	17, 262	204		+ npb-mg
3		99, 100, 137, 83, 149, 87, 89, 186	218, 204	+ uperf, gmic
4		14		+ imagemagick
5		157		+ blackscholes, ffmpeg
6		131, 7		+ python3, mruby, npb-ep, aobench, npb-bt, stream, npb-ua, lua, npb-sp, rust-pie-example
7		98, 228, 63		+ iperf3
8		95	8	+ npb-is, npb-lu, netperf, npb-ft, npb-cg, lzma
9	8			+ rpm, groonga, python2, whetstone, perllhello, postmark, npb-dc
10	10		302	+ tesseract-ocr
11		28		+ rawtherapee
12		35, 233, 234, 15, 24, 281	291	+ golang-pie-httpserver

continued on next page

Browsix (commit 04f0830, supports 26 syscalls)				
Step	Implement	Stub	Fake	Apps supported
13		55		+ iperf
14		138, 60, 221, 332	318	+ rsvg
15			25	+ webassembly
16	21	112, 203, 269		+ aircrack-ng
17	89	290, 82, 86, 280, 314, 315, 285	120, 118	+ inkscape
18	100			+ dhystone
19	85	162, 77, 74		+ iozone
20	15	192, 56, 191		+ busybox
21	131	258		+ caddy
22	56	97, 45	44	+ traefik
23	290	48, 20	232, 332	+ node-express
24	72			+ zstd
25	291	232		+ rust-httpserver
26	90	32, 58		+ gccgo
27	128			+ pbzip2
28	233, 53	91, 93	330	+ deno
29	60			+ nodejs
30	24	237		+ octave
31	13	81, 229		+ openjdk8zulu
32		230		+ openjdkzulu9
33	83	25, 18, 75		+ darktable
34	202			+ dacapo
35	7	33, 2, 263	32	+ rust
36	32	43, 213		+ jetty
37	63	115, 84		+ embulk-example
38	318	289, 40, 105, 106, 116		+ kong
39	12	292, 22, 23	47	+ httpd
40	302			+ rhino
41			58	+ dropwizard-example
42	218	143, 144, 145, 146, 147	77	+ mono
43	213			+ vertx
44	281			+ golang-httpclient
45	37			+ openssl
46	230			+ java-httpserver
47	87			+ sqlite
48		44		+ twmemproxy
49	43			+ weborf
50	46		98	+ cryptsetup
51	232			+ akka
52	22			+ zookeeper, redis
53	20		102	+ h2o
54	186			+ keydb
55	44	222, 78, 223		+ haproxy
56	45			+ derby

continued on next page

Browsix (commit 04f0830, supports 26 syscalls)				
Step	Implement	Stub	Fake	Apps supported
57	18	92		+ nginx
58	307			+ wrk
59	97	73, 47		+ consul
60	162			+ blogbench
61	283, 219	299, 286		+ minecraft-server
62	25, 58	67, 140, 141, 270, 121, 29, 31	30	+ gimp
63	77, 47	27, 19	334	+ envoy
64	81, 82			+ activemq
65	67, 29, 30			+ gnuradio
66	258, 292, 247	326		+ golang-example
67	14			+ golang-netiterate
68	280			+ golang-pie-example
69	11, 28			+ golang-httpserver
70	33, 55			+ lighttpd
71	19, 270	319, 271		+ erlang
72	273, 228, 334			+ linpack
73	229, 26, 221		151	+ cassandra
74	74, 157, 102			+ kafka
75	98, 149, 86			+ gnupg
76	99, 73, 27		137	+ mongodb
77	137, 138			+ gegl
78	104, 107, 108			+ webfsd
79	204			+ jython
80	88, 263			+ ocrmypdf
81	208, 209, 206	207		+ aio-stress
82	112, 319, 286, 271			+ elixir
83	93, 75, 84, 269			+ libreoffice
84	64, 66, 220			+ dbench
85	289, 277, 237			+ fio
86	259, 285, 203, 238		48, 109, 31	+ amg
87	105, 106, 140, 141, 239, 48, 116, 95			+ mysql

OSv (commit 6fd4a65, supports 180 syscalls)				
Step	Implement	Stub	Fake	Apps supported
0				(6 apps)
1	158	102, 262, 231, 104, 108, 334, 302, 273, 218		+ perl
2		89, 79	25	+ sqlite
3	262	204, 332		+ rust-httpserver
4		217		+ npb-mg
5		137, 100	218, 204	+ npb-dc, uperf, gmic

continued on next page

OSv (commit 6fd4a65, supports 180 syscalls)				
Step	Implement	Stub	Fake	Apps supported
6		91, 230	302, 334	+ imagemagick, blackscholes, ffmpeg, python3, mruby, envoy
7		40, 289, 53	56	+ lighttpd, kong
8			332	+ npb-ep, aobench, npb-bt, stream, npb-ua, lua, node-express
9		60		+ zstd
10		98		+ npb-sp, rust-pie-example, iperf3
11		138, 221		+ npb-is, iperf, rsvg
12		43		+ npb-lu, netperf, npb-ft, npb-cg, twmemproxy
13		95		+ webassembly, aio-stress, lzma
14	43	56		+ rpm, groonga, python2, whetstone, perlhell, postmark, redis
15	53			+ nginx
16	89	82	330	+ deno
17	60		98	+ cryptsetup
18	231			+ nodejs
19		128, 237		+ octave
20		86, 280, 314, 315, 285		+ tesseract-ocr, inkscape
21		15		+ rawtherapee, golang-pie-httpserver
22	307			+ wrk
23	15	81		+ dacapo
24		192, 191		+ openjdk8zulu, openjdkzulu9, caddy, busybox
25	56			+ golang-httpclient, traefik
26		80, 90		+ httpd
27	217	203, 269		+ keydb, weborf, aircrack-ng
28		25		+ jetty, consul, gnuradio, embulk-example, akka, darktable
29		219, 247		+ golang-netiterate
30	90			+ rust
31	302			+ gccgo, vtx
32		62, 319		+ rhino, zookeeper, derby, erlang
33		222, 78, 223		+ dropwizard-example, haproxy
34	218	143, 144, 145, 146, 147		+ mono
35			102	+ h2o
36	219	299		+ minecraft-server
37	25			+ gimp
38	128		137	+ mongodb
39	100			+ pbzip2, dhystone

continued on next page

OSv (commit 6fd4a65, supports 180 syscalls)				
Step	Implement	Stub	Fake	Apps supported
40	85			+ openssl, iozone
41	247	326		+ golang-example
42	230			+ java-httpserver
43	280			+ golang-httpserver
44	80			+ golang-pie-example, blog-bench
45	273, 334			+ linpack
46	204, 319			+ elixir
47	82, 221			+ cassandra
48	81			+ activemq
49	88, 86			+ ocrmypdf
50	102, 62, 79			+ kafka
51	98			+ gnupg
52	104, 108			+ jython
53	137, 138			+ webfsd, gegl
54	269			+ libreoffice
55	259, 285, 203			+ amg
56	237, 95			+ mysql
57	289, 277			+ fio
58	64, 66, 220			+ dbench

Linux nolibc (commit 7efd762, supports 44 syscalls)				
Step 0	Implement	Stub	Fake	Apps supported (6 apps)
1	158	257, 262, 72, 202, 10, 13, 334, 17, 273, 21, 218, 102, 231, 104, 107, 108, 302, 318		+ perl
2	257, 262, 17	204		+ npb-mg
3		99, 100, 137, 149, 89	218, 204	+ npb-dc, uperf, gmic
4		14		+ imagemagick
5		157		+ blackscholes, ffmpeg
6		131		+ python3, mruby, npb-ep, aobench, npb-bt, stream, npb-ua, lua, npb-sp, rust-pie-example
7		98, 228, 41, 49, 50, 54, 63		+ iperf3
8		42		+ npb-is, npb-lu, netperf, npb-ft, npb-cg, lzma, rpm, groonga
9	100			+ python2, whetstone, perlhello, postmark, dhrystone
<i>continued on next page</i>				

Linux nolibc (commit 7efd762, supports 44 syscalls)				
Step	Implement	Stub	Fake	Apps supported
10	85	162, 77		+ iotzone
11	15	56, 192, 332, 191		+ busybox
12	10	138, 28, 221	318, 302	+ rsvg
13		24	25	+ webassembly
14	231			+ tesseract-ocr
15		288, 35, 233, 234, 51, 281	49, 291, 293	+ golang-pie-httpserver
16	21	203, 269, 79		+ aircrack-ng
17		58, 293	89	+ gccgo
18	89	290, 82, 52, 280, 314, 315, 285	120, 42, 118	+ inkscape
19		25, 18, 75		+ darktable
20	24	128, 237	41	+ octave
21	5			+ rawtherapee
22		6	63	+ sqlite
23	13	81, 229		+ openjdk8zulu
24		230		+ openjdkzulu9
25	202			+ dacapo
26	293	263		+ rust
27	63	115, 84, 53		+ embulk-example
28	72			+ zstd
29	302			+ rhino
30	218	143, 144, 145, 146, 147	77	+ mono
31	41	55		+ iperf
32	128			+ pbzip2
33	233, 290		232, 332	+ nodejs
34	291, 53	232, 91, 93	330	+ deno
35	25, 58	67, 140, 141, 270, 219, 29, 31	30	+ gimp
36	49, 50	48, 43, 20, 213		+ jetty
37	54	45		+ node-express, dropwizard-example, rust-httpserver
38	213			+ vertx
39		44		+ twmemproxy
40	318	289, 40, 105, 106, 116	56	+ kong
41	56	22	51, 44, 47	+ httpd
42	37			+ openssl
43	230			+ java-httpserver
44	43			+ weborf
45	46		98	+ cryptsetup
46	232			+ akka
47	51			+ zookeeper
48	162			+ blogbench
49	288, 131	97, 267		+ traefik
50		258		+ caddy

continued on next page

Linux nolibc (commit 7efd762, supports 44 syscalls)				
Step	Implement	Stub	Fake	Apps supported
51	20		102	+ h2o
52	283, 219	307, 299, 286		+ minecraft-server
53	52, 22			+ redis
54	44	222, 78, 223		+ keydb, haproxy
55	45			+ derby
56	18			+ nginx
57	42, 307			+ wrk
58	281			+ golang-httpclient
59	97	73, 47		+ consul
60	77, 47	27, 19	334	+ envoy
61	14, 55			+ lighttpd
62	258	247		+ golang-netiterate
63	247	326		+ golang-example
64	280			+ golang-pie-example
65	28			+ golang-httpserver
66	204, 263			+ ocrmypdf
67	19, 270	319, 271		+ erlang
68	81, 82			+ activemq
69	273, 228, 334			+ linpack
70	98, 149, 102			+ gnupg
71	229, 157, 79			+ kafka
72	26, 221		151	+ cassandra
73	319, 286, 271			+ elixir
74	67, 29, 30			+ gnuradio
75	99, 73, 27		137	+ mongodb
76	137, 138			+ gegl
77	104, 107, 108			+ jython
78	208, 209, 206	207		+ webfsd, aio-stress
79	93, 75, 84, 269			+ libreoffice
80	64, 66, 220			+ dbench
81	289, 277, 237			+ fio
82	259, 267, 203, 238, 285		48, 31	+ amg
83	105, 106, 140, 141, 239, 48, 116			+ mysql

2 Description of Applications and Workloads

We present below the list of applications and workloads that were measured by Loupe, along with a description of what was exactly measured and a link with more details regarding the application’s execution.

App. name	Binary traced	Workload	Link
activemq	activemq	activemq-admin performing the list command.	https://github.com/cloudius-systems/osv-apps/tree/master/apache-activemq
aio-stress	aio-stress	Run with parameters -s 25m -r 64k -t 1	https://openbenchmarking.org/test/pts/aio-stress-1.1.3
aircrack-ng	aircrack-ng	Run with parameters -S -Z 5	https://openbenchmarking.org/test/pts/aircrack-ng
akka	The JVM	The JVM running akka while netcat connects to the port akka listens to	https://github.com/cloudius-systems/osv-apps/tree/master/akka-example
amg	mpirun	mpirun running the algebraic multigrid benchmark (amg) with parameters -n 96 96 96	https://openbenchmarking.org/test/pts/amg
aobench	aobench	The aobench lightweight ambient occlusion renderer running with default parameters	https://openbenchmarking.org/test/pts/aobench
blackscholes	PARSEC blackscholes	The PARSEC Blackscholes benchmark running with parameters 1 in _64K.txt output-file	https://parsec.cs.princeton.edu/
blogbench	blogbench	BlogBench benchmark running with default parameters	https://openbenchmarking.org/test/pts/blogbench
busybox	busybox ash	Busybox' ash shell running a few sample scripts	https://github.com/cloudius-systems/osv-apps/tree/master/busybox
caddy	caddy	Caddy server running while wrk accesses its listening port	https://github.com/caddyserver/caddy
cassandra	The JVM	The JVM running cassandra, while cassandra-test runs with parameters write n=1000 -rate threads=1	https://github.com/cloudius-systems/osv-apps/tree/master/cassandra
consul	consul server	Consul server running while a client issuing the consul member command	https://github.com/hashicorp/consul
cryptsetup	cryptsetup	Run with the benchmark command line parameter	https://openbenchmarking.org/test/system/cryptsetup
dacapo	The JVM	The JVM running the dacapo benchmark	https://openbenchmarking.org/test/pts/dacapobench
darktable	darktable-cli	darktable-cli processes the openbechmarkin.org image input	https://openbenchmarking.org/test/system/darktable
dbench	dbench	Run with parameters -t 5 1	https://openbenchmarking.org/test/pts/dbench
deno	deno	The deno typescript/JS runtime running an example script from the osv-apps repo	https://github.com/cloudius-systems/osv-apps/tree/master/deno

App. name	Binary traced	Workload	Link
derby	The JVM	The JVM running Apache's derby while while derby's ij command accesses the server	https://github.com/cloudius-systems/osv-apps/tree/master/apache-derby
dhrystone	dhrystone	Benchmark run with default parameters	https://github.com/Keith-S-Thompson/dhrystone/blob/master/v2.1/dhrystone.c
django	python3	Python3 running the Django test suite.	https://docs.djangoproject.com/en/dev/internals/contributing/writing-code/unit-tests/
dropwizardd-example	dropwizard	The dropwizard server receiving requests from wrk	https://github.com/cloudius-systems/osv-apps/tree/master/dropwizard-example
elixir	elixir	Elixir outputs version information	https://github.com/cloudius-systems/osv-apps/tree/master/elixir
embulk-example	The JVM	The JVM running Embulk transferring data from CVS format to stdout1	https://github.com/cloudius-systems/osv-apps/tree/master/embulk-example
envoy	envoy	The Envoy proxy receiving requests from wrk	https://github.com/envoyproxy/envoy
erlang	erlang	Erlang runs a hello world script	https://github.com/cloudius-systems/osv-apps/tree/master/erlang
ffmpeg	ffmpeg	ffmpeg running on the sample data from openbenchmarking.org	https://openbenchmarking.org/test/pts/ffmpeg
fio	fio	fio running a series of sequential/random direct IO workloads in a file	https://github.com/axboe/fio
flask	python3	python3 running the flask test suite	https://github.com/pallets/flask
gccgo	gccgo	The gccgo compiler processes a hello world go source file	https://github.com/cloudius-systems/osv-apps/tree/master/gccgo-example
gegl	gegl	GEGL processing the openbenchmarking.org workload	https://openbenchmarking.org/test/system/gegl
gimp	gimp	Gimp processing the openbenchmarking.org workload	https://openbenchmarking.org/test/system/gimp
gmic	gmic	G'MIC processing sample images from openbenchmarking.org	https://openbenchmarking.org/test/system/gmic
gnupg	gnupg	GnuPG encrypting sample data from openbenchmarking.org	https://openbenchmarking.org/test/pts/gnupg

App. name	Binary traced	Workload	Link
gnuradio	gnuradio	GNU Radio processing sample data from openbenchmarking.org	https://openbenchmarking.org/test/system/gnuradio
golang-example	go	The Go runtime running a hello world program	https://github.com/cloudius-systems/osv-apps/tree/master/golang-example
golang-httpclient	A simple HTTP client written in Go	The client fetching the Google landing page	https://github.com/cloudius-systems/osv-apps/tree/master/golang-httpclient
golang-httpserver	A simple HTTP server written in Go	The server receiving requests from wrk	https://github.com/cloudius-systems/osv-apps/tree/master/golang-httpserver
golang-netiterate	A simple program written in Go enumerating network interfaces and IPs	Run with default parameters	https://github.com/cloudius-systems/osv-apps/tree/master/golang-net-iterate
golang-pie-example	A Go hello world program compiled as Position Independent Executable	Run with default parameters	https://github.com/cloudius-systems/osv-apps/tree/master/golang-pie-example
golang-pie-httpserver	An HTTP server written in GO and compiled as position independent executable	The server receiving requests from wrk	https://github.com/cloudius-systems/osv-apps/tree/master/golang-pie-httpserver
groonga	groonga	Groonga outputting version information	https://github.com/cloudius-systems/osv-apps/tree/master/groonga
h2o	H2o webserver	The H2O web server receiving requests from wrk	https://h2o.example.net/
haproxy	haproxy	HAProxy receiving requests from wrk	https://www.haproxy.org/
httpd	apache2	Apache httpd server receiving requests from wrk	https://httpd.apache.org/
imagemagick	imagemagick	ImageMagick converting a sample image from jpg to png	https://imagemagick.org/index.php
inkscape	inkscape	Inkscape processing sample data from openbenchmarking.org	https://openbenchmarking.org/test/system/inkscape

App. name	Binary traced	Workload	Link
iozone	iozone	Iozone running the openbenchmarking.org configuration	https://openbenchmarking.org/test/system/iozone
iperf	iperf	Initialization process of iperf (in server mode)	https://github.com/cloudius-systems/osv-apps/tree/master/iperf
iperf3	iperf3	Initialization process of iperf3 (in server mode)	https://github.com/cloudius-systems/osv-apps/tree/master/iperf3
java-httpserver	The JVM	The JVM running a HTTP server, receiving requests from wrk	https://github.com/cloudius-systems/osv-apps/tree/master/java-httpserver
jetty	The JVM	Loupe tracing the JVM running Jetty's demo app, receiving requests from wrk	https://github.com/cloudius-systems/osv-apps/tree/master/jetty
jython	jython	Jython processing a hello world script	https://github.com/cloudius-systems/osv-apps/tree/master/jython
kafka	The JVM	The JVM running Kafka processing the producer perf test benchmark	https://gist.github.com/ueokande/b96eadd798fff852551b80962862bfb3
keydb	keydb-server	The KeyDB server processing the keydb-benchmark	https://github.com/Snapchat/KeyDB
kong	nginx	The Kong's nginx server receiving requests from wrk	https://github.com/Kong/kong
leveldb	leveldb	LevelDB passing its test suite	https://github.com/google/leveldb
libreoffice	libreoffice	LibreOffice converting a sample ODT document from openbenchmarking.org into PDF	https://openbenchmarking.org/test/system/libreoffice
lighttpd	lighttpd	Lighttpd receiving requests from wrk	https://github.com/lighttpd/lighttpd1.4
linpack	linpack	The Linpack benchmark running with default parameters	https://people.math.sc.edu/Burkardt/workshops/bootcamp_2008_vt/linpack_bench/linpack_bench.c
lua	lua	The lua interpreter running a hello world script	https://github.com/cloudius-systems/osv-apps/tree/master/lua-hello
lzma	lzma	LZMA compressing sample data from openbenchmarking.org	https://openbenchmarking.org/test/pts/compress-lzma
memcached	memcached	Memcached passing its test suite	https://github.com/memcached/memcached

App. name	Binary traced	Workload	Link
minecraft-server	The JVM	The JVM running the Minecraft server receiving requests from wrk	https://github.com/cloudius-systems/osv-apps/tree/master/minecraft-server
mongodb	mongodb	MongoDB running the Mongo-perf benchmark	https://github.com/mongodb/mongo-perf
mono	mono	A hello world C# application running on top of mono	https://github.com/cloudius-systems/osv-apps/tree/master/mono-example
mruby	mruby	The mruby shell initializing	https://github.com/cloudius-systems/osv-apps/tree/master/mruby
mysql	mysql	MySQL processing the sysbench oltp_read_write benchmark	https://github.com/akopytov/sysbench/blob/master/src/luao/oltp_read_write.lua
netperf	netper	Netperf outputting version information	https://github.com/cloudius-systems/osv-apps/tree/master/netperf
nginx	nginx	Nginx receiving request from wrk	https://github.com/nginx/nginx
node-express	node	NodeJS running a toy web server receiving requests from wrk	https://github.com/cloudius-systems/osv-apps/tree/master/node-express-example
nodejs	node	NodeJS processing an ad-hoc regex-based benchmark	https://github.com/nodejs/node
npb-bt	bt.S.x	The NAS parallel benchmark Block Tri-diagonal solver running problem class S	https://www.nas.nasa.gov/software/npb.html
npb-cg	cg.S.x	The NAS parallel benchmark Conjugate Gradient running problem class S	https://www.nas.nasa.gov/software/npb.html
npb-dc	dc.S.x	The NAS parallel benchmark Data Cube running problem class S	https://www.nas.nasa.gov/software/npb.html
npb-ep	ep.S.x	The NAS parallel benchmark Embarrassingly Parallel running problem class S	https://www.nas.nasa.gov/software/npb.html
npb-ft	ft.S.x	The NAS parallel benchmark 3D fast Fourier Transform running problem class S	https://www.nas.nasa.gov/software/npb.html
npb-is	is.S.x	The NAS parallel benchmark Integer Sort running problem class S	https://www.nas.nasa.gov/software/npb.html
npb-lu	lu.S.x	The NAS parallel benchmark Lower-Upper Gauss-Seidel solver running problem class S	https://www.nas.nasa.gov/software/npb.html

App. name	Binary traced	Workload	Link
npb-mg	mg.S.x	The NAS parallel benchmark Multi-Grid running problem class S	https://www.nas.nasa.gov/software/npb.html
npb-sp	sp.S.x	The NAS parallel benchmark Scalar Penta-diagonal solver running problem class S	https://www.nas.nasa.gov/software/npb.html
npb-ua	ua.S.x	The NAS parallel benchmark Unstructured Adaptive mesh running problem class S	https://www.nas.nasa.gov/software/npb.html
ocrmypdf	ocrmypdf	OCRMyPDF processing sample data from openbenchmarking.org	https://openbenchmarking.org/test/system/ocrmypdf
octave	octave	Octave processing a benchmark from openbenchmarking.org	https://openbenchmarking.org/test/system/octave-benchmark
openjdk8zulu	Zulu JVM v8	The Zulu JVM v8 outputting version information	https://github.com/cloudius-systems/osv-apps/tree/master/openjdk8-zulu-full
openjdkzulu9	Zulu JVM v9	The Zulu JVM v9 outputting version information	https://github.com/cloudius-systems/osv-apps/tree/master/openjdk-zulu-9-and-above
openssl	openssl	OpenSSL running its speed measurement feature (--speed switch)	https://openbenchmarking.org/test/pts/openssl
pbzip2	pbzip2	Pbzip2 compressing sample data from openbenchmarking.org	https://openbenchmarking.org/test/system/compress-pbzip2
perl	perl	Perl outputting version information	https://github.com/cloudius-systems/osv-apps/tree/master/perl
perlhello	perl	Perl running a hello world script	https://github.com/cloudius-systems/osv-apps/tree/master/perl-hello
postmark	postmark	The postmark benchmark running with its default configuration	https://packages.debian.org/bullseye/postmark
python	python3	Python3 (cpython) running its entire test suite	https://github.com/python/cpython
python2	python2	Python2 outputting version information	https://github.com/cloudius-systems/osv-apps/tree/master/python2x
python3	python3	Python3 outputting version information	https://github.com/cloudius-systems/osv-apps/tree/master/python3x
rawtherapee	rawtherapee	RawTherapee processing sample images from openbenchmarking.org	https://openbenchmarking.org/test/system/rawtherapee
redis	redis-server	Redis processing the redis-benchmark	https://github.com/redis/redis/blob/unstable/src/redis-benchmark.c

App. name	Binary traced	Workload	Link
rhino	rhino	The Rhino JS engine running a hello world script	https://github.com/cloudius-systems/osv-apps/tree/master/rhino
rpm	rpm	The RPM package manager outputting version information	https://github.com/cloudius-systems/osv-apps/tree/master/rpm
rsvg	rsvg	RSVG/librsvg converting between formats sample data from openbenchmarking.org	https://openbenchmarking.org/test/system/rsvg
ruby	ruby	CRuby running its entire test suite	https://github.com/cloudius-systems/osv-apps/tree/8f8e5930fda707b05f32f7f1b82bf12a023e6dee/ruby
rust	rustc	The rustc compiler compiling a hello world source file	https://www.rust-lang.org/
rust-httpserver	A simple web server written in Rust	A simple web server written in Rust, receiving requests from wrk	https://github.com/cloudius-systems/osv-apps/tree/8f8e5930fda707b05f32f7f1b82bf12a023e6dee/rust-httpserver
rust-pie-example	A Rust PIE hello world executable	Simply running the executable	https://github.com/cloudius-systems/osv-apps/tree/8f8e5930fda707b05f32f7f1b82bf12a023e6dee/rust-pie-example
sqlite	A C application sending various SQL queries to a SQLite database	Simply running the executable	https://sqlite.org/index.html
stream	stream	The STREAM memory bandwidth measurement benchmark	https://www.cs.virginia.edu/stream/
tesseract-ocr	tesseract-ocr	Tesseract-OCR processing sample data from openbenchmarking.org	https://openbenchmarking.org/test/system/tesseract-ocr
Traefik	traefik	The Traefik proxy receiving requests from wrk	https://github.com/traefik/traefik
twmemproxy	twmemproxy	The twmemproxy/nutcracker proxy receiving requests from wrk	https://github.com/twitter/twemproxy
upperf	upperf	The Uperf network performance measurement tool outputting version information	https://github.com/cloudius-systems/osv-apps/tree/master/upperf
vertex	The JVM	The JVM running a simple vertex server, processing requests from wrk	https://github.com/cloudius-systems/osv-apps/tree/master/vertex
webassembly	wasmer	The Wasmer WebAssembly runtime executing a hello world LUA script	https://github.com/cloudius-systems/osv-apps/tree/master/webassembly

App. name	Binary traced	Workload	Link
webfsd	webfsd	The Webfsd web server receiving requests from wrk	https://github.com/ourway/webfsd
weborf	weborf	The Weborf web server receiving requests from wrk	https://ltworf.github.io/weborf/
whetstone	whetstone	The Whetstone benchmark	https://netlib.org/benchmark/whetstone.c
wrk	wrk	The wrk benchmarking tool submitting requests to a web server	https://github.com/cloudius-systems/osv-apps/tree/master/wrk
zookeeper	The JVM	The JVM running an Apache ZooKeeper server receiving requests from wrk	https://github.com/cloudius-systems/osv-apps/tree/master/apache-zookeeper
zstd	zstd	Zstd compressing sample data from openbenchmarking.org	https://openbenchmarking.org/test/pts/compress-zstd