Unsafe: халява закончилась?

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Что такое Unsafe

- **Очень специальный объект**
- Существует с JDK 1.4 — уже 15 лет
- Нужен в Class Library, чтобы оттуда дергать JVM

> *“A VM/library interface, designed strictly for use within the JDK”*
> Mark Reinhold, Java Platform Architect
> JVMLS 2015

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Используется в разных частях JDK

- **1.4** — Reflection, Serialization, NIO
- **1.5** — JSR166 (atomics, locks), CORBA, AWT
- **6.0** — JSR166 (CopyOnWriteArrayList etc.)
- **7** — JSR166 (ForkJoin etc.), BigDecimal, java.lang.invoke
- **8** — JSR166 (много!), Mac OS X objective C bridge

sun.misc.Unsafe

- Лежит в приватном пакете sun.misc
  - раньше в Sun JDK
  - потом в OpenJDK
  - перекочевал в Oracle JDK

А что на других JDK?

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```
public final class Unsafe {

    static {
        registerNatives();
        Reflection.registerMethodsToFilter(Unsafe.class, "getUnsafe");
        …
    }

    private Unsafe() {}

    private static final Unsafe theUnsafe = new Unsafe();

    @CallerSensitive
    public static Unsafe getUnsafe() {
        Class cc = Reflection.getCallerClass();
        if (cc.getClassLoader() != null)
            throw new SecurityException("Unsafe");
        return theUnsafe;
    }
```

Как получить Unsafe

```
public static final Unsafe UNSAFE = getUnsafe();

private static Unsafe getUnsafe() {
    try {
        Field f = Unsafe.class.getDeclaredField("theUnsafe");
        f.setAccessible(true);
        return (Unsafe) f.get(null);
    } catch (Exception e) {
        throw new RuntimeException(e);
    }
}
```

И всё???

По умолчанию Secutiry Manager в Java выключен!

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По умолчанию Secutiry Manager в Java выключен!

```
$ java -Djava.security.manager

java.security.AccessControlException: access denied
("java.lang.RuntimePermission" "accessClassInPackage.sun.misc")
```

«Тебя предупреждали»

```
$ javac Test.java

Test.java:2: warning: Unsafe is internal proprietary API
and may be removed in a future release
import sun.misc.Unsafe;
                ^
```

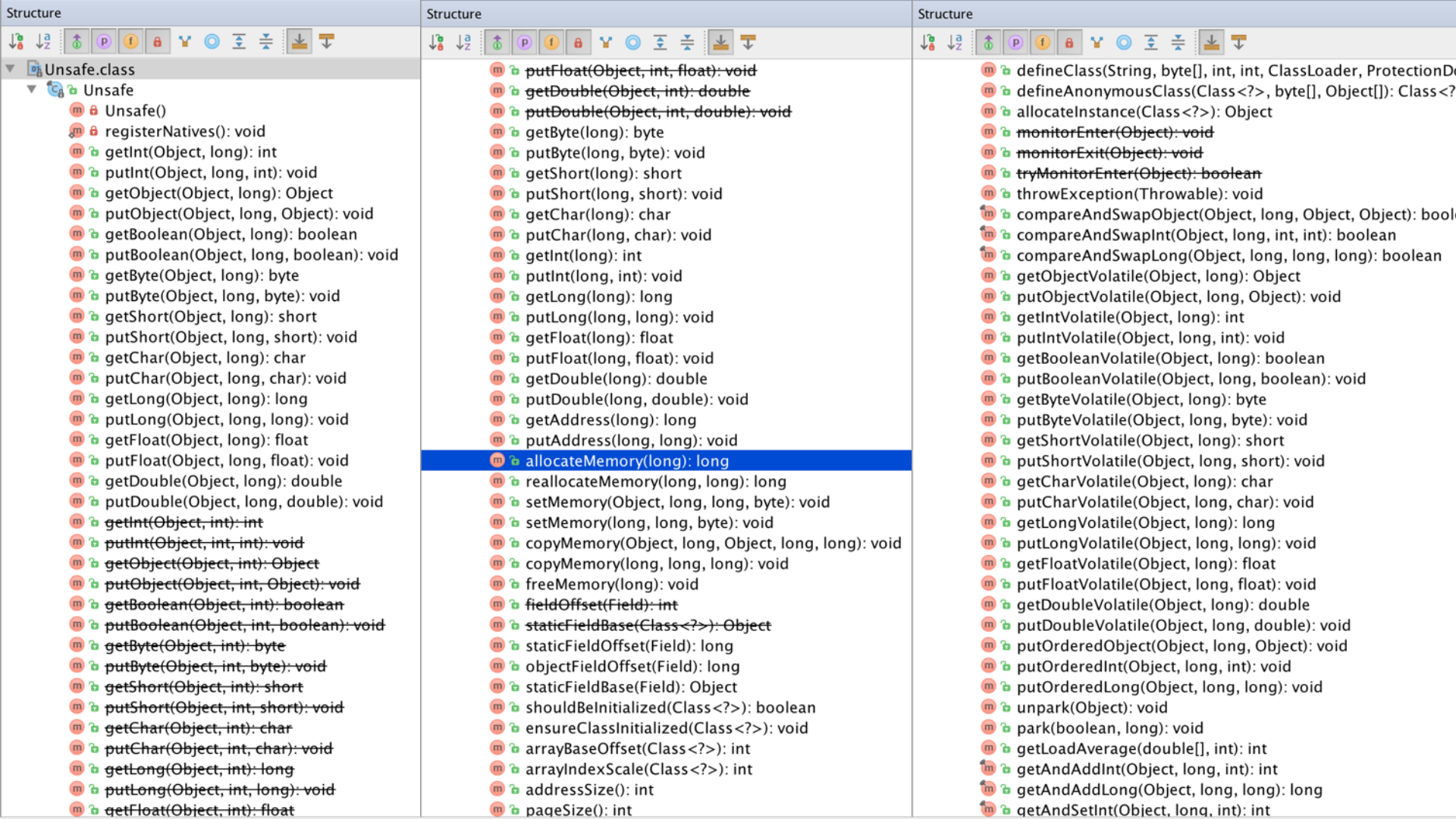
«Да мне пофиг!»

```
$ javac Test.java

Test.java:2: warning: Unsafe is internal proprietary API
and may be removed in a future release
import sun.misc.Unsafe;
                ^
```

```
$ javac -XDignore.symbol.file Test.java
```

Что умеет Unsafe?


Structure
Unsafe.class
Unsafe
Unsafe()
registerNatives(): void
getInt(Object, long): int
putInt(Object, long, int): void
getObject(Object, long): Object
putObject(Object, long, Object): void
getBoolean(Object, long): boolean
putBoolean(Object, long, boolean): void
getByte(Object, long): byte
putByte(Object, long, byte): void
getShort(Object, long): short
putShort(Object, long, short): void
getChar(Object, long): char
putChar(Object, long, char): void
getLong(Object, long): long
putLong(Object, long, long): void
getFloat(Object, long): float
putFloat(Object, long, float): void
getDouble(Object, long): double
putDouble(Object, long, double): void
getInt(Object, int): int
putInt(Object, int, int): void
getObject(Object, int): Object
putObject(Object, int, Object): void
getBoolean(Object, int): boolean
putBoolean(Object, int, boolean): void
getByte(Object, int): byte
putByte(Object, int, byte): void
getShort(Object, int): short
putShort(Object, int, short): void
getChar(Object, int): char
putChar(Object, int, char): void
getLong(Object, int): long
putLong(Object, int, long): void
getFloat(Object, int): float
Structure
putFloat(Object, int, float): void
getDouble(Object, int): double
putDouble(Object, int, double): void
getByte(long): byte
putByte(long, byte): void
getShort(long): short
putShort(long, short): void
getChar(long): char
putChar(long, char): void
getInt(long): int
putInt(long, int): void
getLong(long): long
putLong(long, long): void
getFloat(long): float
putFloat(long, float): void
getDouble(long): double
putDouble(long, double): void
getAddress(long): long
putAddress(long, long): void
allocateMemory(long): long
reallocateMemory(long, long): long
setMemory(Object, long, long, byte): void
setMemory(long, long, byte): void
copyMemory(Object, long, Object, long, long): void
copyMemory(long, long, long): void
freeMemory(long): void
fieldOffset(Field): int
staticFieldBase(Class<?>): Object
staticFieldOffset(Field): long
objectFieldOffset(Field): long
staticFieldBase(Field): Object
shouldBeInitialized(Class<?>): boolean
ensureClassInitialized(Class<?>): void
arrayBaseOffset(Class<?>): int
arrayIndexScale(Class<?>): int
addressSize(): int
pageSize(): int
Structure
defineClass(String, byte[], int, int, ClassLoader, ProtectionD
defineAnonymousClass(Class<?>, byte[], Object[]): Class<?
allocateInstance(Class<?>): Object
monitorEnter(Object): void
monitorExit(Object): void
tryMonitorEnter(Object): boolean
throwException(Throwable): void
compareAndSwapObject(Object, long, Object, Object): bool
compareAndSwapInt(Object, long, int, int): boolean
compareAndSwapLong(Object, long, long, long): boolean
getObjectVolatile(Object, long): Object
putObjectVolatile(Object, long, Object): void
getIntVolatile(Object, long): int
putIntVolatile(Object, long, int): void
getBooleanVolatile(Object, long): boolean
putBooleanVolatile(Object, long, boolean): void
getByteVolatile(Object, long): byte
putByteVolatile(Object, long, byte): void
getShortVolatile(Object, long): short
putShortVolatile(Object, long, short): void
getCharVolatile(Object, long): char
putCharVolatile(Object, long, char): void
getLongVolatile(Object, long): long
putLongVolatile(Object, long, long): void
getFloatVolatile(Object, long): float
putFloatVolatile(Object, long, float): void
getDoubleVolatile(Object, long): double
putDoubleVolatile(Object, long, double): void
putOrderedObject(Object, long, Object): void
putOrderedInt(Object, long, int): void
putOrderedLong(Object, long, long): void
unpark(Object): void
park(boolean, long): void
getLoadAverage(double[], int): int
getAndAddInt(Object, long, int): int
getAndAddLong(Object, long, long): long
getAndSetInt(Object, long, int): int

```java
package cee.secr.misc;

public class MyUnsafe {

    public native int getInt(long address);
```

```c
#include <jni.h>

JNIEXPORT jint JNICALL
Java_snow_misc_MyUnsafe(JNIEnv* env, jobject myUnsafe,
                        jlong address) {
    return *(jint*)address;
}
```

Сколько стоит JNI

```
Create stack frame
    Move arguments according to ABI
        Wrap objects into JNI handles
            Obtain JNIEnv* and jclass
                Trace method_entry
                    Lock if synchronized
                        Lazy lookup and linking
                            in_java → in_native thread transition
                                Call the native function
                            Check for safepoint
                        Switch state to in_java
                    Unlock if synchronized
                Notify method_exit
            Unwrap result, reset JNI handles block
        Handle exceptions
  Remove stack frame
```

Intrinsics

- Большинство методов — intrisics:
  - getInt —> mov
  - compareAndSwapInt —> cmpxchg

CAS

```
// native
public final native boolean compareAndSwapInt(
          Object o, long offset, int expected, int x);

//non-native
public final int getAndAddInt(
              Object o, long offset, int delta) {
    int v;
    do {
        v = getIntVolatile(o, offset);
    } while (!compareAndSwapInt(o, offset, v, v + delta));
    return v;
}
```

AtomicInteger — i.getAndAdd(5)

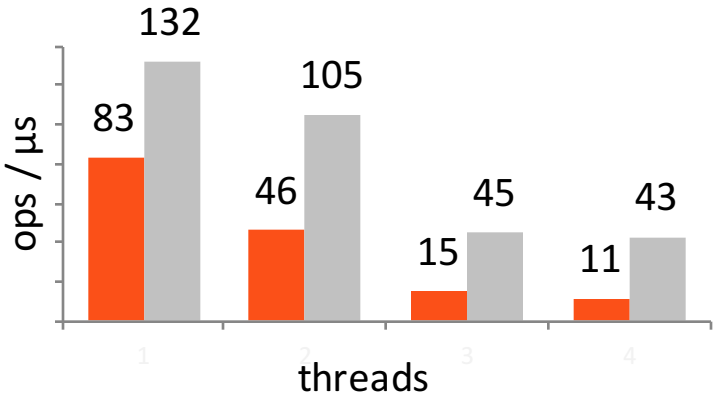
`-XX:+PrintAssembly`

JDK 7u72

```
loop:
   mov     0xc(%r10),%eax
   mov     %eax,%r11d
   add     $0x5,%r11d
   lock cmpxchg %r11d,0xc(%r10)
   sete    %r11b
   movzbl %r11b,%r11d
   test    %r11d,%r11d
   je      loop
```

JDK 8u66

```
lock addl $0x5,0xc(%r10)
```

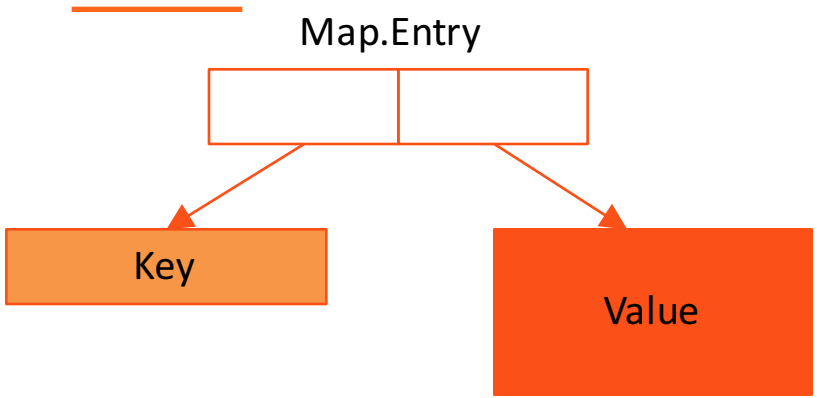


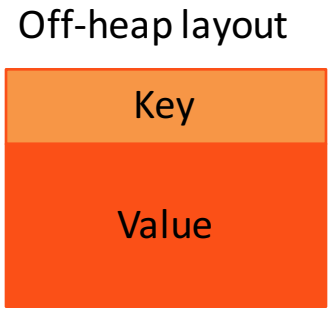
Use cases

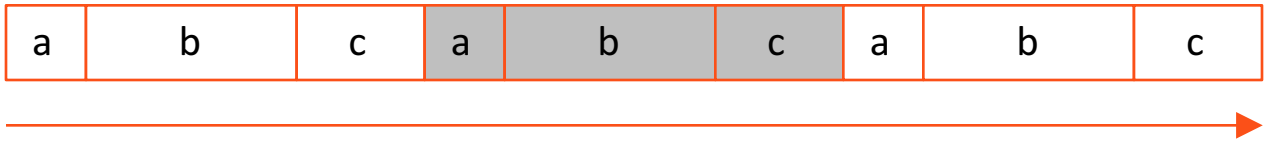
Off-heap Collections

- Lists, sets, maps
  - Large capacity > 2 GB
  - Predictable GC pauses
  - No heap fragmentation
  - Data locality

Data locality







I/O and persistence

- Persistent caches and storages
  - Memory-mapped files (64-bit)
  - Shared memory
- Cooperation with OS
  - Pointer arithmetic, alignment
  - mlock, madvise etc.

IPC, Messaging

- Concurrent off-heap buffers and queues
- High-performance messaging
  - Disruptor
  - Aeron: 6M msg/s
- Shared data structures
  - Chronicle Map

Удаление Unsafe

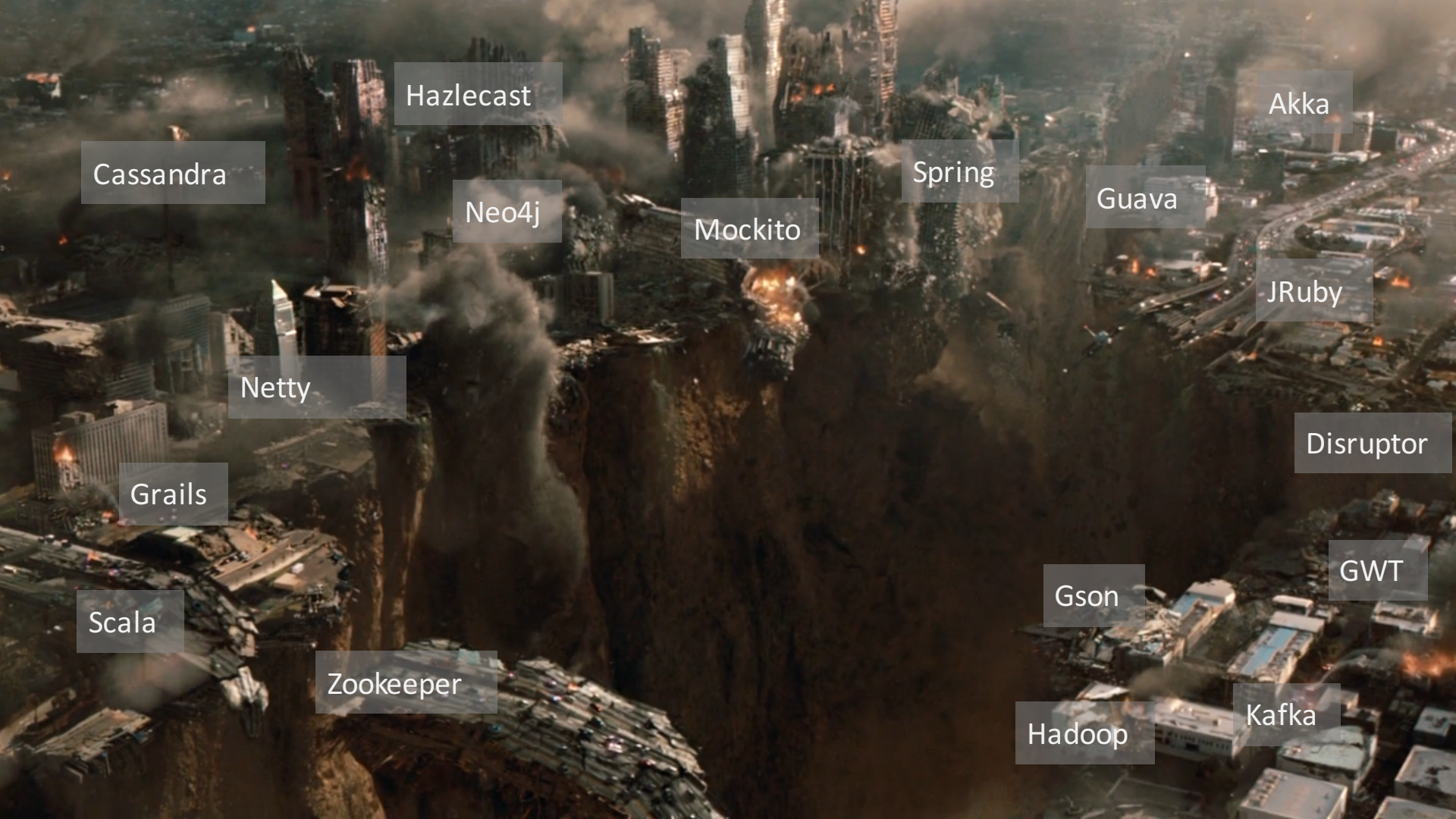
Тактика действий в случие удаления Unsafe

- Переписать куски кода
  - JNI
  - Reflection
  - NIO
  - etc.

Тактика действий в случие удаления Unsafe

- Переписать куски кода
  - JNI
  - Reflection
  - NIO
  - etc.
- Как действовать
  1. Новый layer: wrapper над Unsafe
  2. Заменить на wrapper над public API

Беда 1: Performance Degradation


Hazlecast
Akka
Cassandra
Spring
Guava
Neo4j
Mockito
JRuby
Netty
Disruptor
Grails
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Беда 2: Transitive lock-in

Как так получилось?

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import sun.misc.Unsafe;
                ^
```

Слишком мало евангелизма, Oracle!

Как развивалась ситуация

Хронология событий

- JEP 200: The Modular JDK

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- JEP 200: The Modular JDK
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- Mark Reinhold выступил на JVMLS
  - все немного успокоились
- JEP 260: Encapsulate Most Internal APIs

План замены Unsafe на public API

- Replacement in JDK 8 → hide in JDK 9
  - sun.misc.BASE64Encoder etc.
  - Available via command-line flag
- No replacement in JDK 8 → available outside
  - sun.misc.Unsafe, sun.reflect.ReflectionFactory
  - sun.misc.Cleaner, sun.misc.SignalHandler
- Replacement in JDK 9 → hide in JDK 9, remove in JDK 10

Что приходит на замену

JEP 193: VarHandles

Expected in Java 9

```
class Queue {
    int size;
    ...
}

VarHandle queueSize = VarHandles.lookup()
      .findFieldHandle(Queue.class, "size", int.class);

queueSize.addAndGet(10);
```

```
VarHandle handle = VarHandles.arrayElement(int[].class)

VarHandle viewHandle = VarHandles.arrayElementViewHandle(
        byte[].class, long[].class, true);
```

- get, getVolatile, getAcquire, getOpaque
- set, setVolatile, setRelease, setOpaque
- compareAndSet, compareAndExchangeVolatile
- compareAndExchangeAcquire, compareAndExchangeRelease
- weakCompareAndSet, weakCompareAndSetAcquire, weakCompareAndSetRelease
- getAndSet, getAndAdd, addAndGet

```
ByteBuffer byteBuffer = ByteBuffer.allocateDirect(8);
VarHandle bufferView =
        VarHandles.byteBufferViewHandle(long[].class, true);
```

```
MemoryRegion region = MemoryRegion.allocateNative(
        "myname", MemoryRegion.UNALIGNED, Long.MAX_VALUE);

VarHandle regionView =
     VarHandles.memoryRegionViewHandle(long[].class, true);

regionView.set(region, 0, Long.MAX_VALUE);
return regionView.get(region, 0);
```

Итоги

- Вендор услышал сообщество и изменил планы
  - Вендор готов и дальше слушать
  - Сообщество представляет собой силу, за ним экосистема

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  - Вендор готов и дальше слушать
  - Сообщество представляет собой силу, за ним экосистема
- Unsafe все-таки выпилят
  - Но постепенно, в течение нескольких лет

Development @ Одноклассники

- Tech Blog
  - http://habrahabr.ru/company/odnoklassniki
- Open source
  - https://github.com/odnoklassniki
- Career
  - http://v.ok.ru

Благодарю Андрея Паньгина

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Вопросы и ответы

Спасибо за внимание!

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