Software Engineering Group

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Universidade Técnica de Lisboa

EUROTM

WTM-2012

Objects with adaptive accessors to avoid STM barriers

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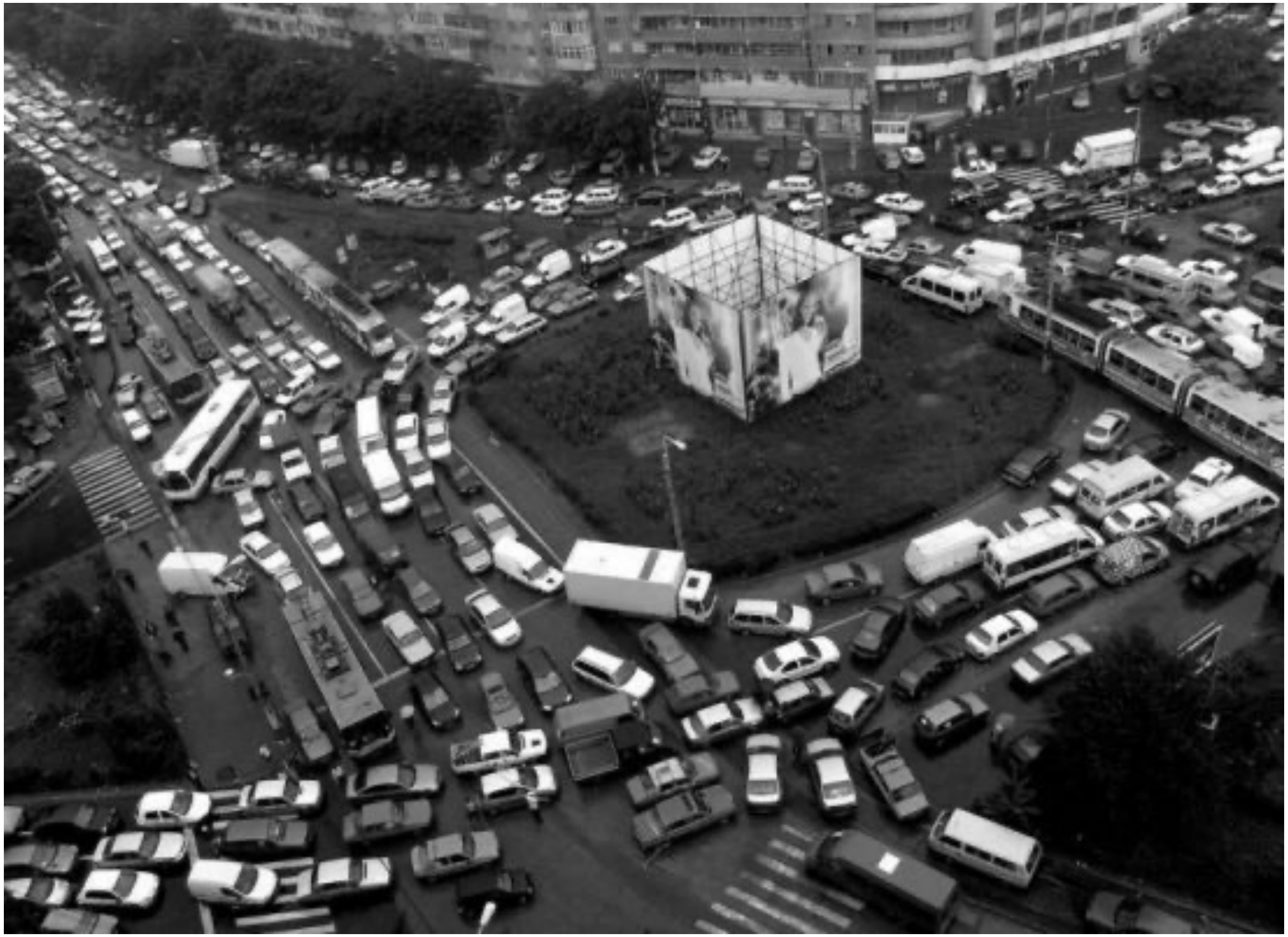
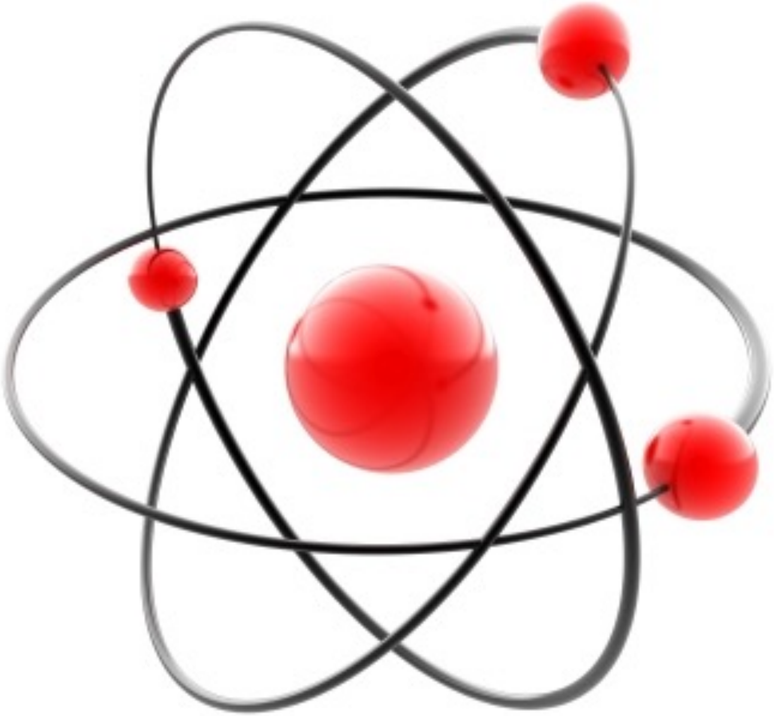
Bern, Switzerland, April 10, 2012

General Goal

Shared data



atomic



Overheads?

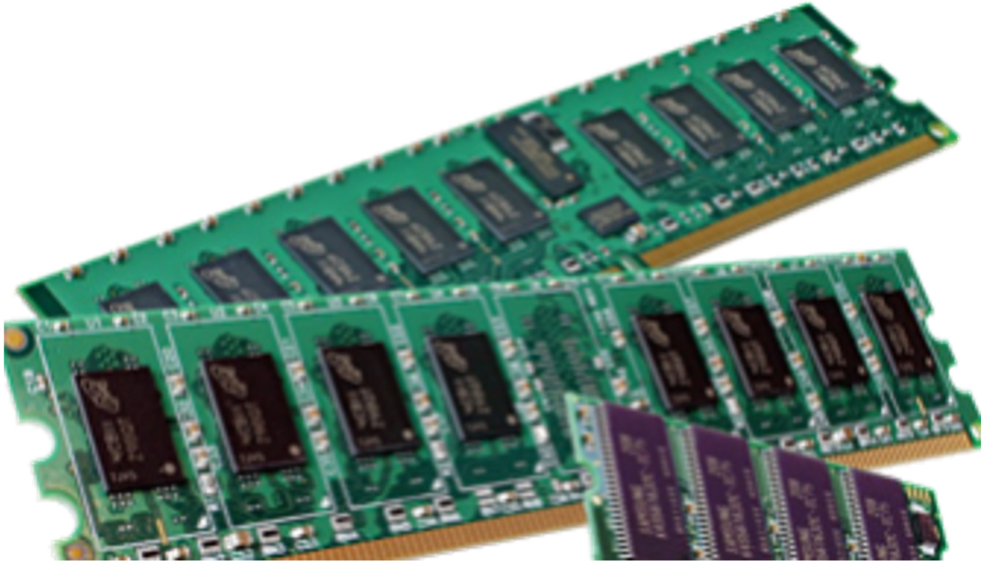
STM Barriers

Reduce Runtime Overheads

- Redo-log <vs> undo-log
- Eager <vs> lazy ownership acquisition
- Transactional versioning
- No ownership records
- Metatada in place
- Multi-versioning (e.g. JVSTM)
- …

Good for read-only

Memory overheads



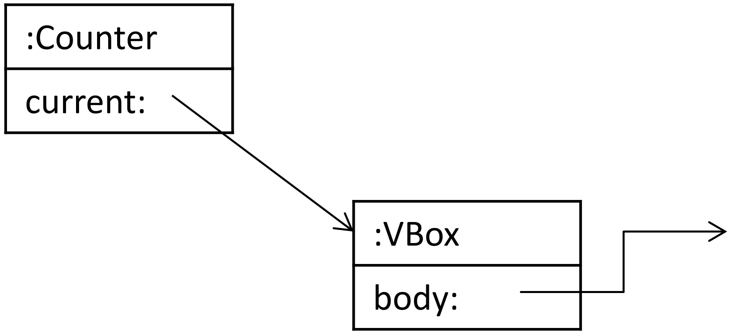
Winding path

Can we suppress these overheads?

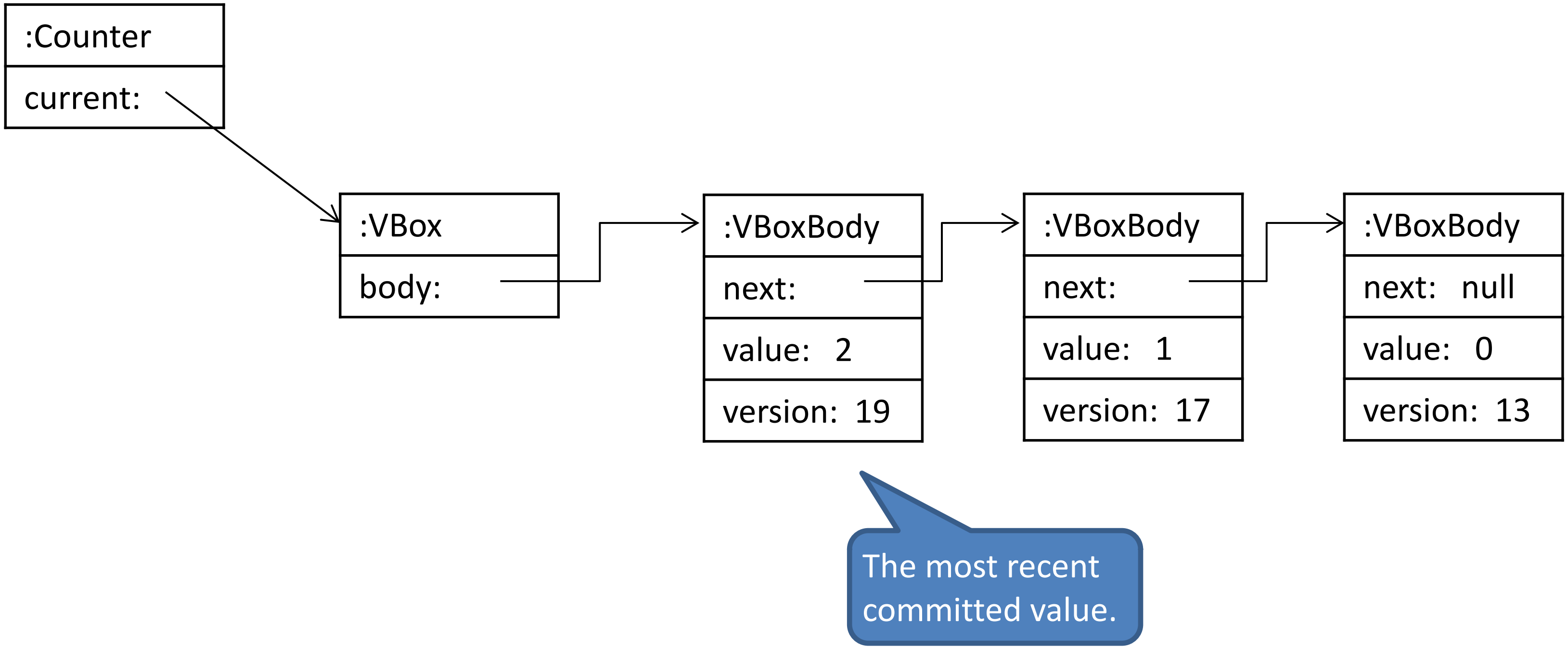
AOM
Adaptive Object Metadata

…implemented in the JVSTM

box

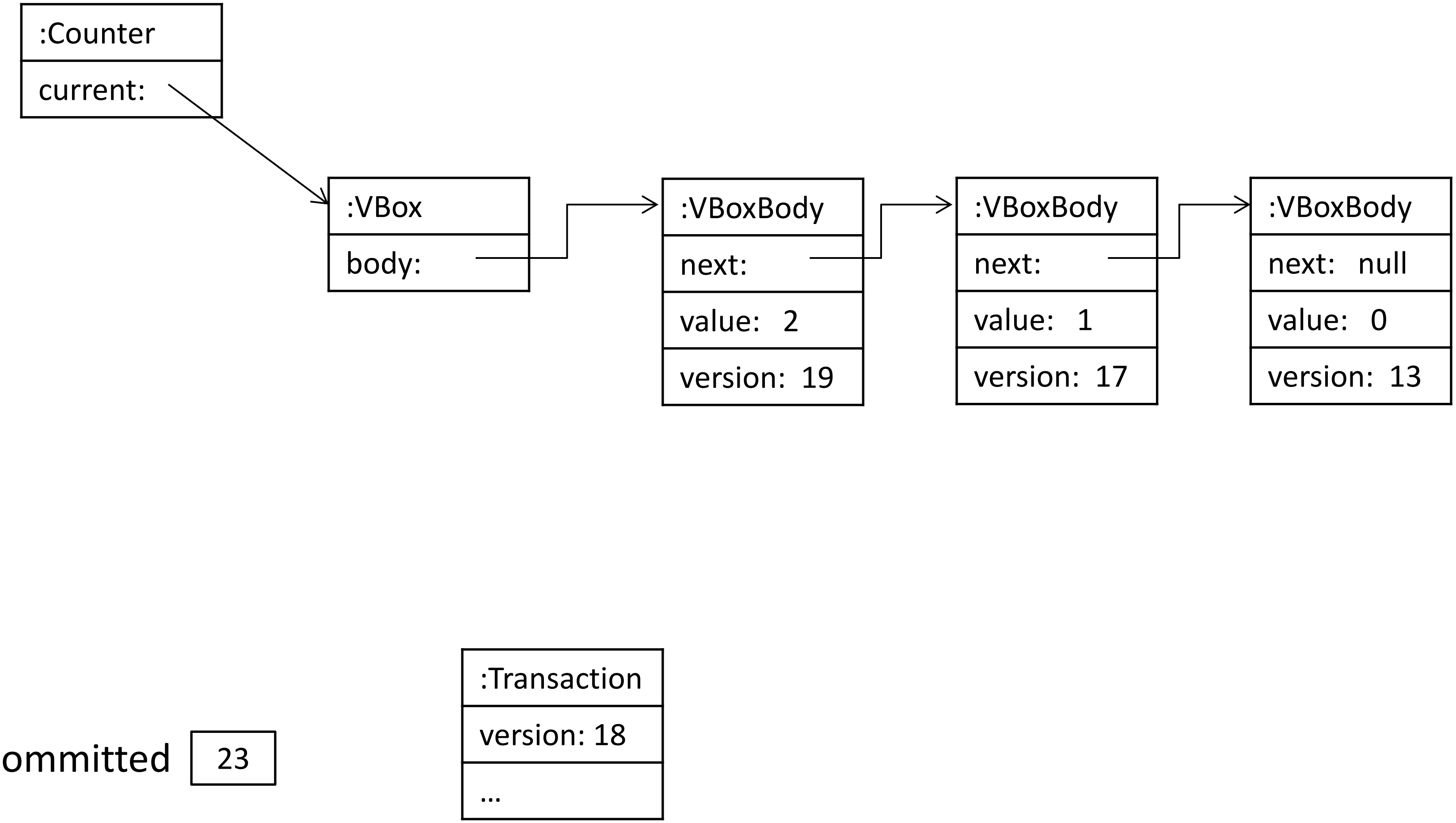


versions' history

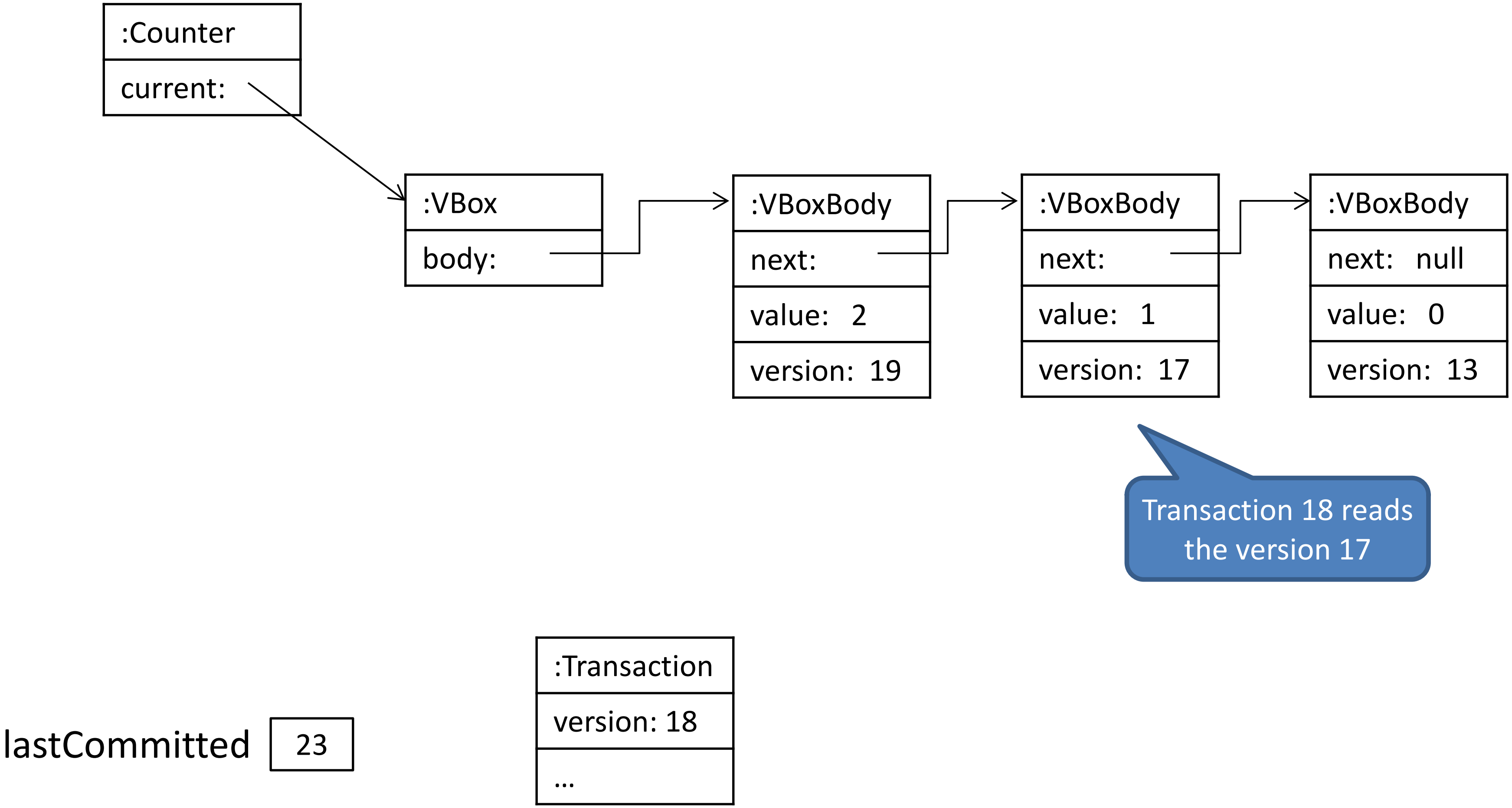


The most recent committed value.

Transaction



Transaction



:Counter
current:

:VBox
body:

:VBoxBody
next:
value: 2
version: 19

:VBoxBody
next:
value: 1
version: 17

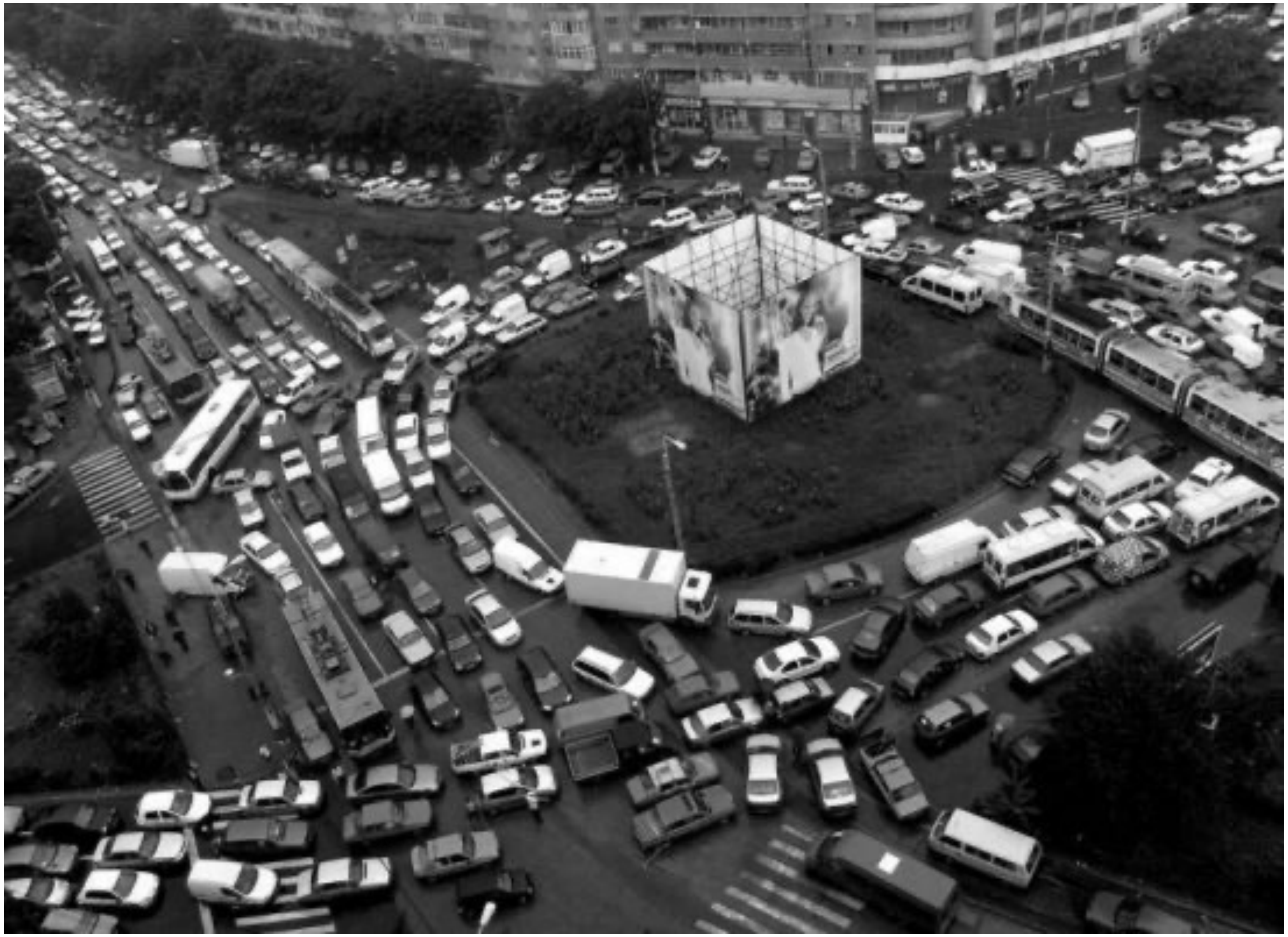
:VBoxBody
next: null
value: 0
version: 13

Transaction 18 reads the version 17

lastCommitted 23

:Transaction
version: 18
…

Shared Data



No contention

AOM

Compact

Extended

AOM

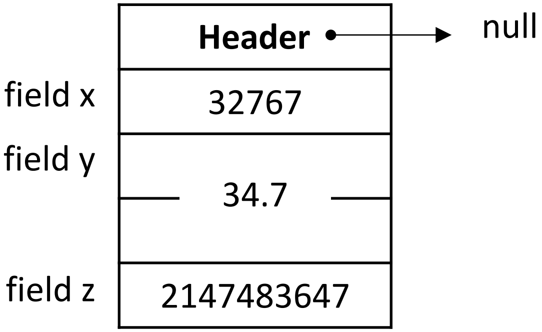
Compact

	:SomeType
field x	32767
field y	34.7
field z	2147483647

Extended

AOM

Compact



Header → null

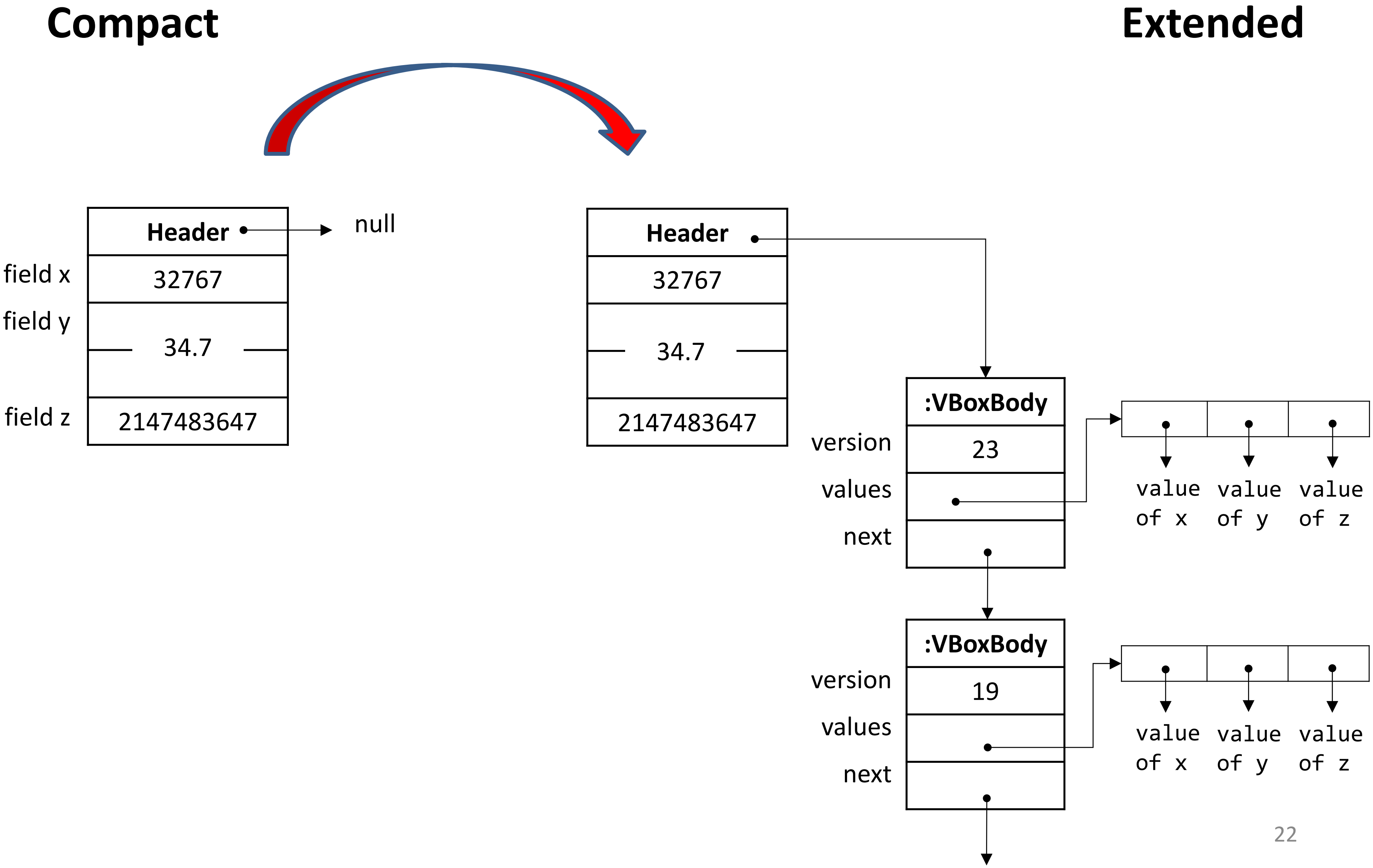
field x 32767

field y 34.7

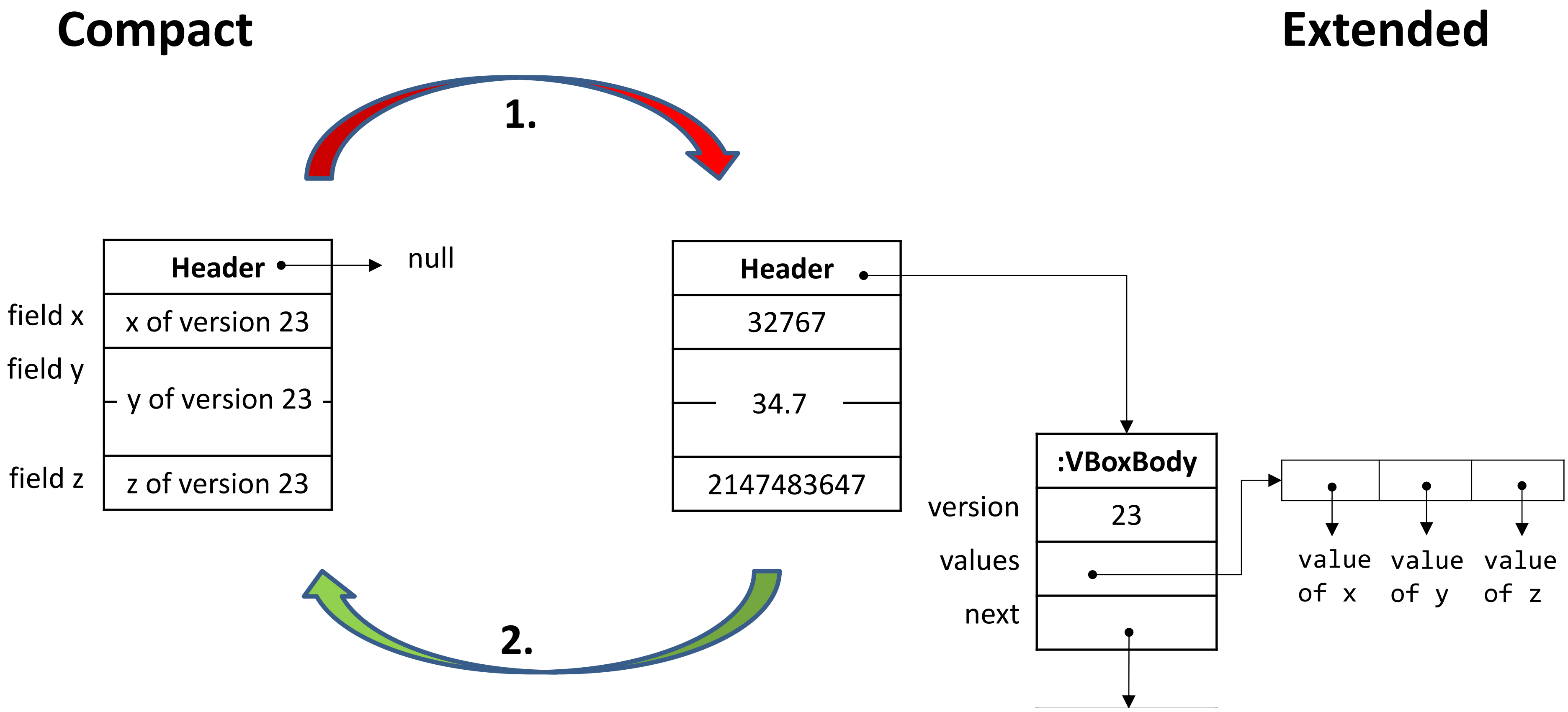
field z 2147483647

Extended

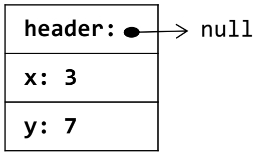
AOM


Compact
Extended
Header
null
field x
32767
field y
34.7
field z
2147483647
Header
32767
34.7
2147483647
:VBoxBody
version
23
values
next
value of x
value of y
value of z
:VBoxBody
version
19
values
next
value of x
value of y
value of z

AOM


Compact
Extended
1.
Header
null
field x
x of version 23
field y
y of version 23
field z
z of version 23
Header
32767
34.7
2147483647
:VBoxBody
version
23
values
next
value of x
value of y
value of z
2.

1. Extending

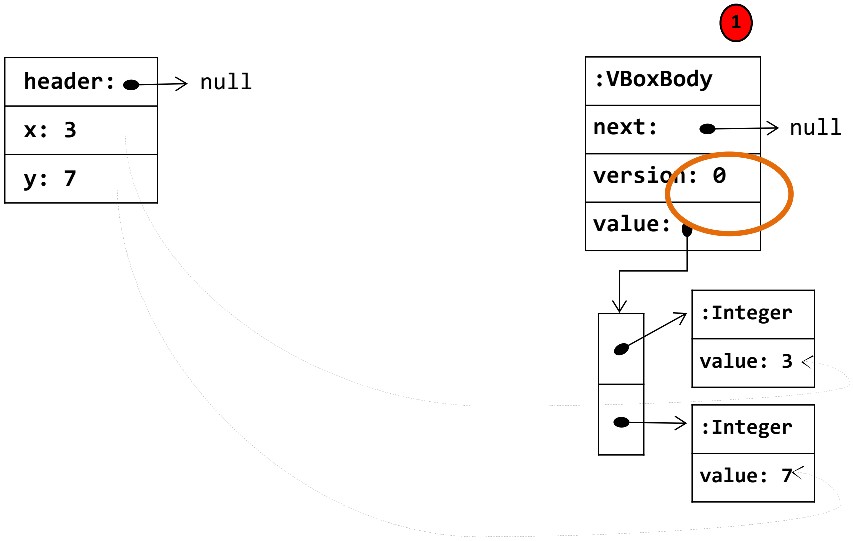


header:

x: 3

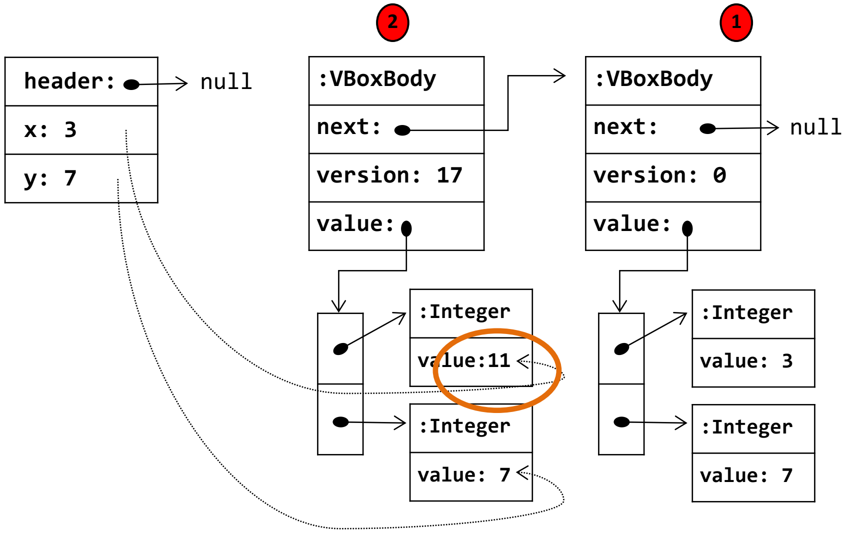
y: 7

1. Extending



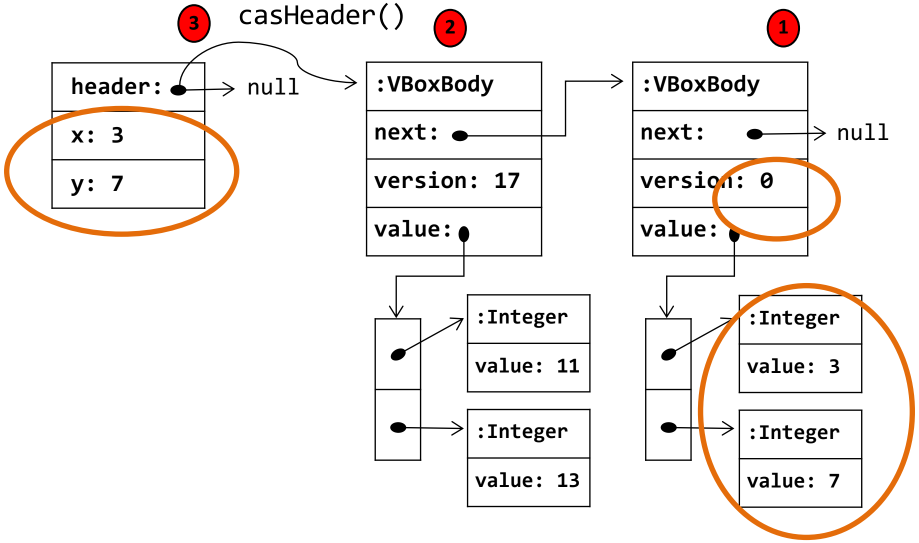
replicate()

1. Extending

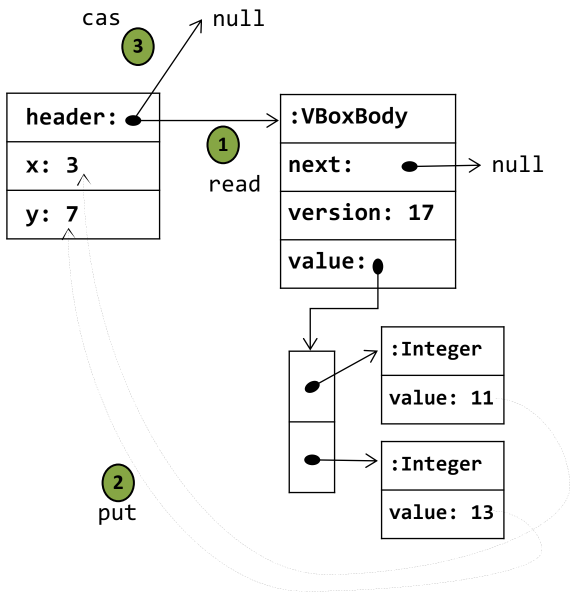


replicate()

1. Extending


3
casHeader()
2
1
header:
null
x: 3
y: 7
:VBoxBody
next:
version: 17
value:
:VBoxBody
next:
null
version: 0
value:
:Integer
value: 11
:Integer
value: 13
:Integer
value: 3
:Integer
value: 7

2. Reverting



```
boolean tryRevert (AdaptiveObject o , VBoxBody body){
  if(o.readHeader() == body){ 1
      o.toCompactLayout(body.value); 2
      return o.casHeaderWithNull(body); 3
    }
  return  false;
}
```

AdaptiveObject

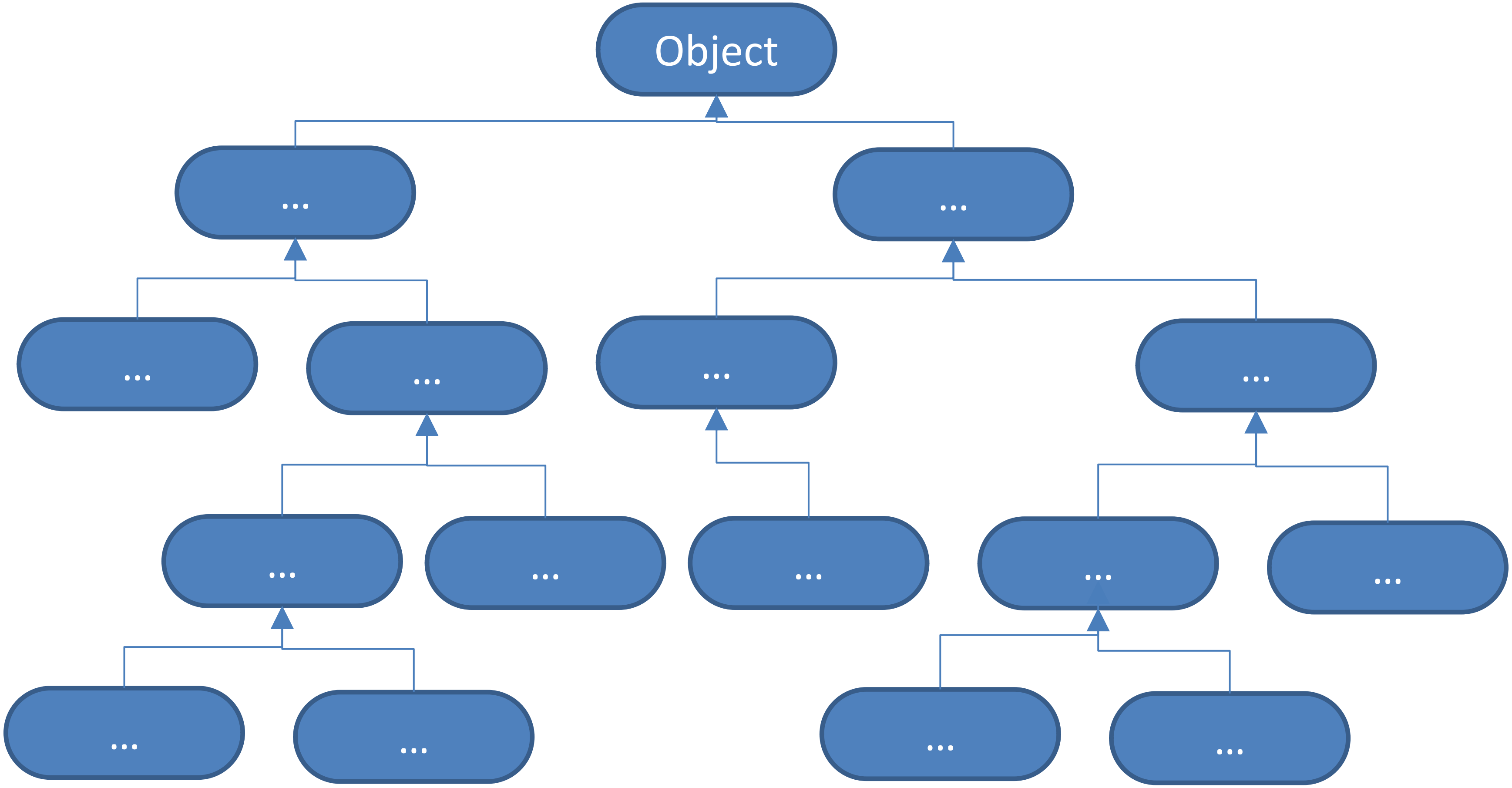
```
abstract class AdaptiveObject <T extends A


    private VBoxBody<T> header;




    public abstract void toCompactLayout(T from);

    public VBoxBody<T> readHeader(){
           return header;
    }

    public boolean casHeaderWithNull(VBoxBody<T> expected){
           return UtilUnsafe.UNSAFE.compareAndSwapObject(this,header__ADDRESS__, expected, null);
    }




}
```

```
boolean tryRevert (AdaptiveObject o , VBoxBody body){
  if(o.readHeader() == body){ ①
      o.toCompactLayout(body.value); ②
      return o.casHeaderWithNull(body); ③
    }
  return  false;
}
```

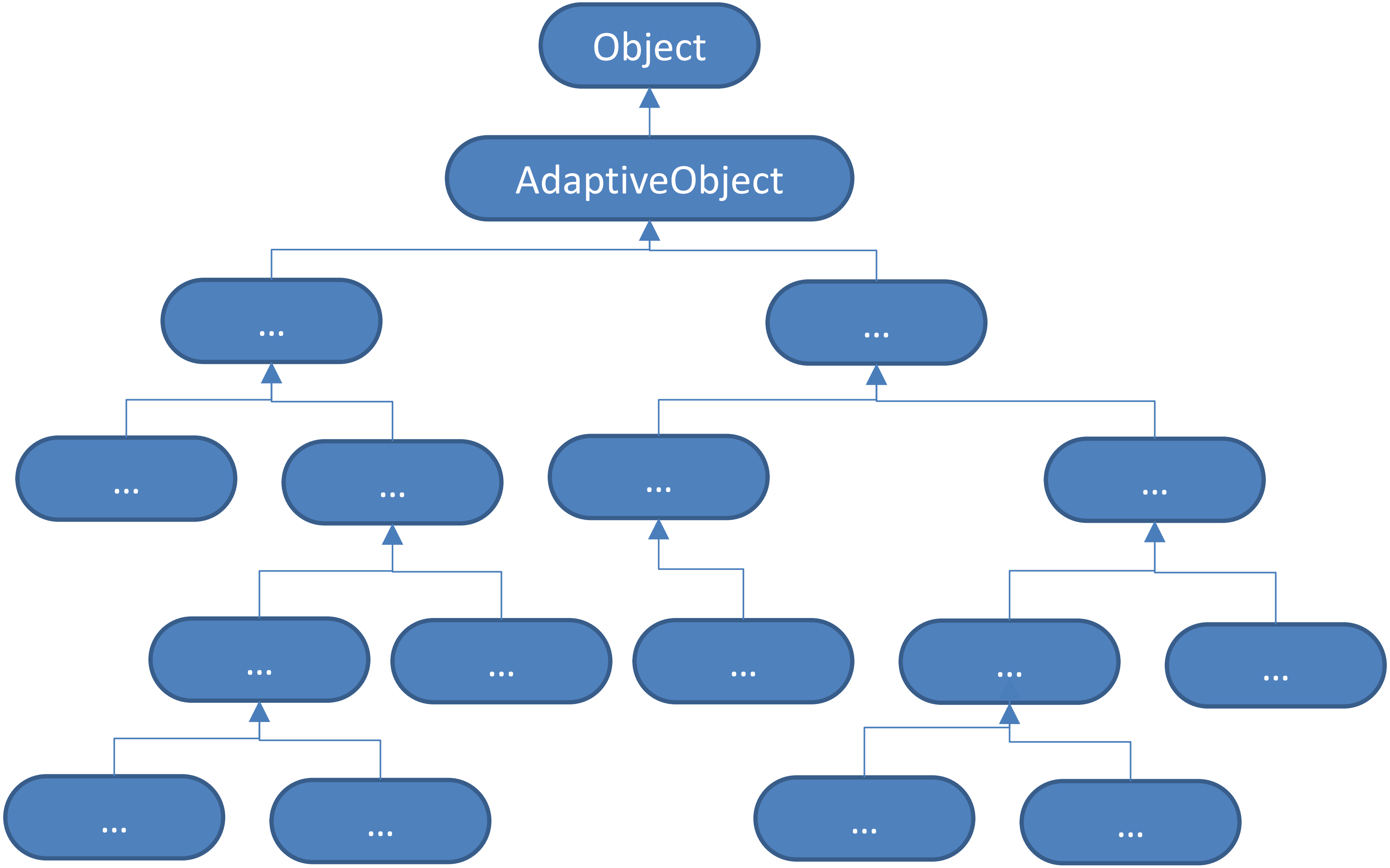
AdaptiveObject

```
abstract class AdaptiveObject <T extends AdaptiveObject{

    private static final long header__ADDRESS__;

    private VBoxBody<T> header;


    public abstract T replicate();

    public abstract void toCompactLayout(T from);

    public VBoxBody<T> readHeader(){
           return header;
    }

    public boolean casHeaderWithNull(VBoxBody<T> expected){
           return UtilUnsafe.UNSAFE.compareAndSwapObject(this,header__ADDRESS__, expected, null);
    }

    public boolean casHeader(VBoxBody<T> expected, VBoxBody<T> newBody){
           return UtilUnsafe.UNSAFE.compareAndSwapObject(this, header__ADDRESS__, expected, newBody);
    }

}
```

hierarchy



hierarchy

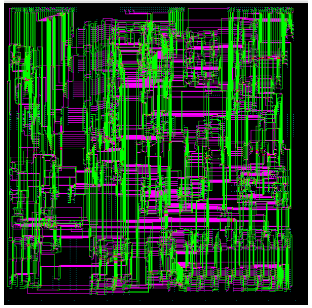


AOM

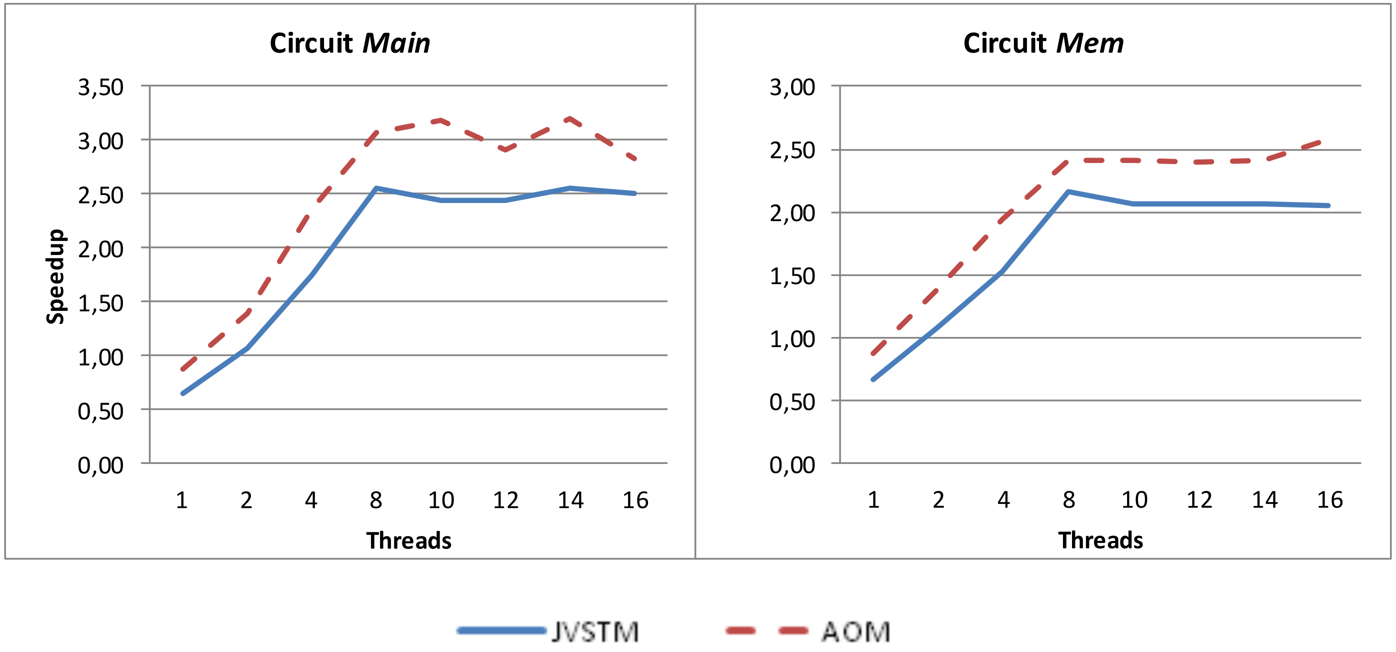
- 1st release (Multiprog 12)
  - implemented with the JVSTM lock based
  - reversion and extension operations specified by an `AdaptiveObject` interface

- 2nd release:
  - Implemented with the JVSTM lock free
  - `AdaptiveObject` as the root base class
  - provides a Transparent API (like Deuce STM)

AOM with JVSTM lock based



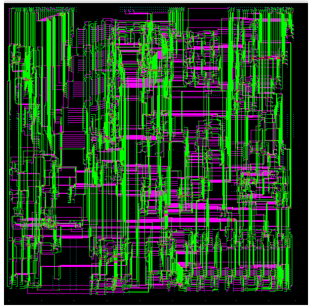
LeeTM



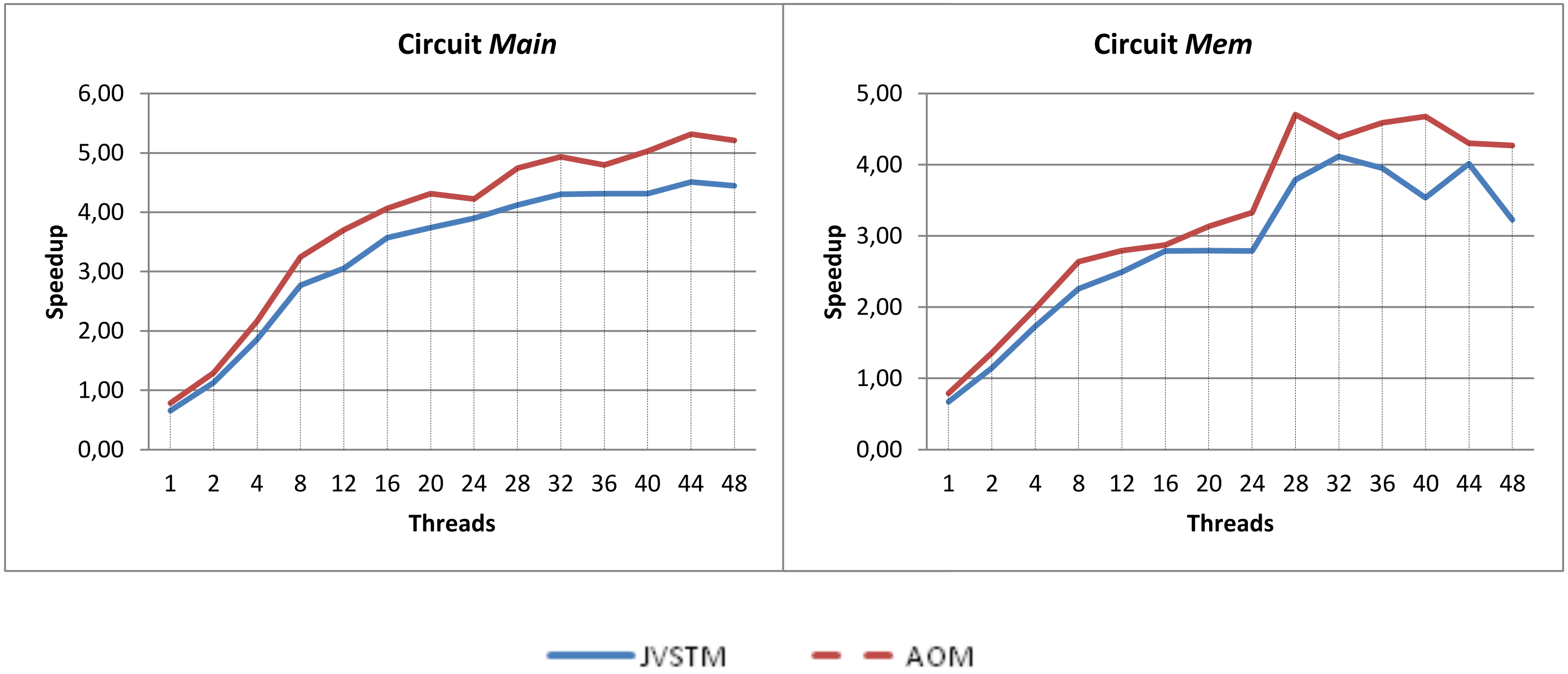
- increases the speedup between 13% and 35%

(* Multiprog12)

new AOM with JVSTM lock free



LeeTM



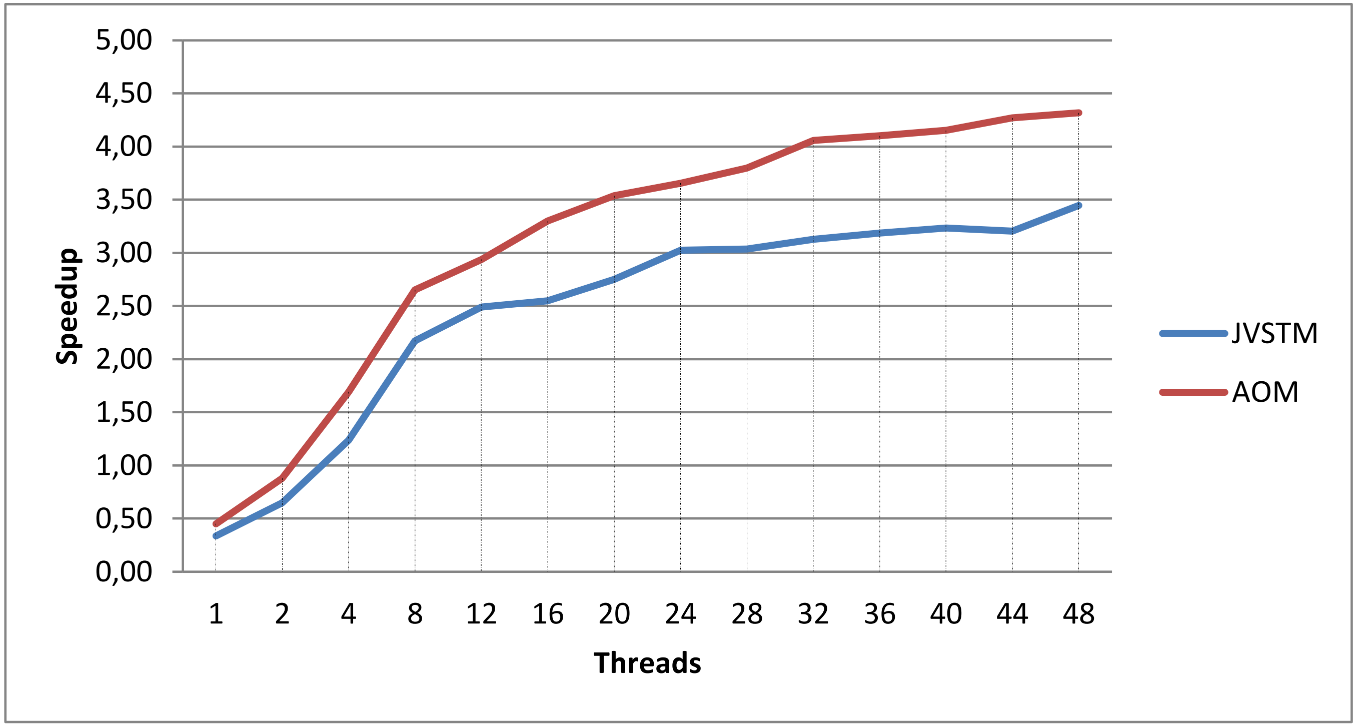
- increases the speedup between 5% and 36%

STAMP Vacation, low++ & long trxs & RO

- Low contention
- ++, large data sets
- -n = 256, longer transactions, instead of the recommendation 2 or 4
- 3 kinds of transactions:
  - Delete and create items: car, flight or room
  - Remove defaulter clients (bill > 0)
  - Query and reserve an item: car, flight or room

Splitted in 2 transactions: RO + RW

STAMP Vacation, low++ & long trxs & RO



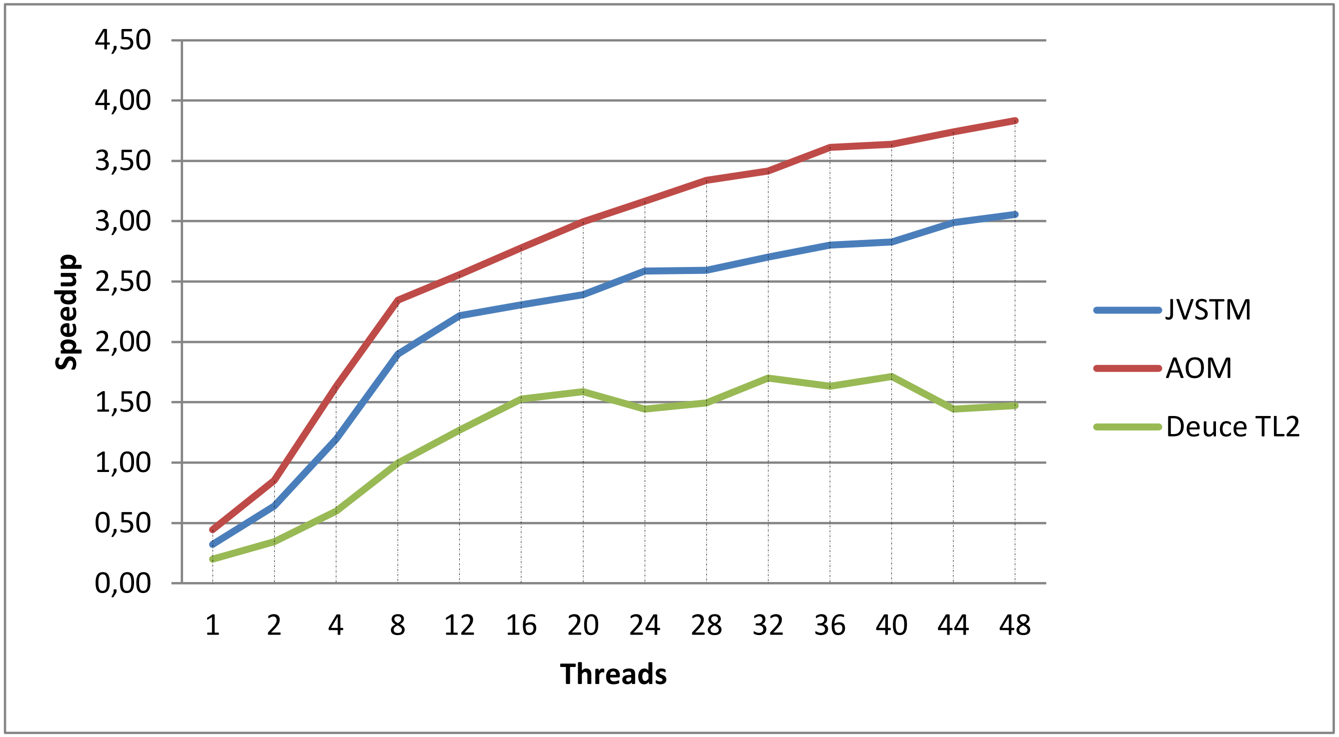
- increases the speedup between 18% and 37%
- Maximum speedup = 4,32

Comparing with the Deuce STM…

and enhancing the AOM with a transparent API

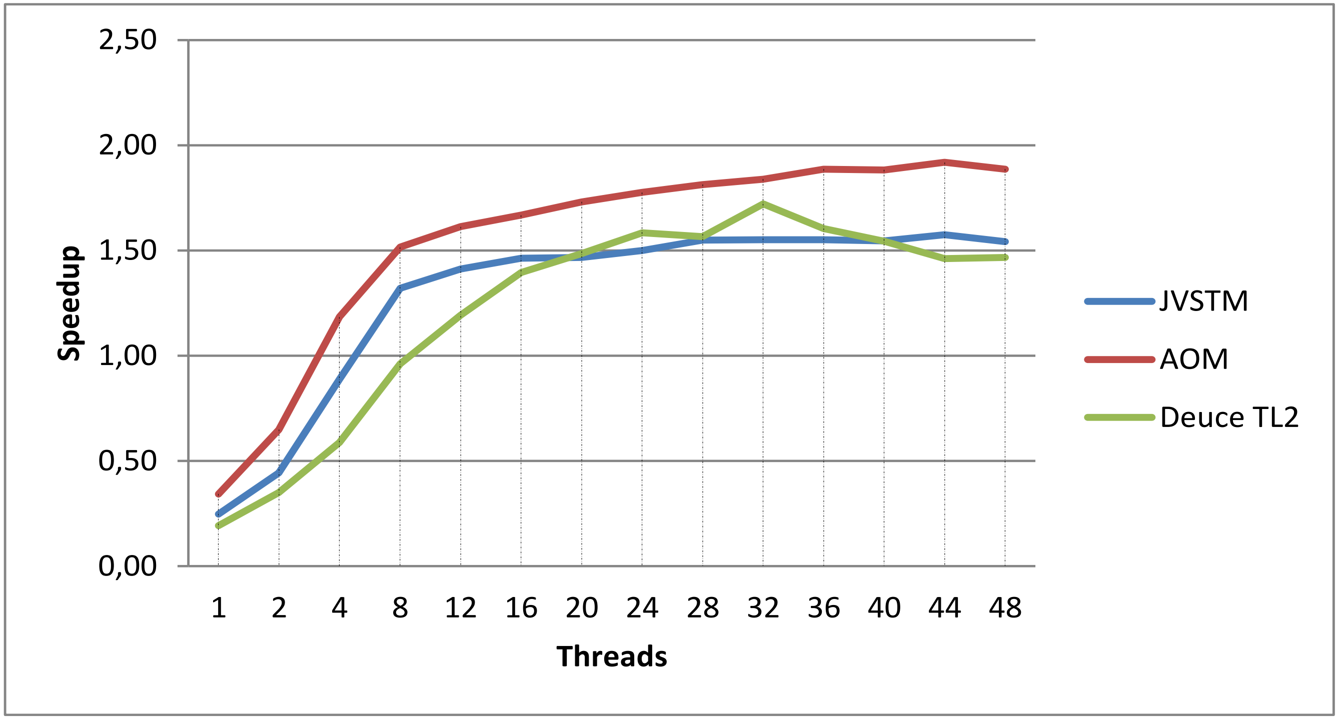
Turning all objects transactional

STAMP Vacation, low++ & long trxs & RO



- Maximum speedup = 3,83 (< 4,32 with a non-transparent API)
- Still better than the Deuce STM with TL2

STAMP Vacation, low++ & long trxs ~~& RO~~



- Maximum speedup = 1,92
- Still better than JVSTM and the Deuce TL2

Future Work

Future Work

- An improved reversion algorithm
- New design for AOM that keeps the contention-free execution path without any barrier or validation
- Integrate the AOM compiler in the implementation of the Deuce STM