Grid Dynamics

Time In Distributed Systems Pt.1

Hello

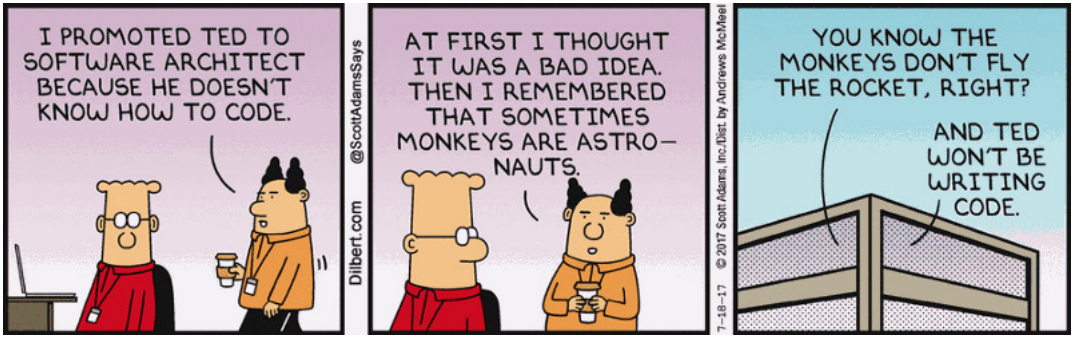
Denis Golovachev

Hello

Hello

Saint-Petersburg

Hello


I PROMOTED TED TO SOFTWARE ARCHITECT BECAUSE HE DOESN'T KNOW HOW TO CODE.
Dilbert.com @ScottAdamsSays
AT FIRST I THOUGHT IT WAS A BAD IDEA. THEN I REMEMBERED THAT SOMETIMES MONKEYS ARE ASTRO-NAUTS.
7-18-17 © 2017 Scott Adams, Inc./Dist. by Andrews McMeel
YOU KNOW THE MONKEYS DON'T FLY THE ROCKET, RIGHT?
AND TED WON'T BE WRITING CODE.

Hello

Hello

Hello

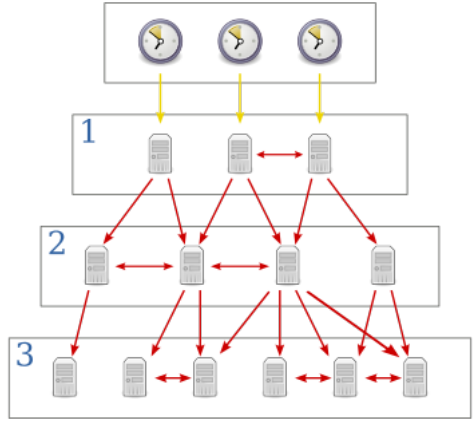
Grid Dynamics

Time

Time

Time

Time



Question

What is time?

Time is ...

1998 2004 3XXX

MYSTERY SOLVED

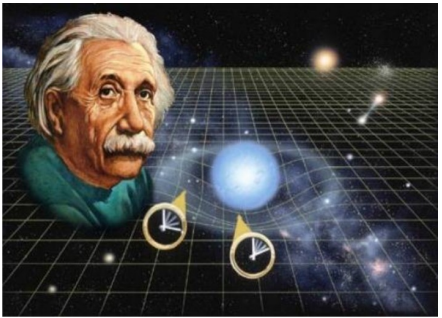
Way of arrange the order of events

Time is ...

1998 2004 3XXX

MYSTERY SOLVED

Way of arrange the order of events



Another dimension

Definition of time

Compact and robust definition of time has proved to be remarkably tricky and elusive.

- What clocks measure (attr. to physicists Albert Einstein, Donald Ivey, and others)

Definition of time

Compact and robust definition of time has proved to be remarkably tricky and elusive.

- What clocks measure (attr. to physicists Albert Einstein, Donald Ivey, and others)
- What prevents everything from happening at once (physicist John Wheeler and others)
- A linear continuum of instants (philosopher Adolf Grünbaum)

Religion

Wikipedia

In Zurvanism, Zurvan was perceived as the god of infinite time and space and was aka ("one", "alone").

Time is ...

Time is something we deal with every day, and something that everyone thinks they understand

Game Time

Let’s play a game

Round 1

There are always 24 hours in a day

Round 1

There are always 24 hours in a day

Daylight saving time

Round 2

A month always ends in the same year it started

Round 2

A month always ends in the same year it started

- Fiscal year/calendar
- Chinese Year

Round 3

Months have either 28, 29, 30 or 31 days

Round 3

Months have either 28, 29, 30 or 31 days

September 1752 had 19 days in British Empire

Everyone do it wrong!?

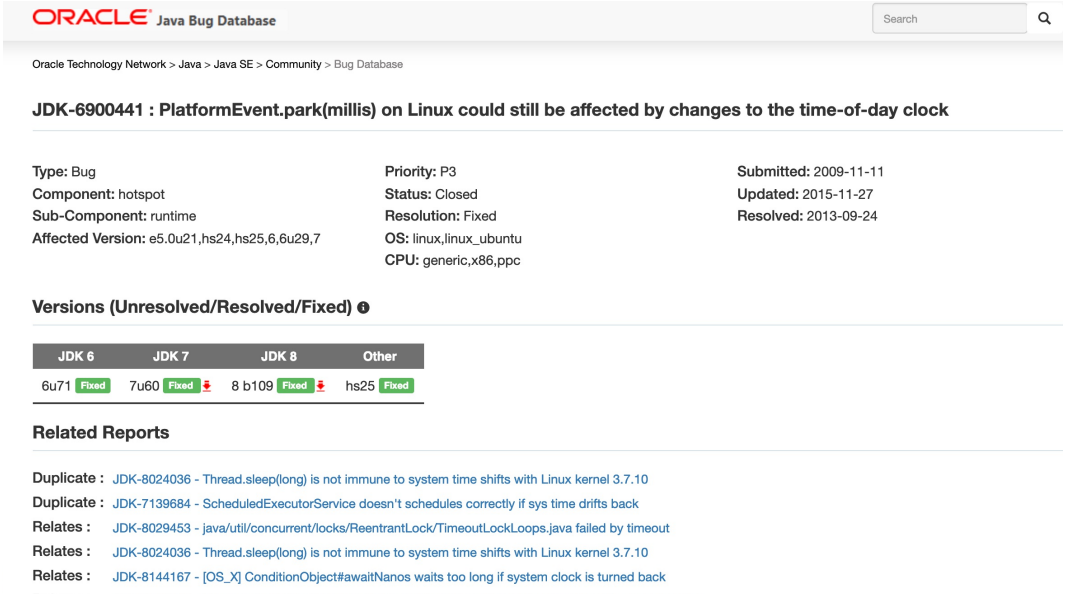
Bug 479765 - Leap second message can hang the kernel

Status: CLOSED ERRATA
Alias: None
Product: Red Hat Enterprise Linux 5
Component: kernel
Sub Component: Type a sub-component na (Show other bugs)
Version: 5.2
Hardware: All Linux
Priority: high
Severity: medium
Target Milestone: rc
Target Release: ---
Assignee: Prarit Bhargava
QA Contact: Red Hat Kernel QE team
Docs Contact:
URL:
Whiteboard:
Keywords: Reopened, ZStream
Duplicates (1): ~~800289~~ (view as bug list)
Depends On:
Blocks: 1300182 ~~483701~~ ~~485920~~ ~~801794~~
TreeView+ depends on / blocked

Reported: 2009-01-12 22:31 UTC by Chris Adams
Modified: 2018-11-28 20:21 UTC (History)
CC List: 15 users (show)
Fixed In Version:
Doc Type: Bug Fix
Doc Text:
Clone Of:
Environment:
Last Closed: 2009-09-02 08:33:56 UTC

Dependent Products:

Everyone do it wrong!?



ORACLE Java Bug Database

Search

Oracle Technology Network > Java > Java SE > Community > Bug Database

JDK-6900441 : PlatformEvent.park(millis) on Linux could still be affected by changes to the time-of-day clock

Type: Bug
Component: hotspot
Sub-Component: runtime
Affected Version: e5.0u21,hs24,hs25,6,6u29,7

Priority: P3
Status: Closed
Resolution: Fixed
OS: linux,linux_ubuntu
CPU: generic,x86,ppc

Submitted: 2009-11-11
Updated: 2015-11-27
Resolved: 2013-09-24

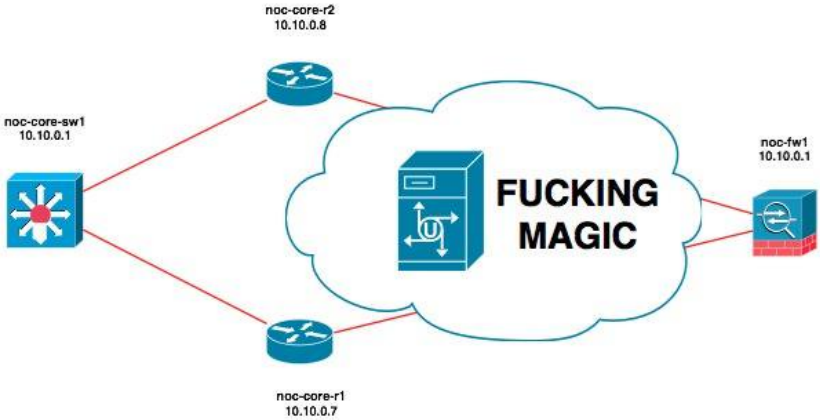
Versions (Unresolved/Resolved/Fixed)

JDK 6	JDK 7	JDK 8	Other
6u71 Fixed	7u60 Fixed	8 b109 Fixed	hs25 Fixed

Related Reports

Duplicate : JDK-8024036 - Thread.sleep(long) is not immune to system time shifts with Linux kernel 3.7.10
Duplicate : JDK-7139684 - ScheduledExecutorService doesn't schedules correctly if sys time drifts back
Relates : JDK-8029453 - java/util/concurrent/locks/ReentrantLock/TimeoutLockLoops.java failed by timeout
Relates : JDK-8024036 - Thread.sleep(long) is not immune to system time shifts with Linux kernel 3.7.10
Relates : JDK-8144167 - [OS_X] ConditionObject#awaitNanos waits too long if system clock is turned back
Relates : JDK-6546236 - Thread interrupt() of Thread.sleep() can be lost on Solaris due to race with signal handler

Distributed environment



I am the Law and Order

Needed to establish the order of events that have occurred in the system or when they will occur in the future

Order in Chaos

- Maintain consistency
- Build reliable systems

Order in Chaos

- Maintain consistency
- Build reliable systems
- Mutual exclusions
- Debug [Resumption of execution]

Distributed Systems

Synchronization in distributed systems is hard

- No shared memory
- No common clock

Common Clock

We can reliably define

Common Clock

We can reliably define

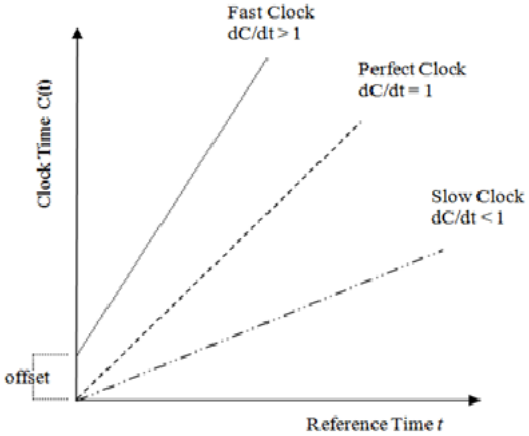
- simultaneous: all events that happen between clock ticks
- before: an event that happens in a previous clock tick
- after: an event that happens in a subsequent clock tick

Wall Clock

When kept under tension the quartz crystal oscillates at a well-defined frequency

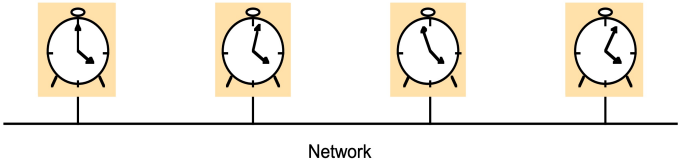
Clock Drift

We can't have perfect clocks



Ordinary quartz clocks drift by about 1 sec in 11-12 days

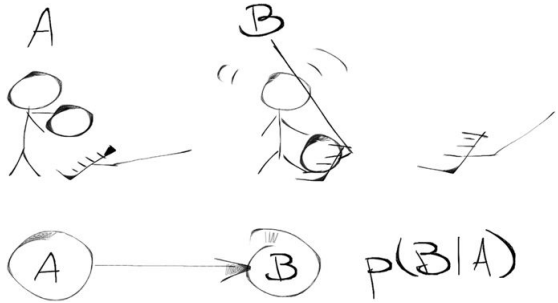
Clock Skew



Skew: the difference

between the times on two clocks (at any instant)

Causality



Causal relations
An example of a causal relation and its representation in a graph.
Credits: C. Giarmatzi

The WHY of things

- The concept of causality between events is fundamental to the design and analysis of parallel and distributed computing and operating systems
- Usually causality is tracked using physical time

The WHY of things

- The concept of causality between events is fundamental to the design and analysis of parallel and distributed computing and operating systems
- Usually causality is tracked using physical time
- In distributed systems, it is not possible to have a global physical time