Empirical Check of Machine Homogeneity on Timing Protocol

Young-Kyoon Suh

Data-Intensive Systems Laboratory

School of Computer Science and Engineering

Kyungpook National University

May 18, 2018

1 Description

In this work we do a check to see if the result on the same experiment is different on different nodes, each with the same machine specification.

2 Preliminary Experiments

We provide a short description of our preliminary experimental runs.

Experimental Notes: In our experiments we used four nodes (`sodb8`, `sodb9`, `sodb10`, and `sodb12`) in the same cluster. A short summary of the experiments is exhibited in Table 1.

Machine	Task Length	Description	Time Length
`sodb8` (plugged into *bottom left* power strip)	INC1~INC128	Runs of 300 samples	2017-02-09 ∼ 2017-02-10
`sodb9` (plugged into *the upper left* power strip)	INC1~INC128	Runs of 300 samples	2017-02-09 ∼ 2017-02-10
`sodb10` (plugged into *the upper left* power strip)	INC1~INC128	Runs of 300 samples	2017-02-09 ∼ 2017-02-10
`sodb12` (plugged into *the upper right* power strip)	INC1~INC128	Runs of 300 samples	2017-02-09 ∼ 2017-02-10

Table 1: Detailed description of INC data used for histograms

Measurement Quality Across the SoDB Nodes: Fig. 1 shows the standard deviation and relative error of elapsed time (ET) and process time (PT) on the different SoDB nodes as the task length of INC increases.
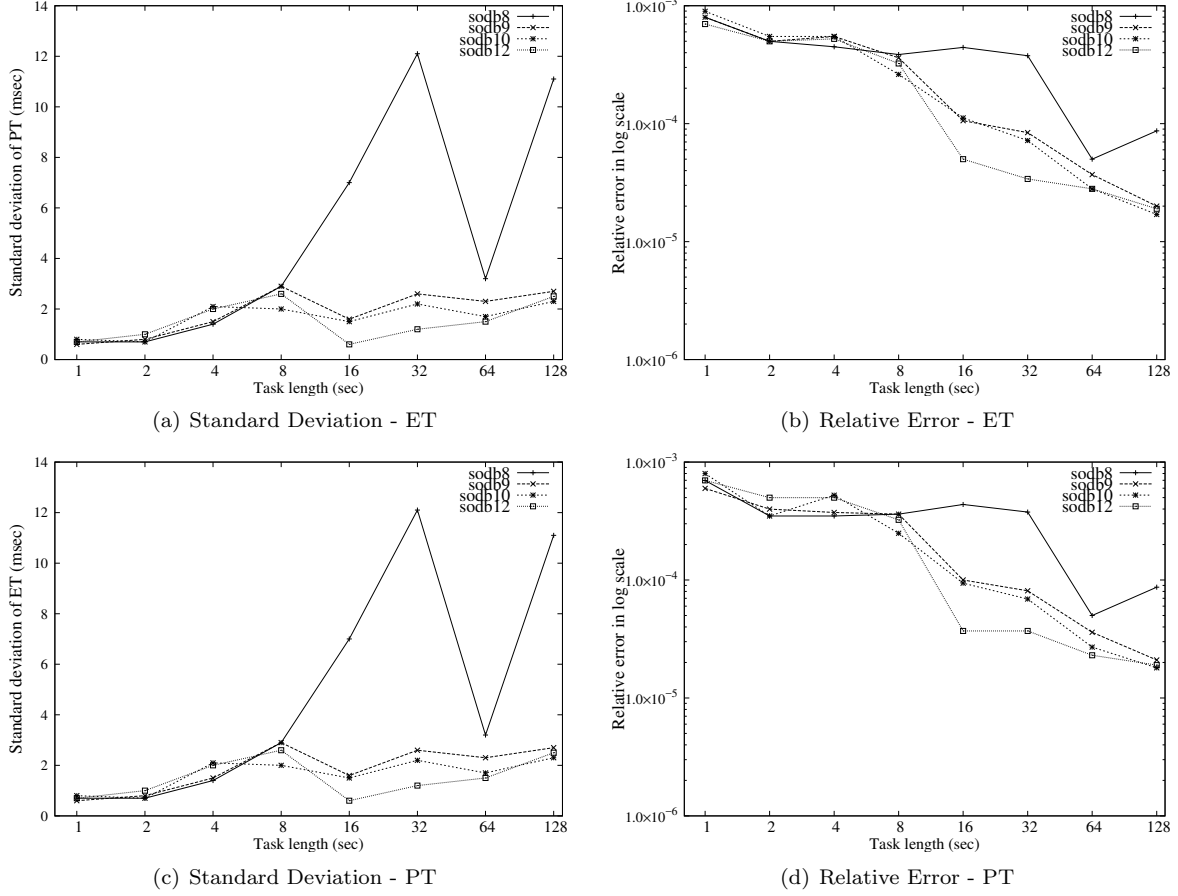

(a) Standard Deviation - ET

(b) Relative Error - ET

(c) Standard Deviation - PT

(d) Relative Error - PT

Figure 1: Measurement Quality Comparison among Different SoDB Machines

Each of the following sections exhibits histograms of ET and PT over increasing INC's task lengths on each individual node.

2.1 `sodb8`

This section exhibits histograms on the EMPv5 data obtained on `sodb8`. The detailed description of the base data are from Table 1.
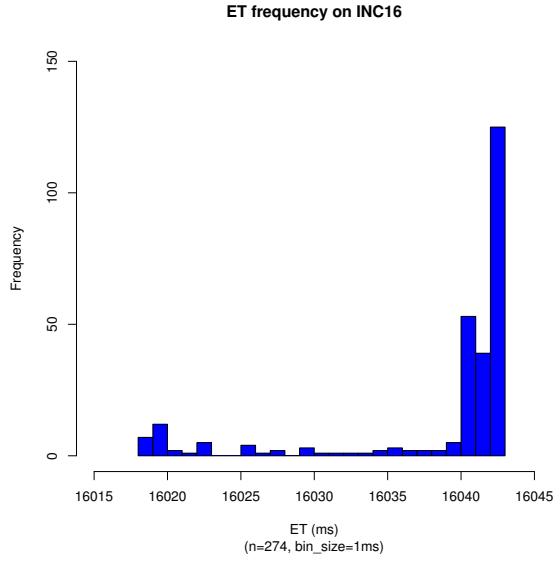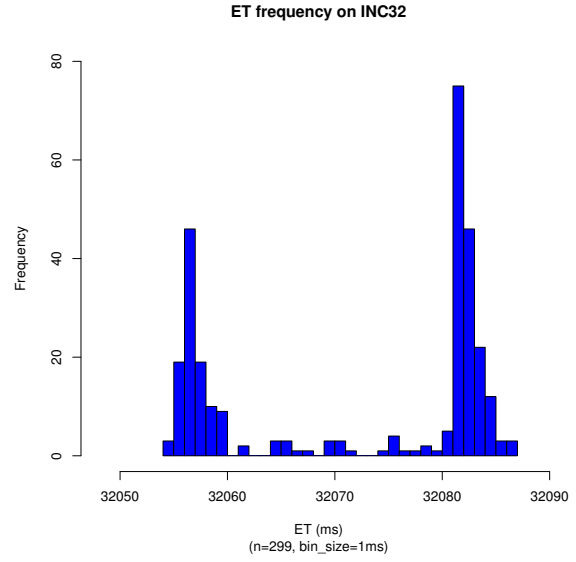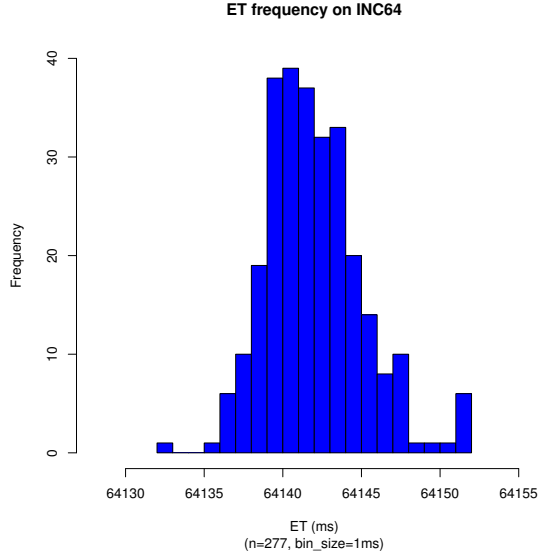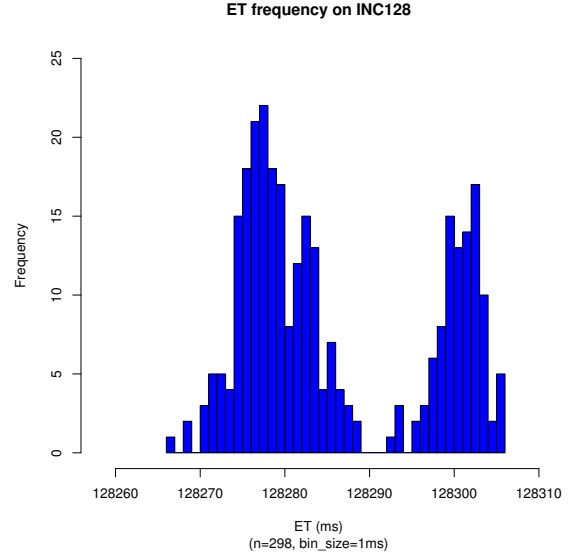
2.1.1 ET

(a) ET frequency on INC1 on `sodb8`

(b) ET frequency on INC2 on `sodb8`

(c) ET frequency on INC4 on `sodb8`

(d) ET frequency on INC8 on `sodb8`
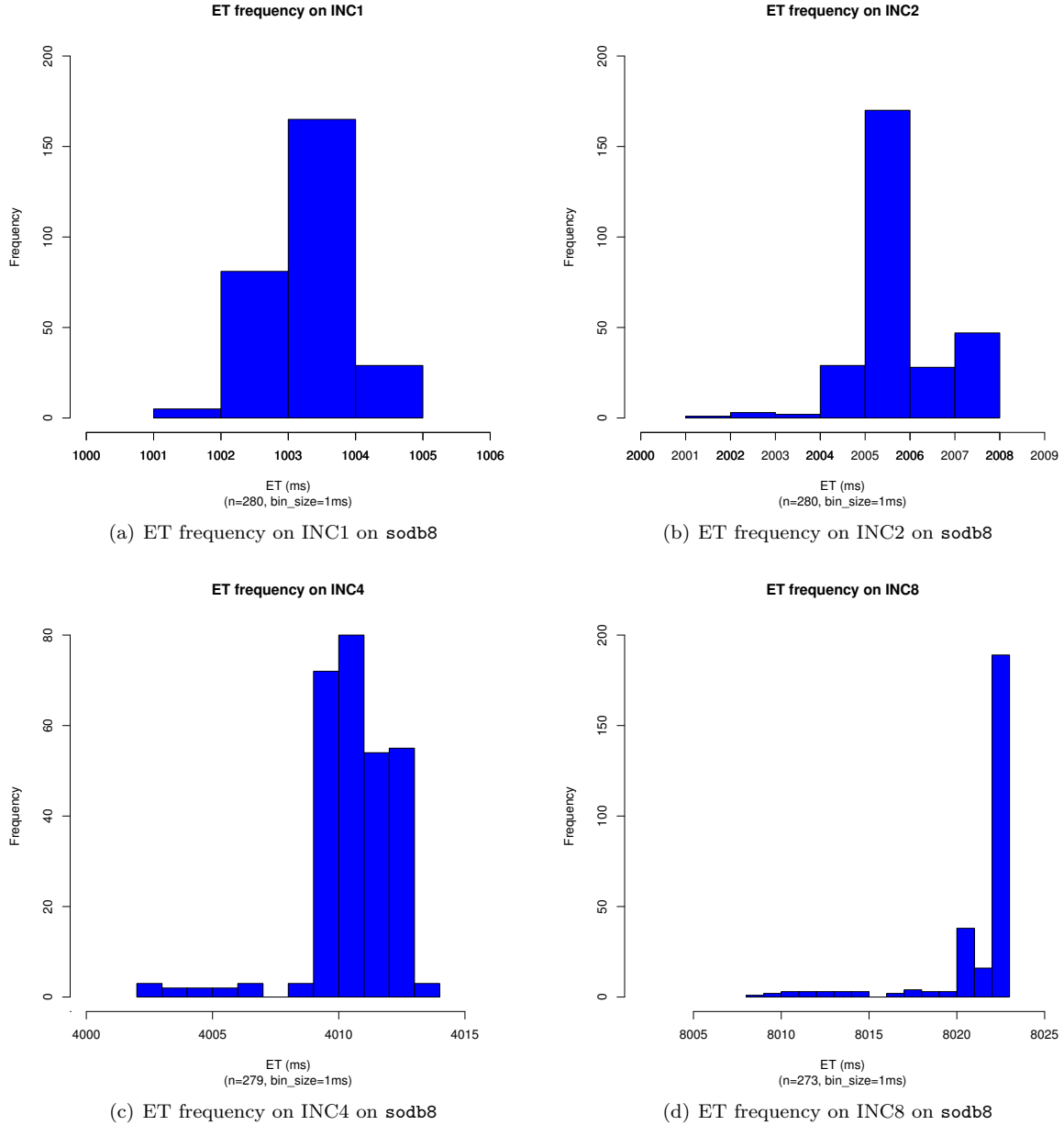
Figure 2: ET Histograms of INC1 ... INC8

(a) ET frequency on INC16 on `sodb8`

(b) ET frequency on INC32 on `sodb8`

(c) ET frequency on INC64 on `sodb8`

(d) ET frequency on INC128 on `sodb8`

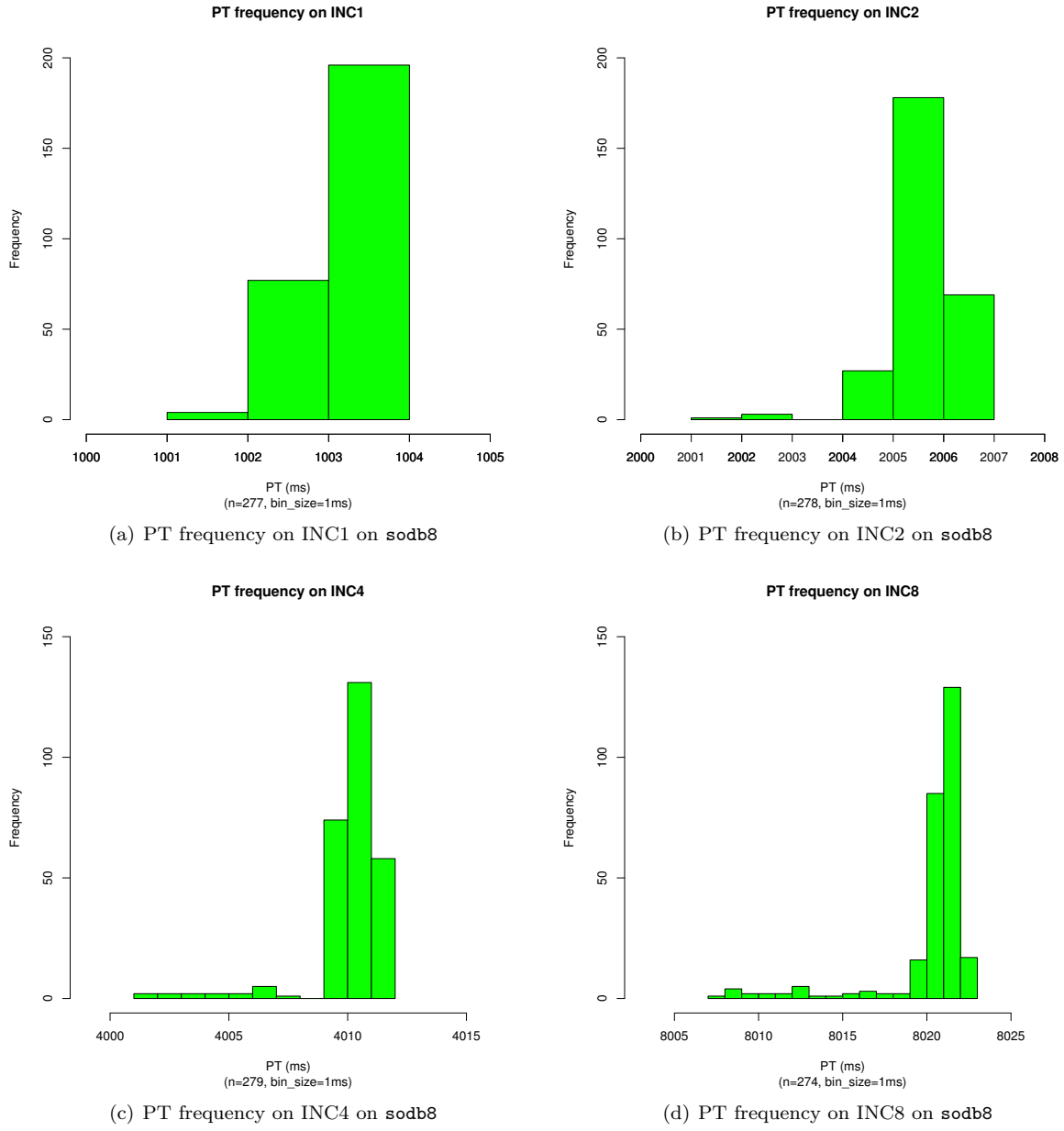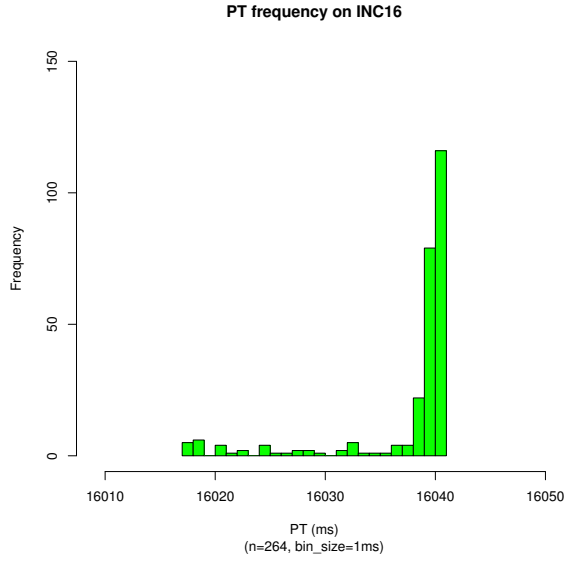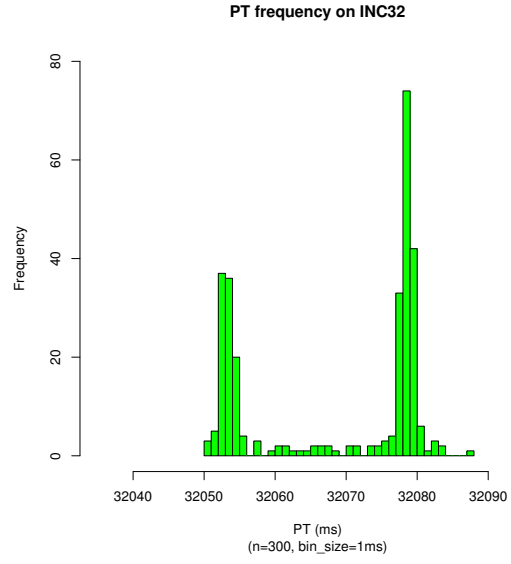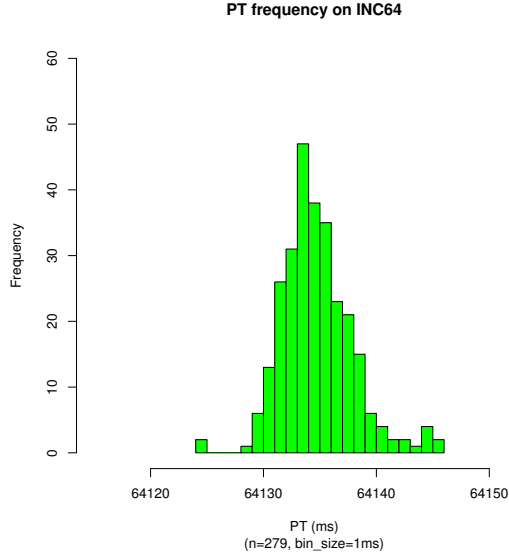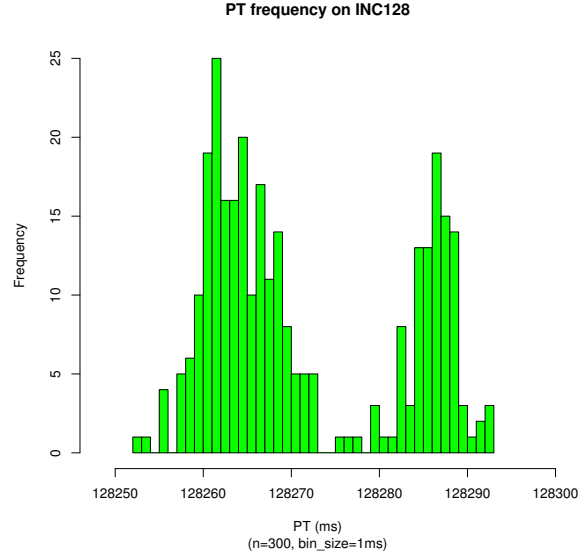Figure 3: ET Histograms of INC16 ... INC128

2.1.2   PT

PT frequency on INC1

(a) PT frequency on INC1 on `sodb8`

PT frequency on INC2

(b) PT frequency on INC2 on `sodb8`

PT frequency on INC4

(c) PT frequency on INC4 on `sodb8`

PT frequency on INC8

(d) PT frequency on INC8 on `sodb8`

Figure 4: PT Histograms of INC1 ... INC8

(a) PT frequency on INC16 on sodb8

(b) PT frequency on INC32 on sodb8

(c) PT frequency on INC64 on sodb8

(d) PT frequency on INC128 on sodb8

Figure 5: PT Histograms of INC16 ... INC64

2.2 `sodb9`

This section exhibits histograms on the EMPv5 data obtained on `sodb9`. The detailed description of the base data are from Table 1.
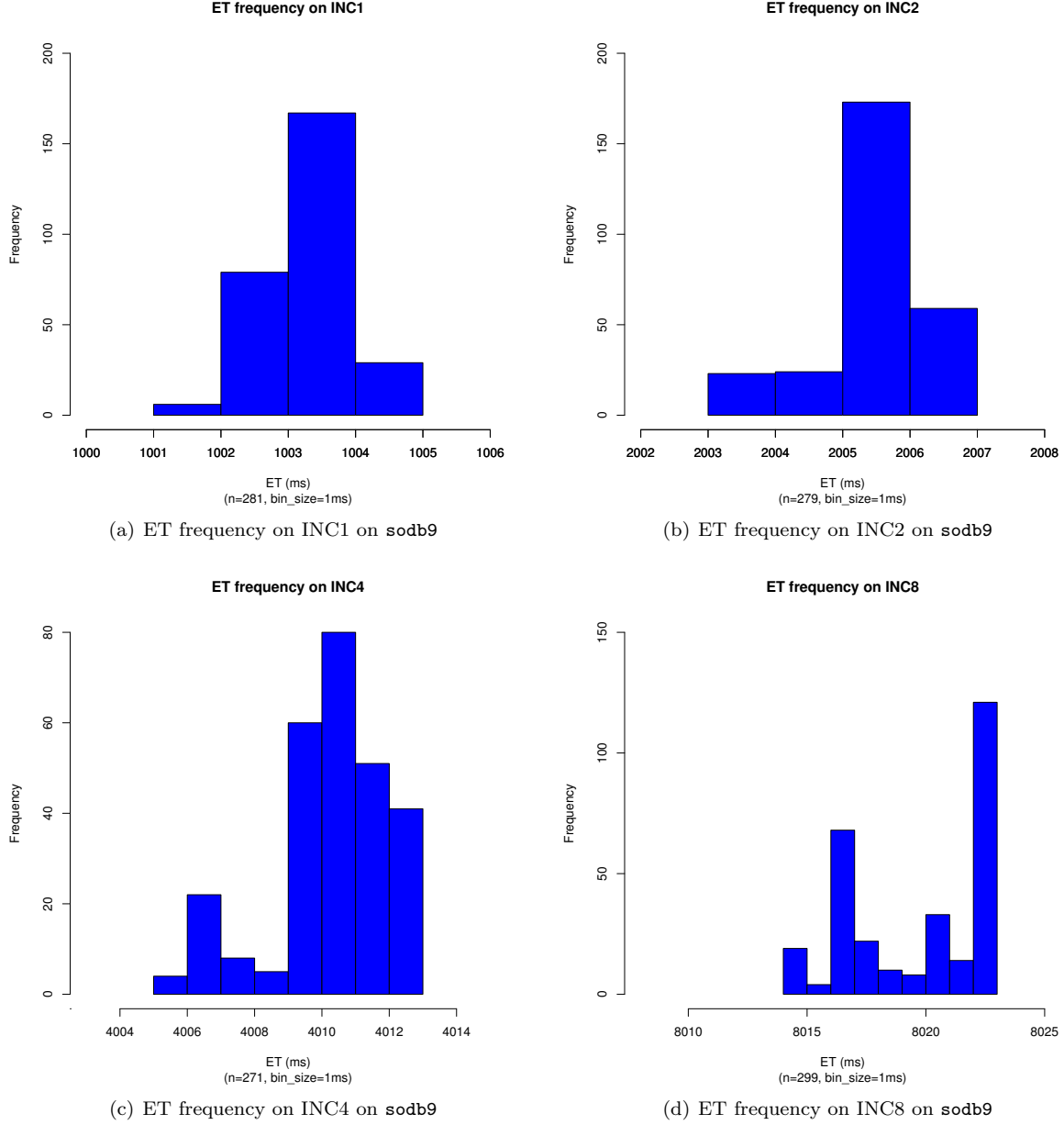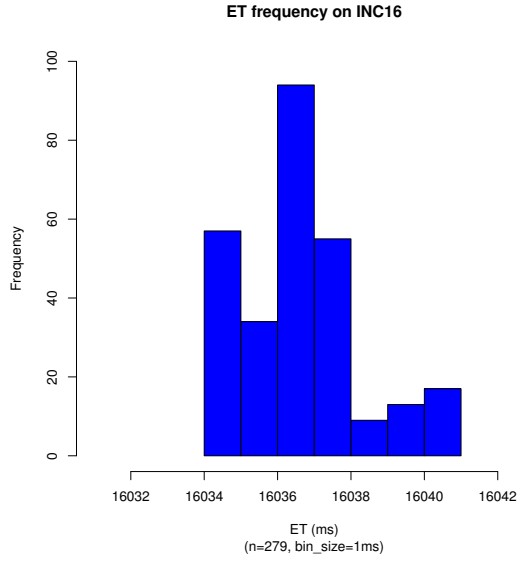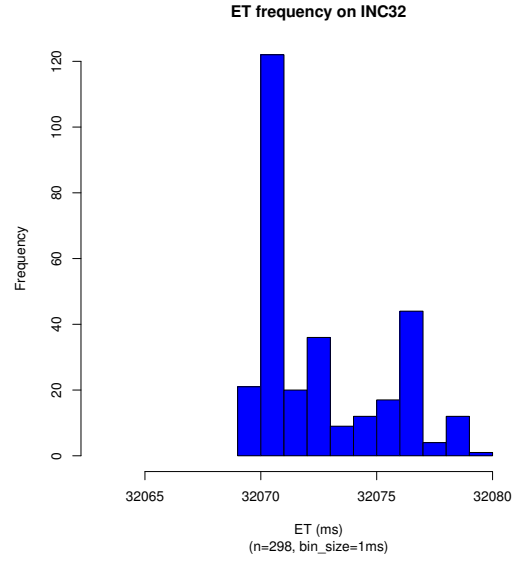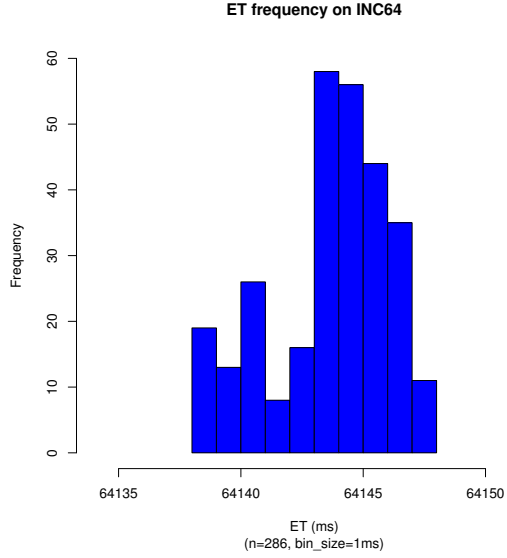
2.2.1 ET

(a) ET frequency on INC1 on `sodb9`

(b) ET frequency on INC2 on `sodb9`

(c) ET frequency on INC4 on `sodb9`

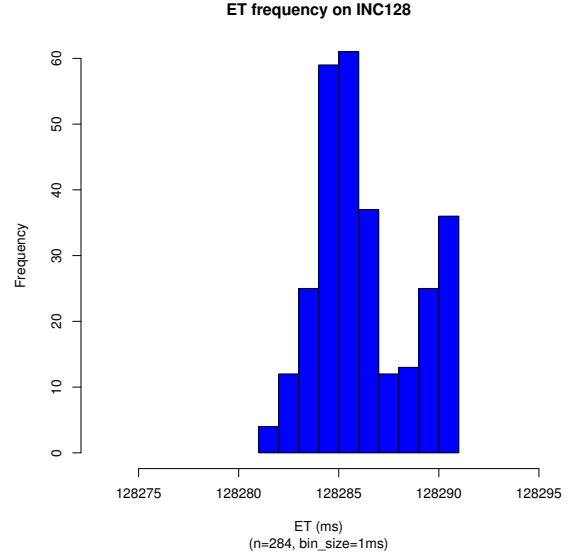(d) ET frequency on INC8 on `sodb9`

Figure 6: ET Histograms of INC1 ... INC8

(a) ET frequency on INC16 on sodb9

(b) ET frequency on INC32 on sodb9

(c) ET frequency on INC64 on sodb9

(d) ET frequency on INC128 on sodb9

Figure 7: ET Histograms of INC16 ... INC128

2.2.2 PT

PT frequency on INC1

PT frequency on INC2

(a) PT frequency on INC1 on `sodb9`

(b) PT frequency on INC2 on `sodb9`

PT frequency on INC4

PT frequency on INC8

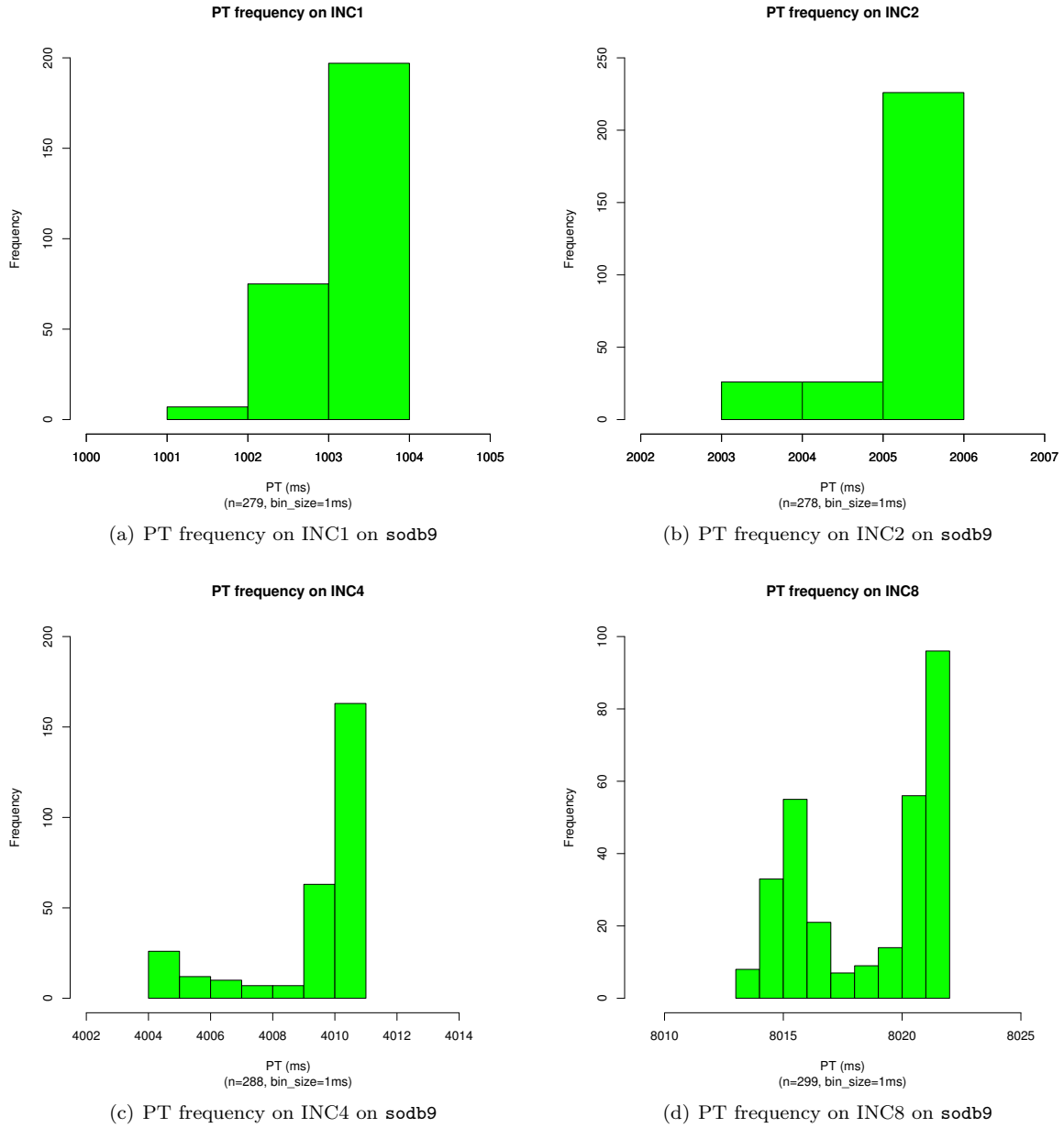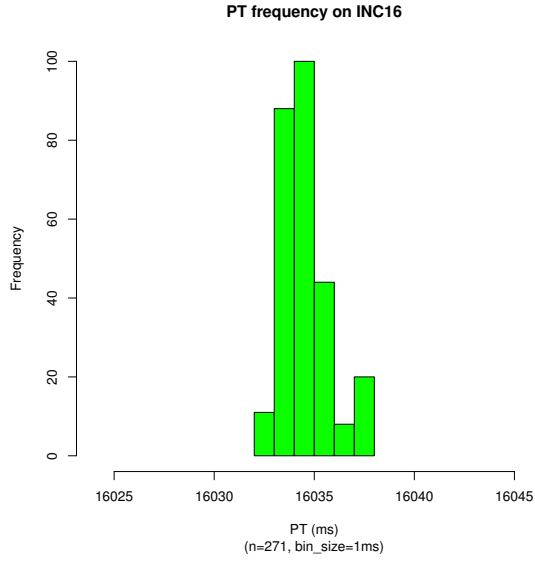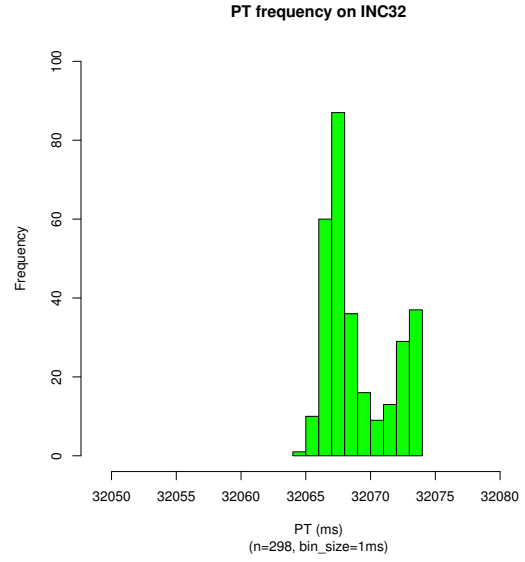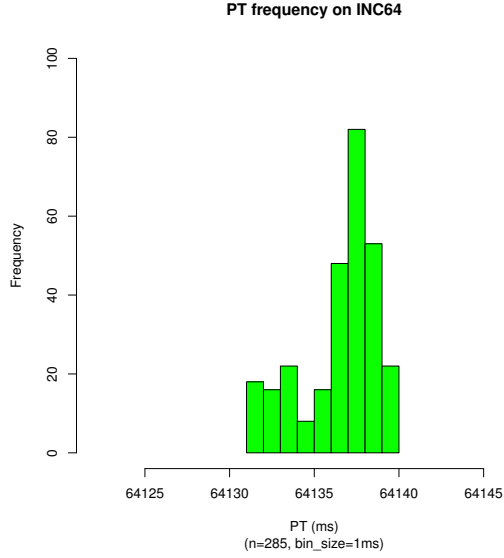(c) PT frequency on INC4 on `sodb9`

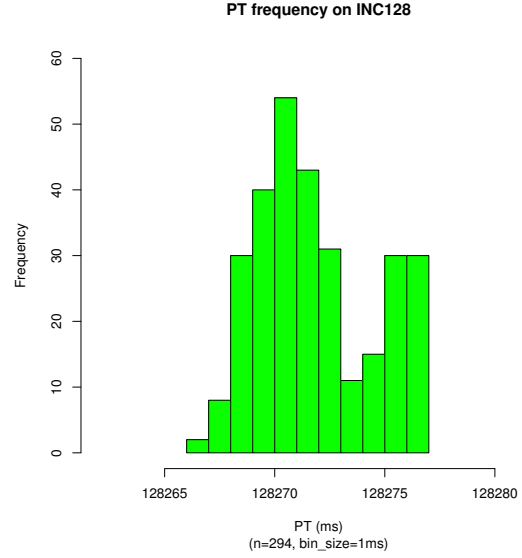(d) PT frequency on INC8 on `sodb9`

Figure 8: PT Histograms of INC1 ... INC8

(a) PT frequency on INC16 on sodb9

(b) PT frequency on INC32 on sodb9

(c) PT frequency on INC64 on sodb9

(d) PT frequency on INC128 on sodb9

Figure 9: PT Histograms of INC16 ... INC64

2.3 `sodb10`

This section exhibits histograms on the EMPv5 data obtained on `sodb10`. The detailed description of the base data are from Table 1.

2.3.1 ET

(a) ET frequency on INC1 on `sodb10`

(b) ET frequency on INC2 on `sodb10`
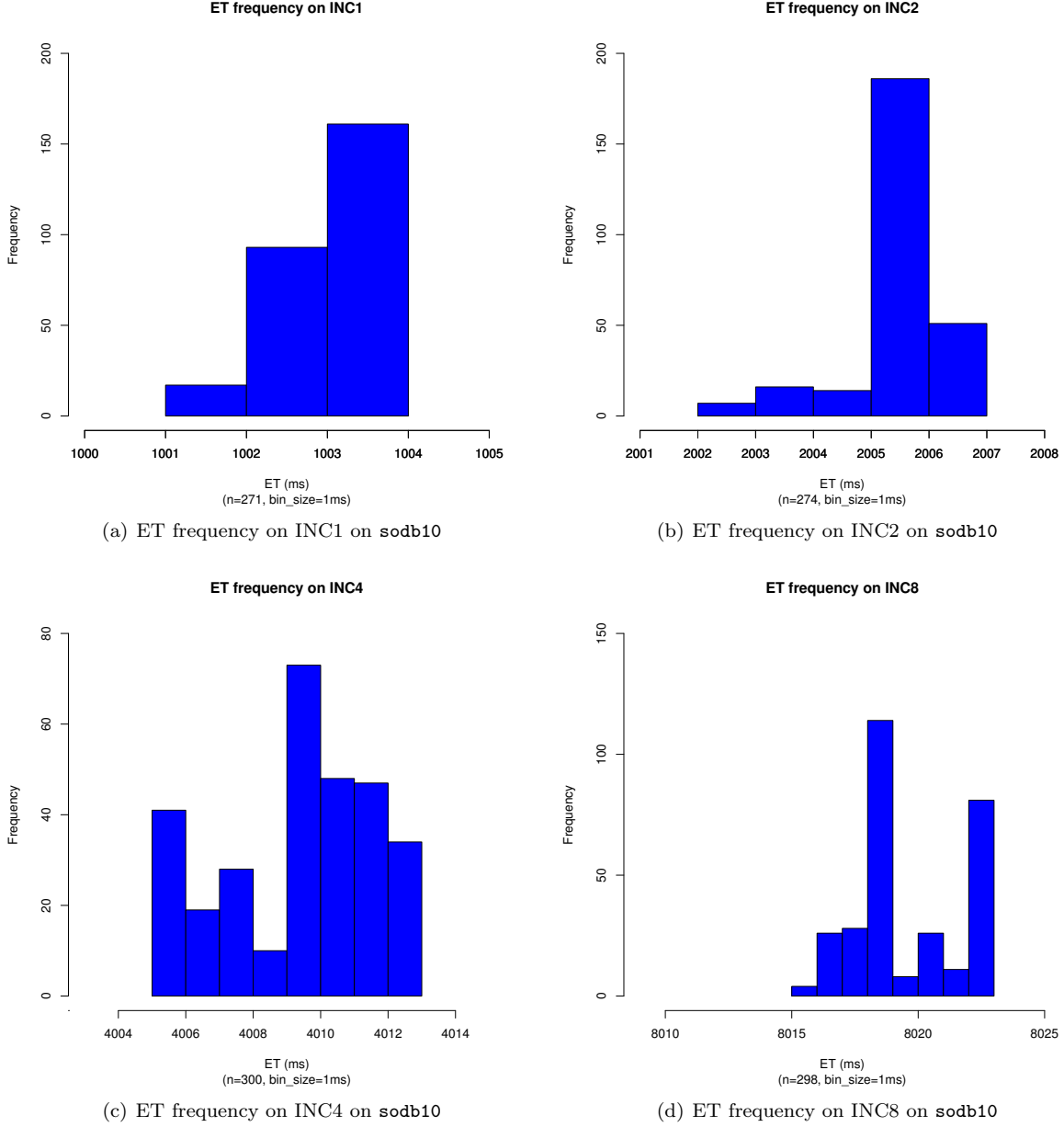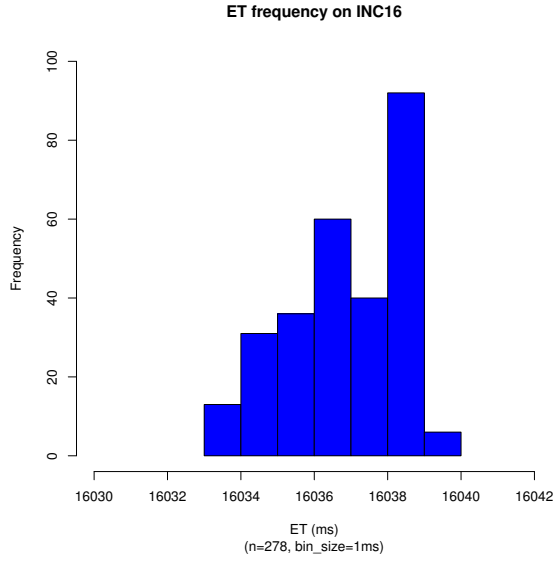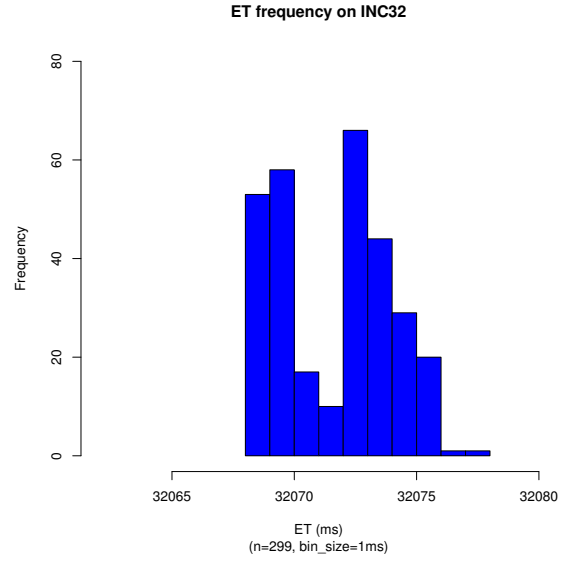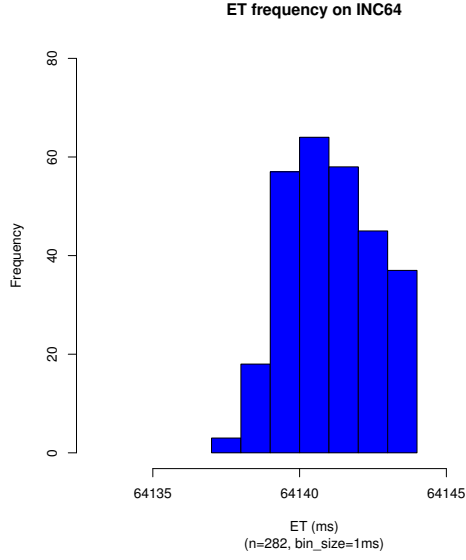

(c) ET frequency on INC4 on `sodb10`

(d) ET frequency on INC8 on `sodb10`

Figure 10: ET Histograms of INC1 ... INC8

(a) ET frequency on INC16 on `sodb10`

(b) ET frequency on INC32 on `sodb10`

(c) ET frequency on INC64 on `sodb10`

(d) ET frequency on INC128 on `sodb10`

Figure 11: ET Histograms of INC16 ... INC128

2.3.2 PT

PT frequency on INC1

(a) PT frequency on INC1 on `sodb10`

PT frequency on INC2

(b) PT frequency on INC2 on `sodb10`

PT frequency on INC4

(c) PT frequency on INC4 on `sodb10`

PT frequency on INC8

(d) PT frequency on INC8 on `sodb10`

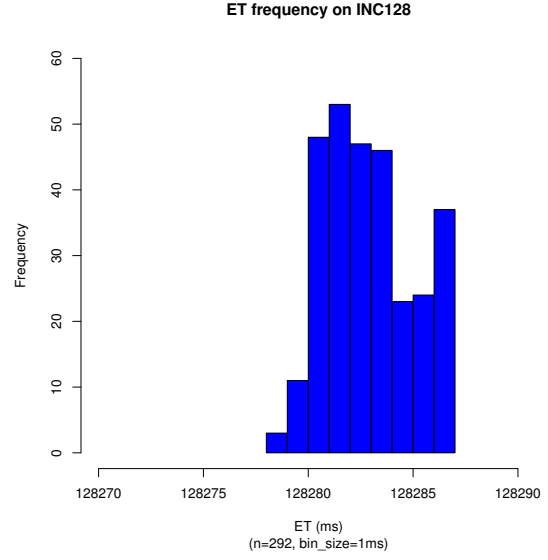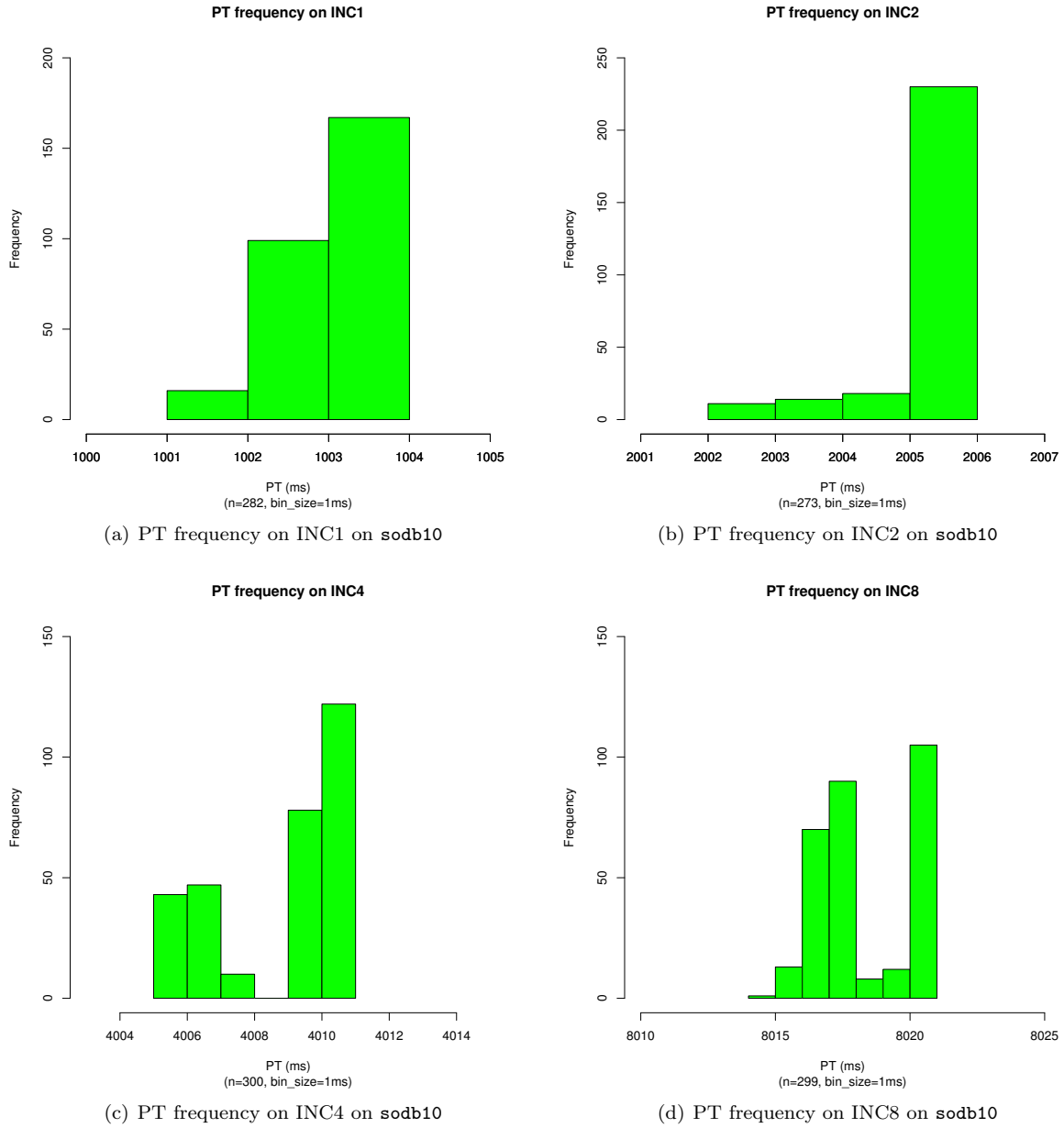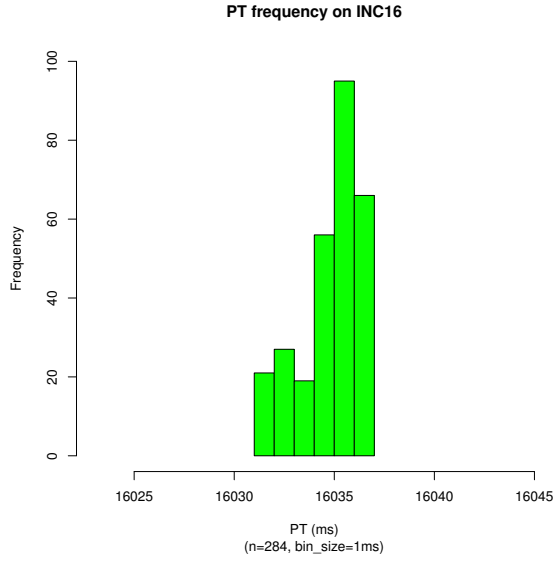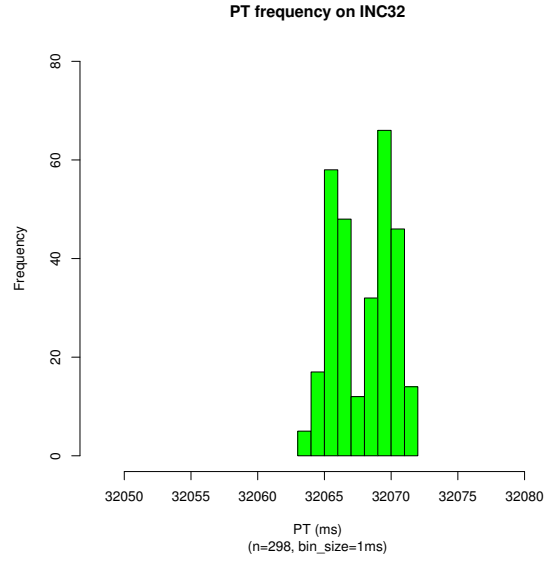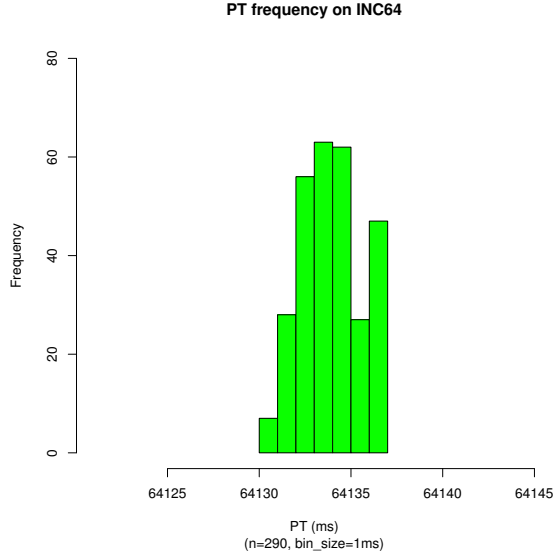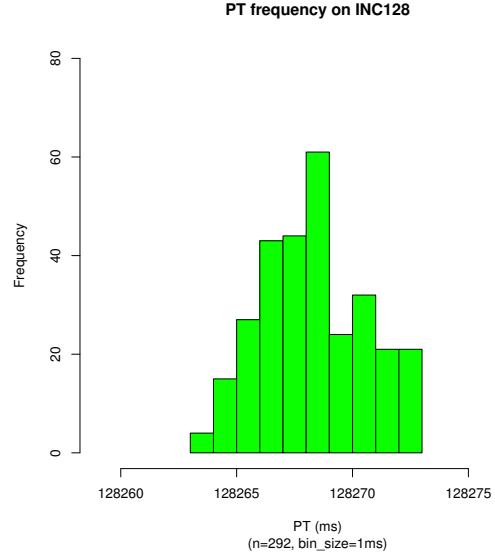Figure 12: PT Histograms of INC1 ... INC8

(a) PT frequency on INC16 on `sodb10`

(b) PT frequency on INC32 on `sodb10`

(c) PT frequency on INC64 on `sodb10`

(d) PT frequency on INC128 on `sodb10`

Figure 13: PT Histograms of INC16 ... INC64

2.4   `sodb12`

This section exhibits histograms on the EMPv5 data obtained on `sodb12`. The detailed description of the base data are from Table 1.

2.4.1   ET

(a) ET frequency on INC1 on `sodb12`

(b) ET frequency on INC2 on `sodb12`
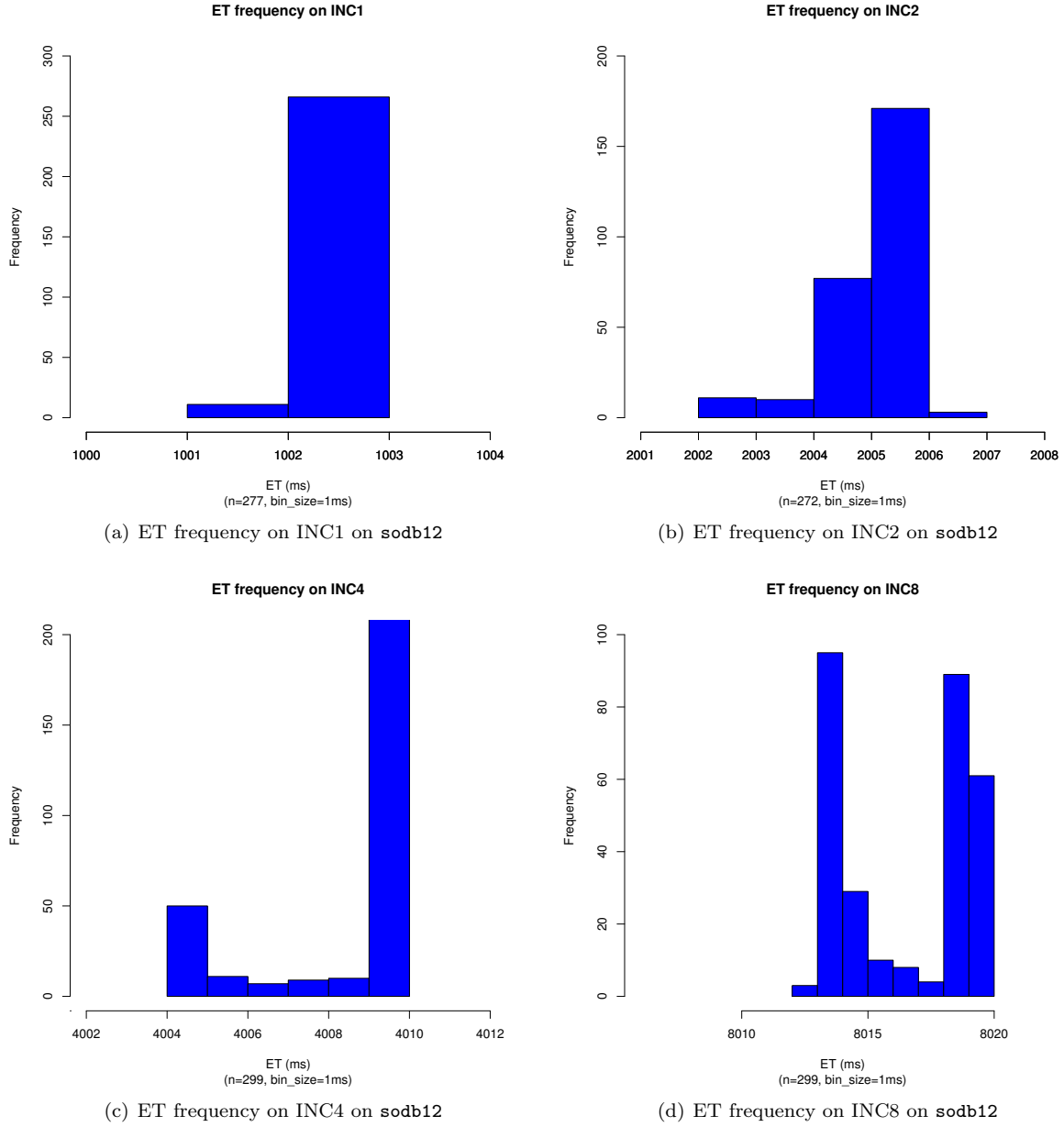
(c) ET frequency on INC4 on `sodb12`

(d) ET frequency on INC8 on `sodb12`

Figure 14: ET Histograms of INC1 ... INC8

ET frequency on INC16

ET frequency on INC32

(a) ET frequency on INC16 on `sodb12`

(b) ET frequency on INC32 on `sodb12`

ET frequency on INC64

ET frequency on INC128

(c) ET frequency on INC64 on `sodb12`

(d) ET frequency on INC128 on `sodb12`

Figure 15: ET Histograms of INC16 ... INC128

2.4.2 PT

PT frequency on INC1

(a) PT frequency on INC1 on `sodb12`

PT frequency on INC2

(b) PT frequency on INC2 on `sodb12`

PT frequency on INC4

(c) PT frequency on INC4 on `sodb12`

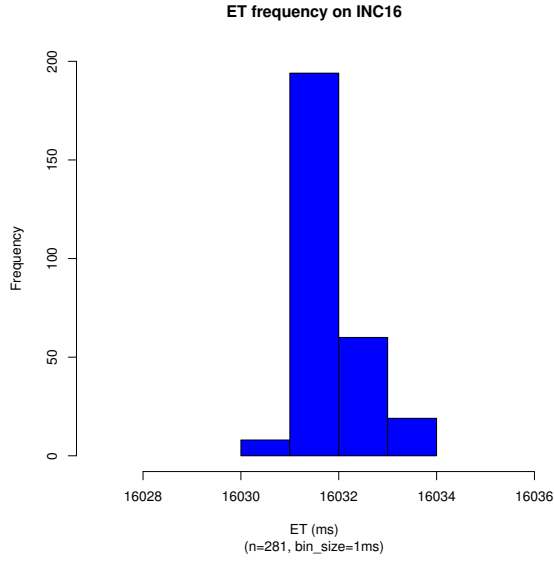**PT frequency on INC8**
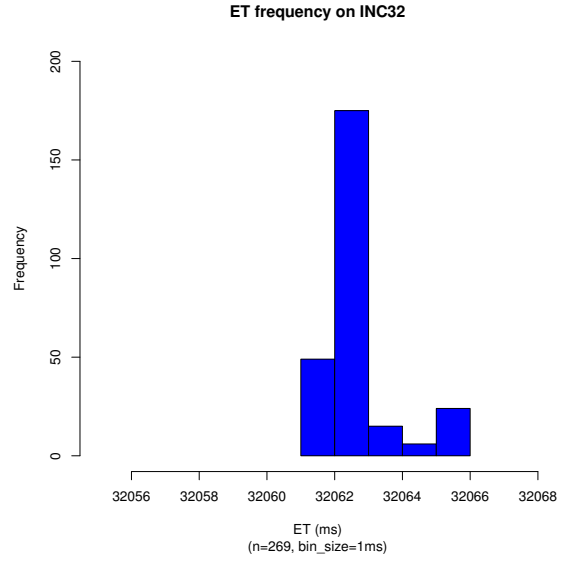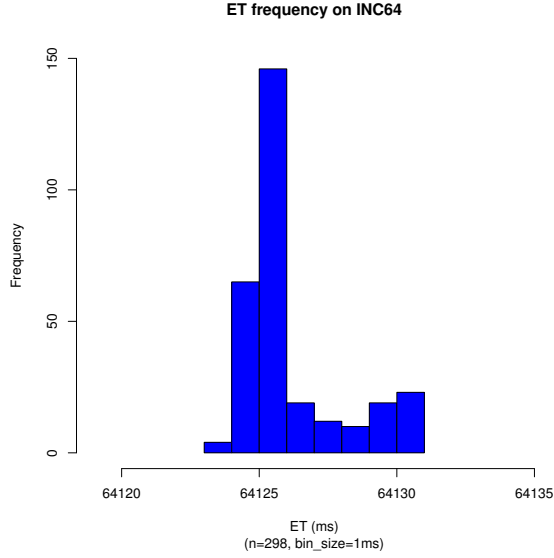

(d) PT frequency on INC8 on `sodb12`

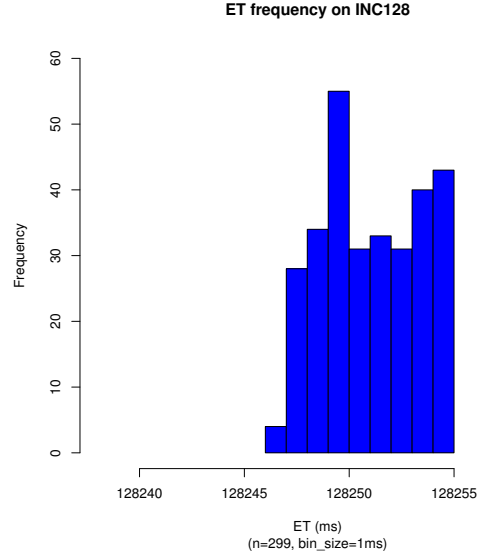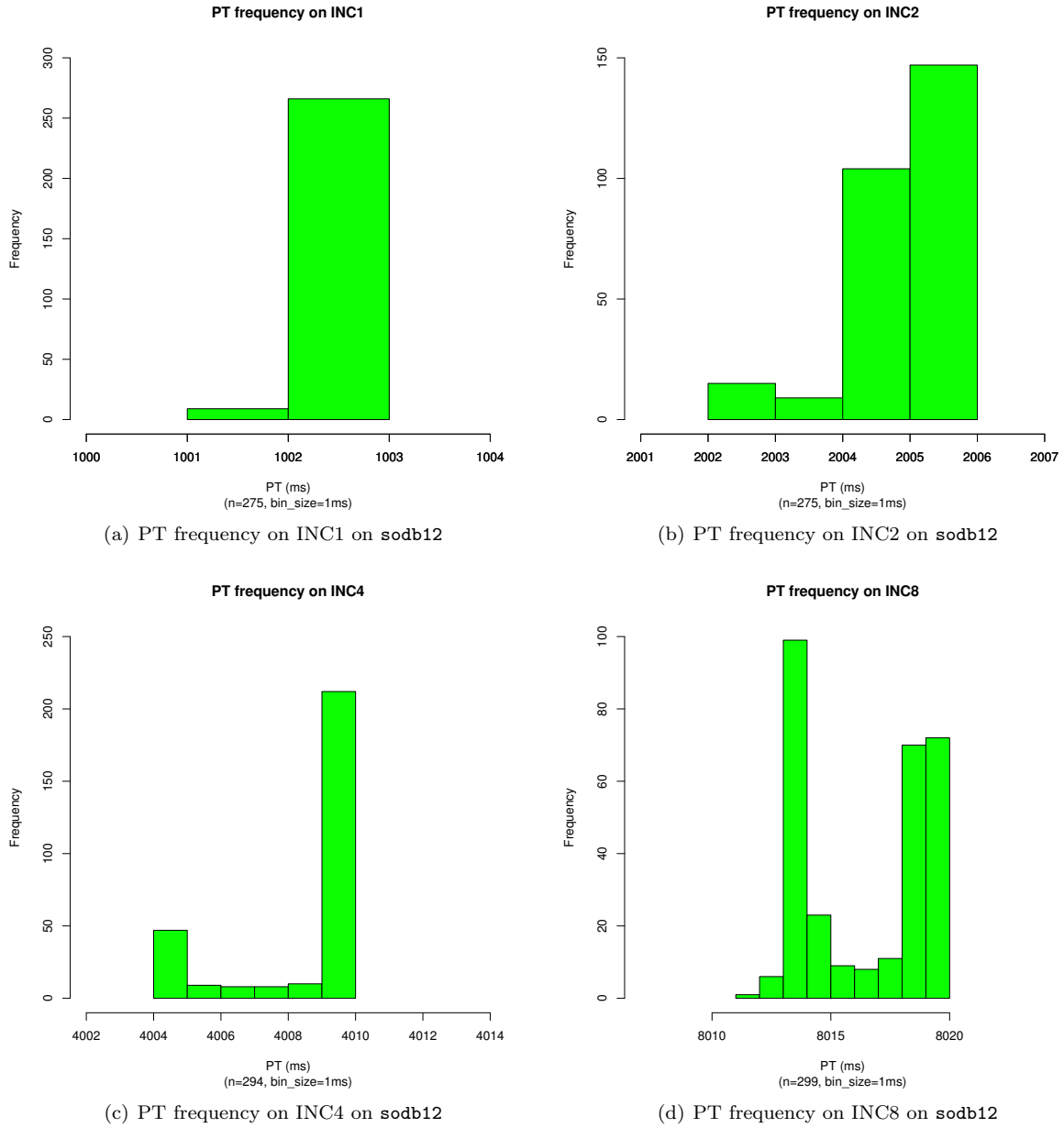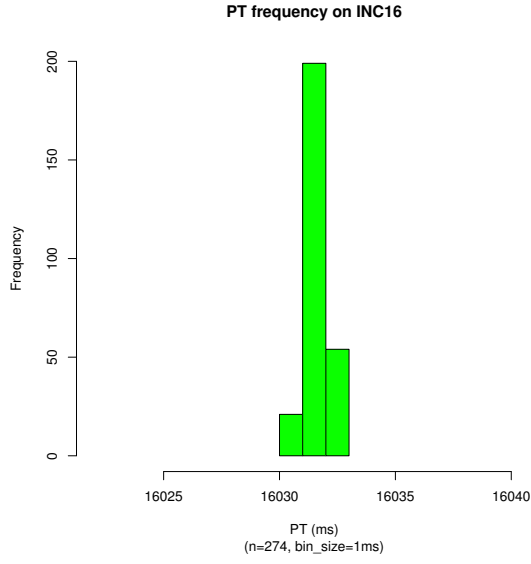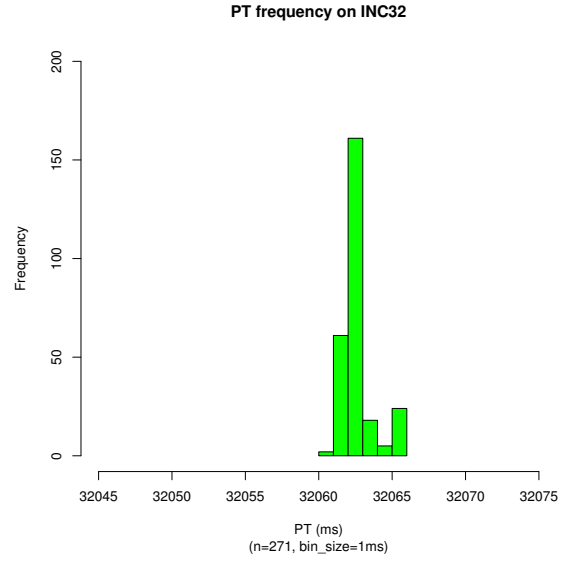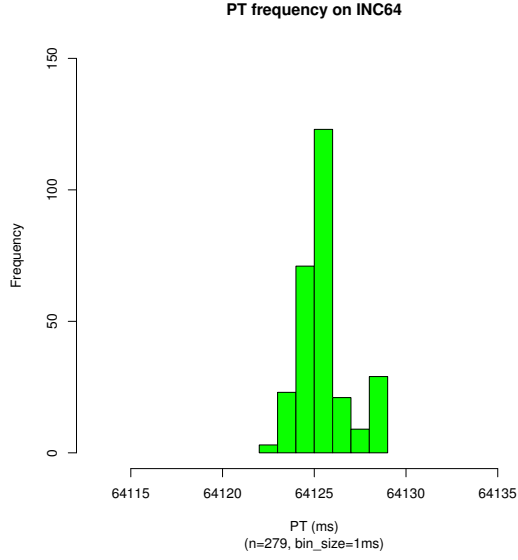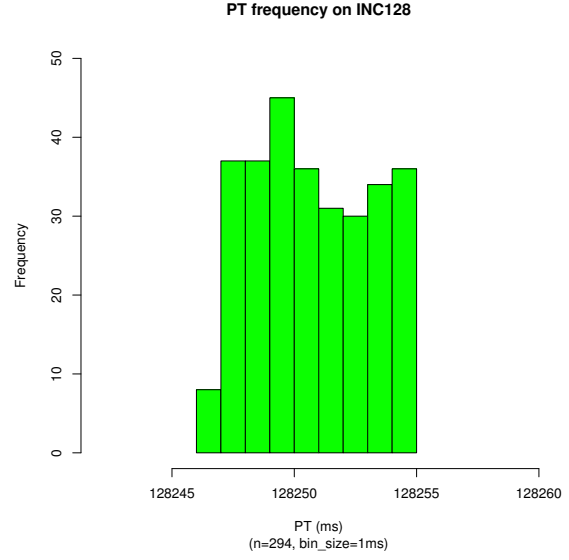Figure 16: PT Histograms of INC1 ... INC8

(a) PT frequency on INC16 on `sodb12`

(b) PT frequency on INC32 on `sodb12`

(c) PT frequency on INC64 on `sodb12`

(d) PT frequency on INC128 on `sodb12`

Figure 17: PT Histograms of INC16 ... INC64

3   Post Experiments

We provide a short description of newer experimental runs.

Experimental Notes: In the experiments we also used four nodes (`sodb8`, `sodb9`, `sodb10`, and `sodb12`) in the same cluster. A short summary of the experiments is shown in Table 2.

Machine	Task Length	Description	Time Length
`sodb8` (plugged into *upper right* power strip)	INC16, INC13, and INC17.2	Runs of 1,000 samples	2018-03-17 ∼2018-03-18
`sodb9` (plugged into *the upper left* power strip)	IINC16, INC13, and INC17.2	Runs of 1,000 samples	2018-03-17 ∼2018-03-18
`sodb10` (plugged into *the upper left* power strip)	INC16, INC13, and INC17.2	Runs of 1,000 samples	2018-03-17 ∼2018-03-18
`sodb12` (plugged into *the upper right* power strip)	INC16, INC13, and INC17.2	Runs of 1,000 samples	2018-03-17 ∼2018-03-18

Table 2: Detailed description of INC data used for histograms

3.1   Inter-Machine Homogeneity

In this section we check if the use of different machines affects the distribution of execution (process) times on the same program. In other words, we examine *inter-machine repeatability*. For this examination, we use a nested for loop program, here termed INC, with different task lengths: 16 seconds, 13 seconds, and 17.2 seconds, each termed *INC16*, *INC13*, and *INC17.2*, respectively.

Figures 18, 19, and 20 display the process time (PT) histograms on INC16, INC13, and INC17.2 run on our machines (from `sodb8` to `sodb12`), respectively. Based on these figures, we conclude that we should stick to one machine for consistency, and `sodb9` should be chosen in a sense that the data measured there consistently reveals a distinct binormal pattern.
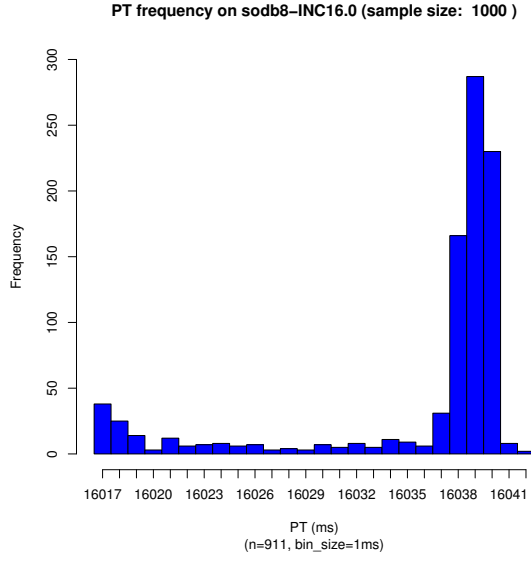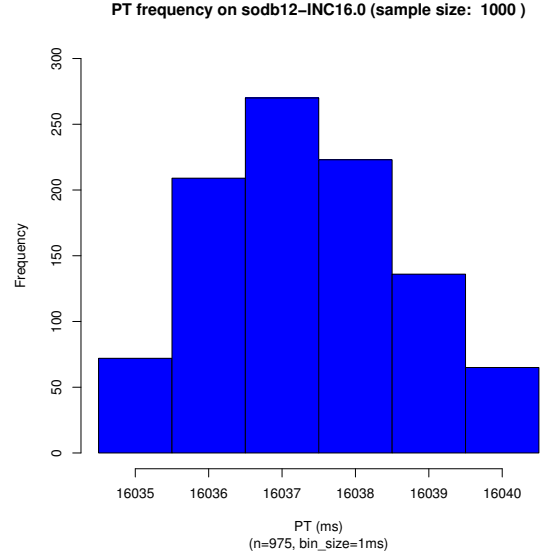
(a) PT frequency on INC16
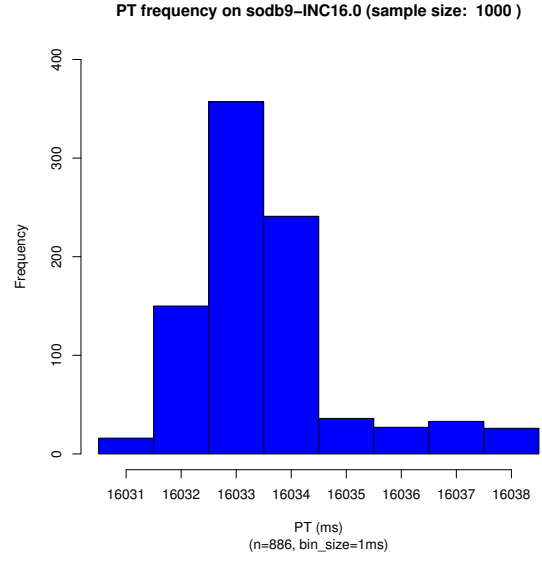
(b) PT frequency on INC16
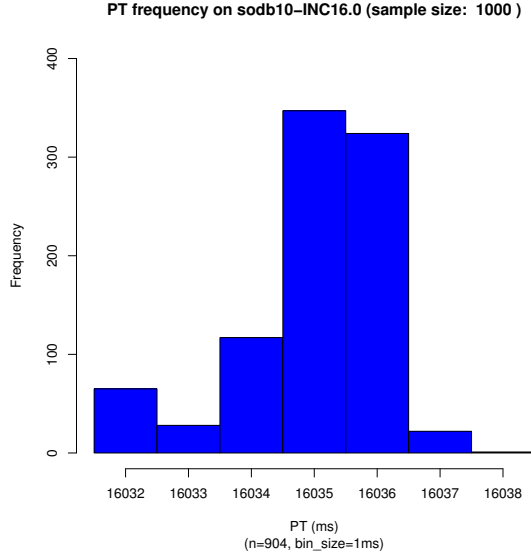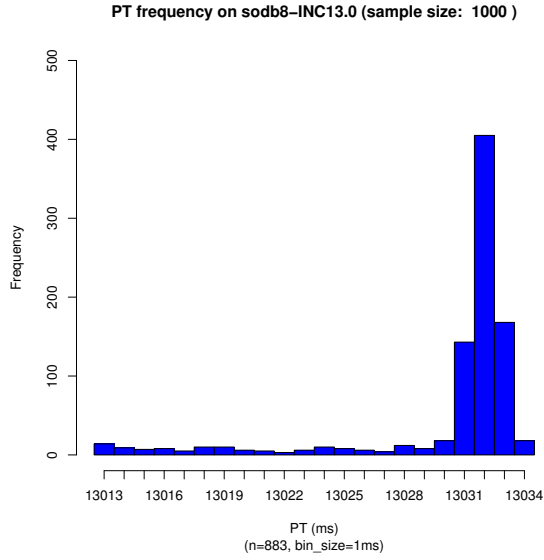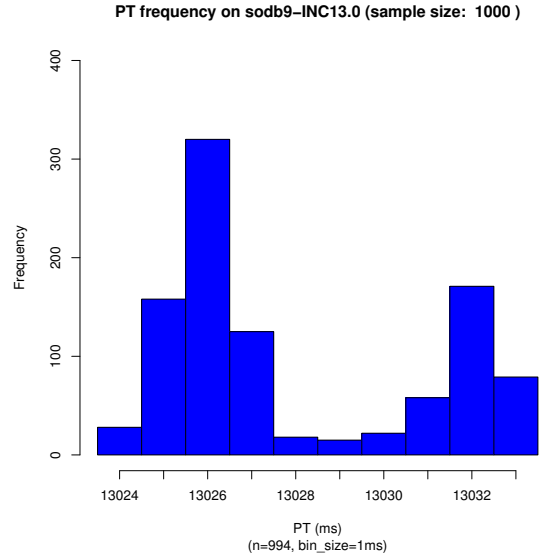
(c) PT frequency on INC16
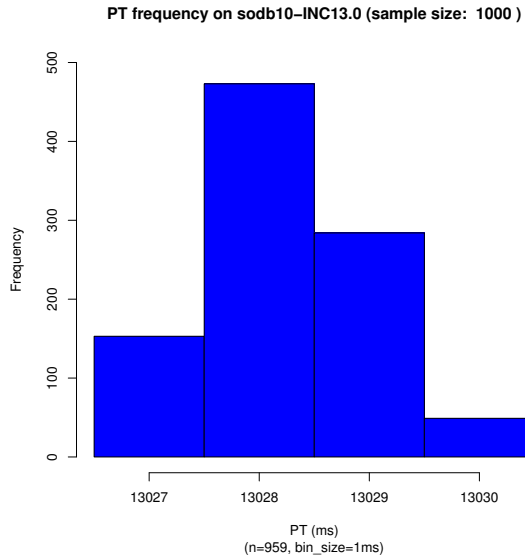
(d) PT frequency on INC16
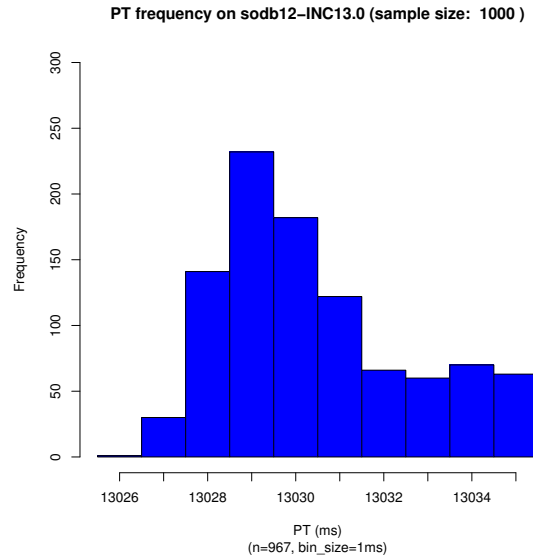
Figure 18: PT Histograms on INC16

(a) PT frequency on INC13

(b) PT frequency on INC13

(c) PT frequency on INC13

(d) PT frequency on INC13

Figure 19: PT Histograms on INC13
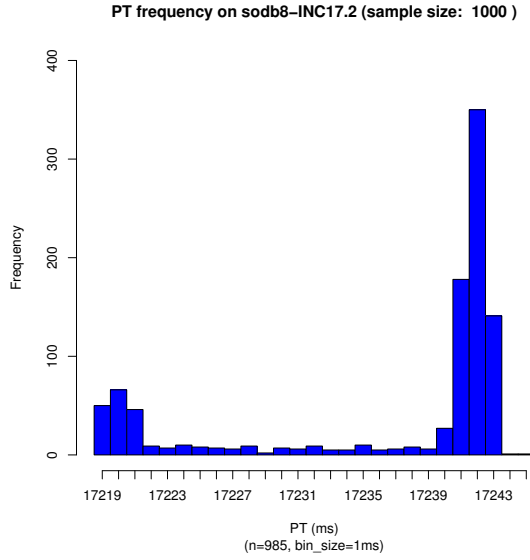
(a) PT frequency on INC17.2
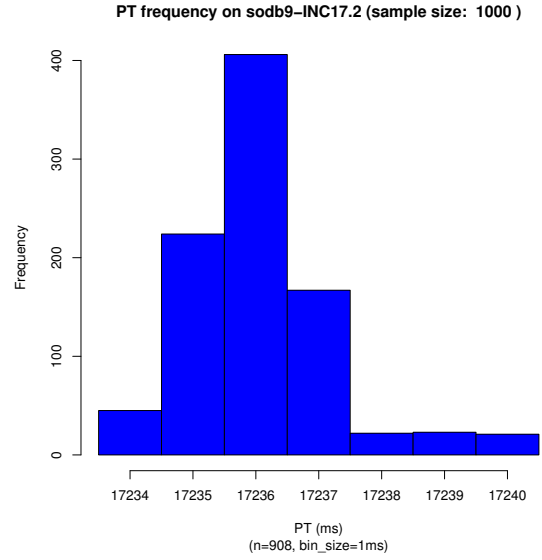
(b) PT frequency on INC17.2
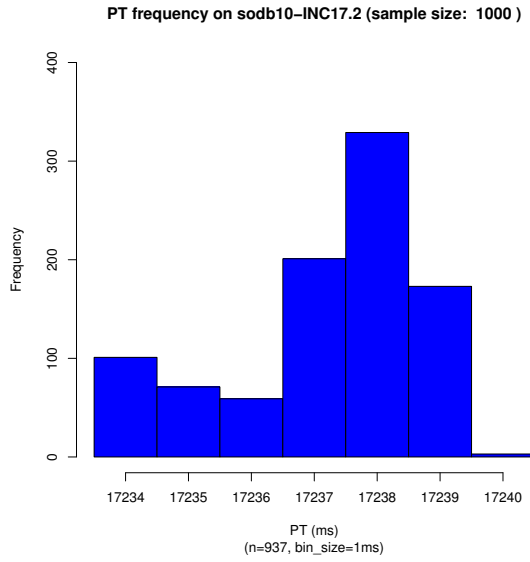
(c) PT frequency on INC17.2
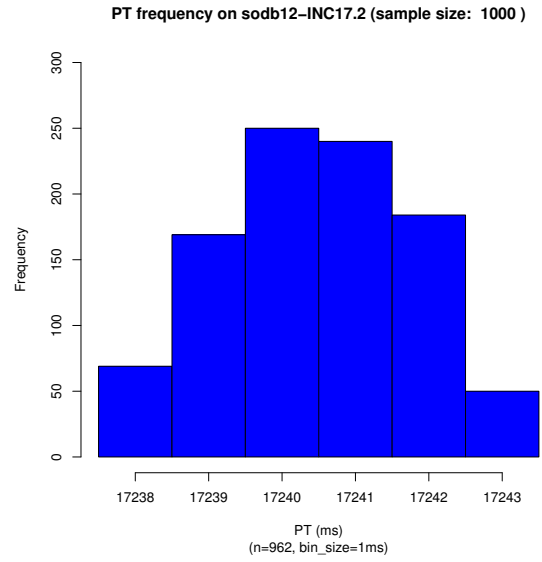
(d) PT frequency on INC17.2

Figure 20: PT Histograms on INC17.2

3.2 Intra-Machine Homogeneity

A short description of the runs we used for this experiment are exhibited in Table 3.

Machine	Task Length	Description	Time Length
sodb9 (plugged into *the upper left* power strip)	INC1∼INC128	Runs of 1,000 samples	2018-04-28 ∼2018-04-30

Table 3: Detailed description of INC data used for histograms

(a) PT frequency on INC1 on sodb9

(b) PT frequency on INC2 on sodb9

(c) PT frequency on INC4 on sodb9

(d) PT frequency on INC8 on sodb9
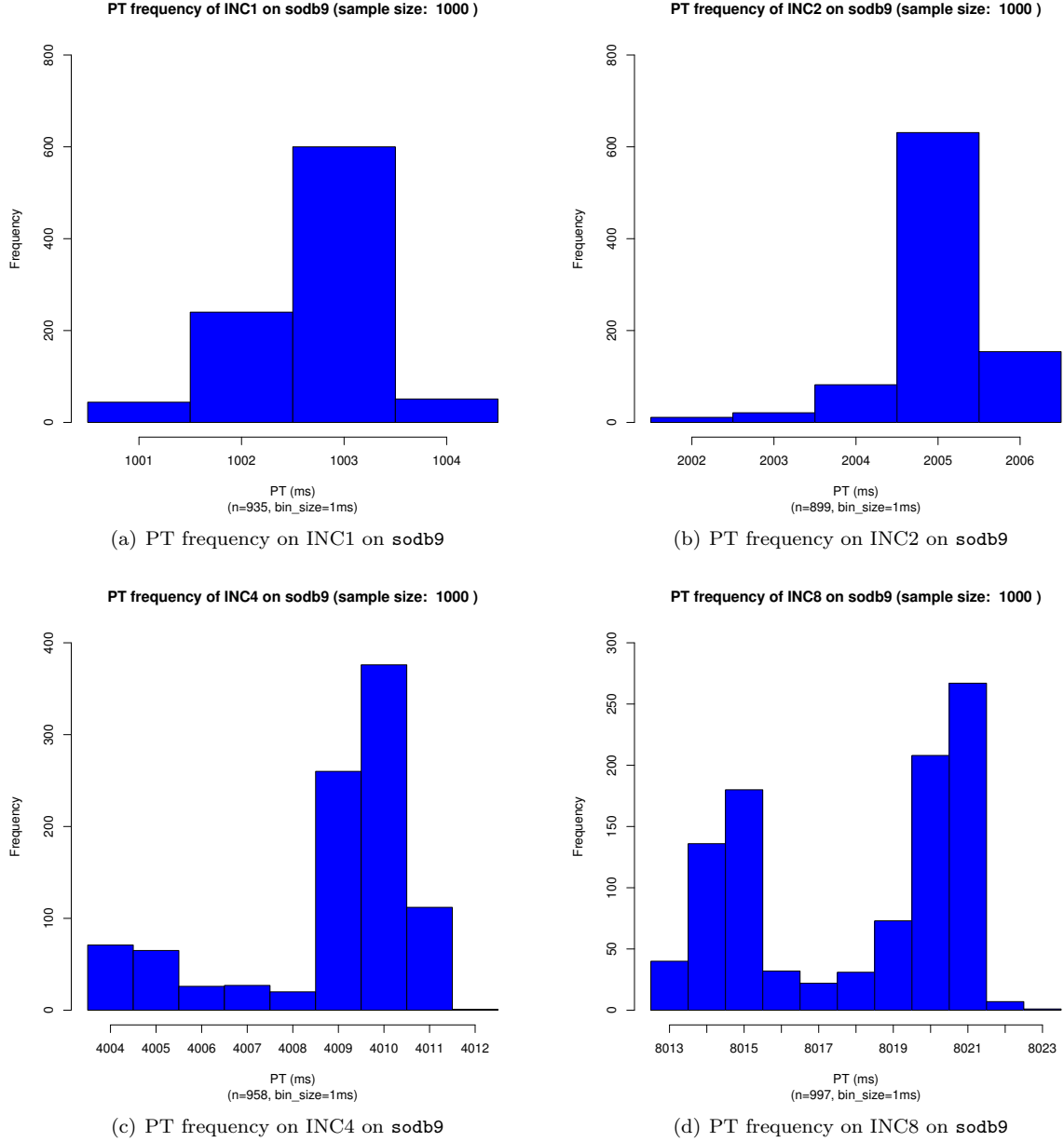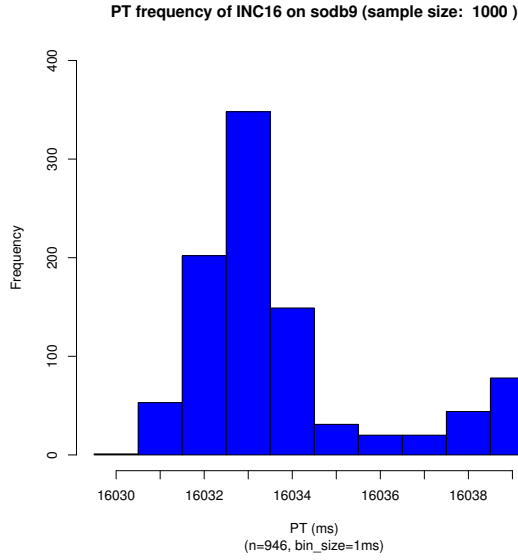
Figure 21: PT Histograms on INC1∼INC8

(a) PT frequency on INC16 on `sodb9`

(b) PT frequency on INC32 on `sodb9`

(c) PT frequency on INC64 on `sodb9`
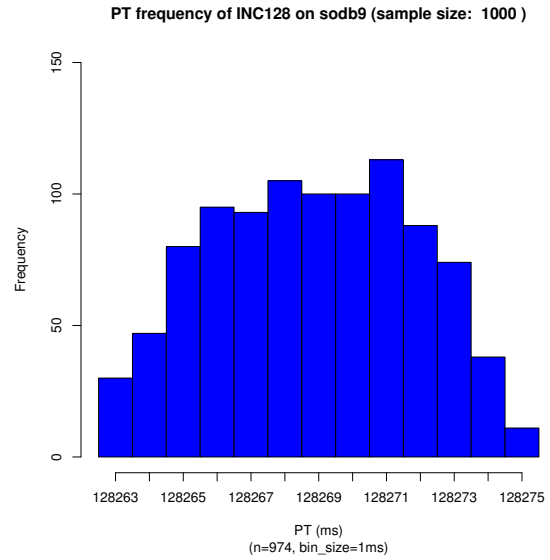
(d) PT frequency on INC128 on `sodb9`

Figure 22: PT Histograms on INC16∼INC128

3.3 Power Strip Influence

A short description of the runs we used for this experiment are exhibited in Table 4.

Machine	Task Length	Description	Time Length
sodb8 (plugged into *bottom left* power strip)	INC13	Runs of 1,000 samples	2018-03-17 ~2018-03-18
sodb8 (plugged into *the upper left* power strip)	INC13	Runs of 1,000 samples	2018-04-28 ~2018-04-30

Table 4: Detailed description of INC data used for histograms

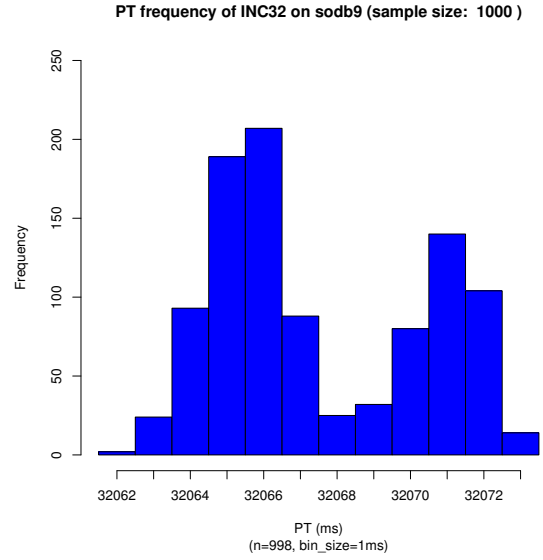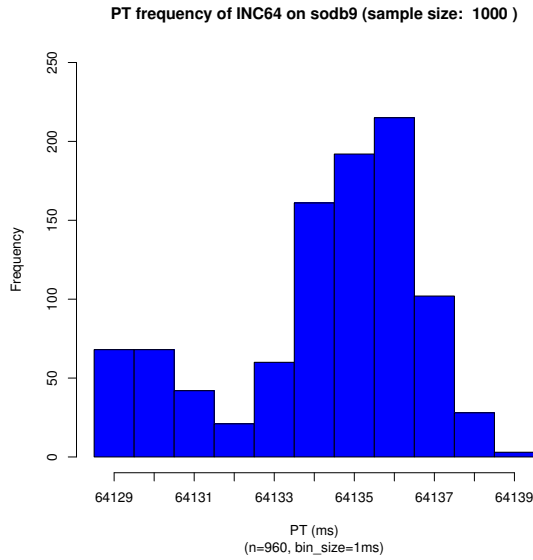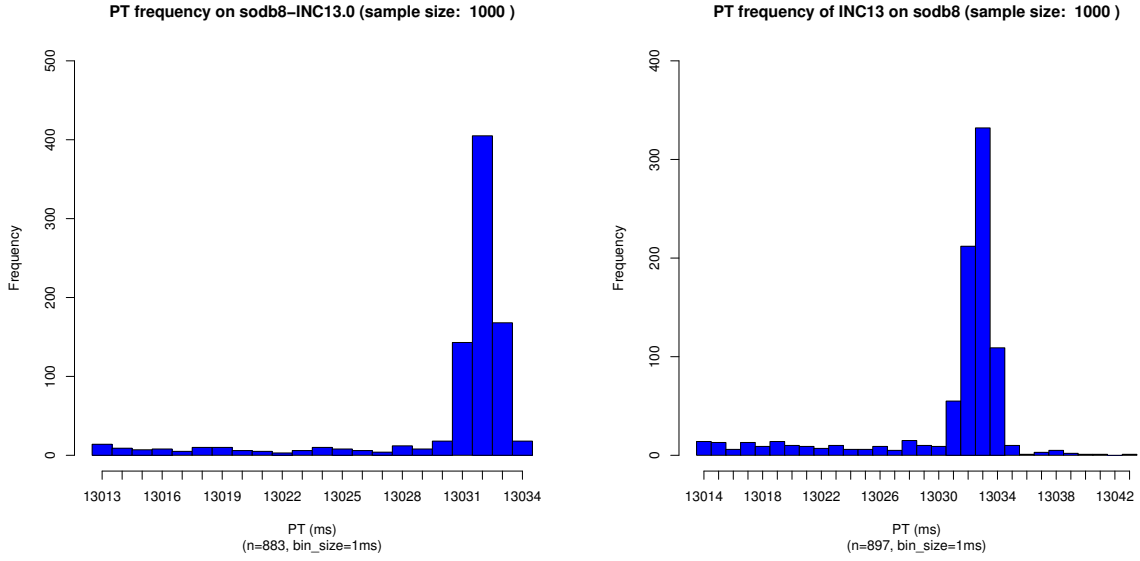(a) PT frequency on INC13 on sodb8 (plugged into *bottom left* power strip) (copied from Fig. 19(a))

(b) PT frequency on INC13 on sodb8 (plugged into *the upper left* power strip)

Figure 23: PT Histograms on INC13 on sodb8 Before and After Power Strip Relocation

3.4 Investigation of Daemons' Influence on Program Time Distribution Regarding Machine Dependence

For the same task length, or INC16, I examined in each of the four runs a few iterations at which more than three daemons (except INC and proc monitor processes) that had positive PT were captured. From Table 5, I suspect that PT distribution seems most likely to be affected by two facts: *how longer the same daemon ran than usual*, and *how many different daemon processes appeared and how long it ran.*

Machine Name	Iteration #	Process Name (id, PT(msec))
sodb8	174	java (2349, 15), java (2335, 2), md127_raid1 (457, 1), kslowd000 (166, 1), kslowd001 (167, 1)
	278	java (2877, 16), java (2335, 2), kslowd000 (166, 1), kslowd001 (167, 1)
	486	java (3190, 21), java (2335, 2), md127_raid1 (457, 1), kslowd000 (166, 1)
	526	md127_raid1 (457, 1), kslowd000 (166, 1), kslowd001 (167, 1), jbd2/md127-8 (470, 1)
	555	java (3815, 8), java (2335, 2), kslowd000 (166, 1), kslowd001 (167, 1)
sodb9	105	java (6634, 16), java (6621, 2), kslowd000 (166, 1), kslowd001 (167, 1)
	175	java (6942, 7), java (6621, 2), kslowd000 (166, 1), kslowd001 (167, 1)
	245	java (7259, 6), java (6621, 2), kslowd000 (166, 1), kslowd001 (167, 1)
	280	java (7365, 3), java (6621, 2), kslowd000 (166, 1), kslowd001 (167, 1)
	350	java (7577, 3), java (6621, 2), kslowd000 (166, 1), kslowd001 (167, 1)
	420	java (7683, 3), java (6621, 2), kslowd000 (166, 1), kslowd001 (167, 1)
	490	java (7894, 4), java (6621, 2), kslowd000 (166, 1), kslowd001 (167, 1)
sodb10	105	java (28394, 14), java (28381, 2), kslowd000 (166, 1), kslowd001 (167, 1)
	314	java (28702, 18), java (28381, 2), md127_raid1 (455, 1), kslowd001 (167, 1)
sodb12	280	kslowd001 (167, 154), kslowd000 (166, 150), java (14820, 37), java (14807, 2)
	311	kslowd000 (166, 154), kslowd001 (167, 153), java (14807, 2), java (15653, 1), khugepaged (30, 1)
	373	kslowd000 (166, 154), kslowd001 (167, 152), java (14807, 2), java (15747, 2)
	435	kslowd000 (166, 154), kslowd001 (167, 153), java (15934, 6), java (14807, 2)
	466	kslowd000 (166, 152), java (16121, 6), java (14807, 2), kblockd/0 (16, 1)

Table 5: Some daemon processes captured across different machines

4 Conclusion

My recommendation is to avoid sodb8 and to use the rest of the SoDB nodes for the rest of our experiments. Further investigation is needed to examine why the experiment results on sodb8 are different than those of the other nodes.