

Getting More out of System Suspend in Linux*

Rafael J. Wysocki

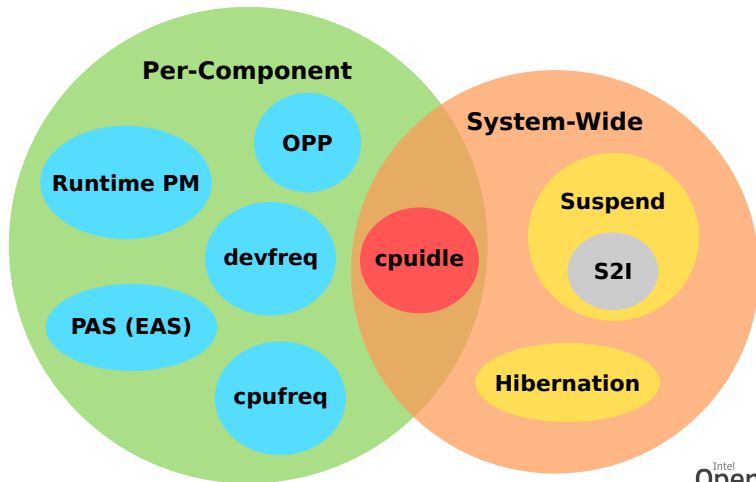
Intel Open Source Technology Center

January 15, 2015

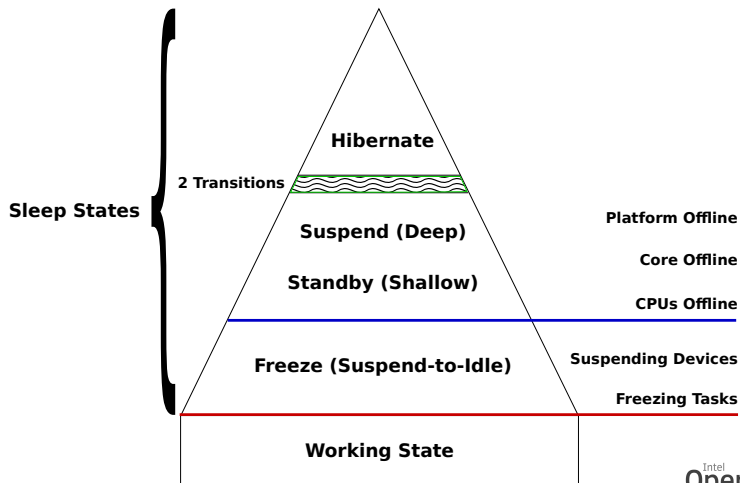
Outline

- 1 Introduction
 - Power Management Frameworks in Linux
 - System-Wide Power Management
- 2 Full Suspend And Suspend-to-Idle
 - General Idea
 - Full Suspend With Platform/HW Support
 - How Different Suspend-to-Idle Has To Be
- 3 Beyond Suspend-to-Idle
 - System Suspend Profiling
 - Reducing Resume Latency
 - PM Callback Reuse Problem
- 4 Resources

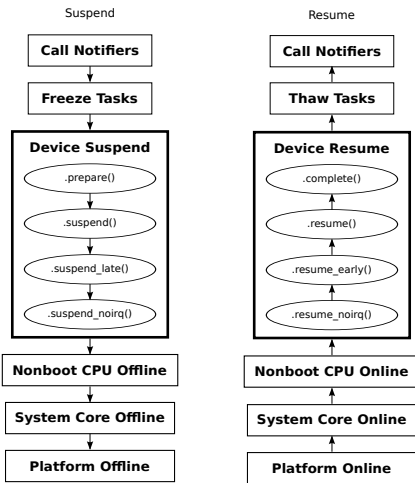
Overview Of Power Management In Linux



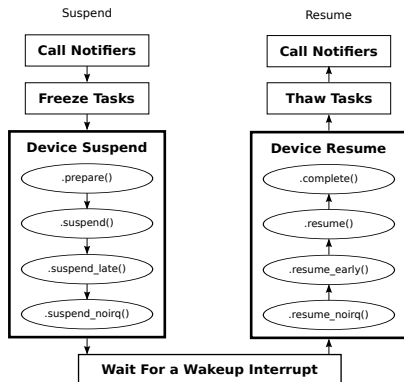
System-Wide PM Overview



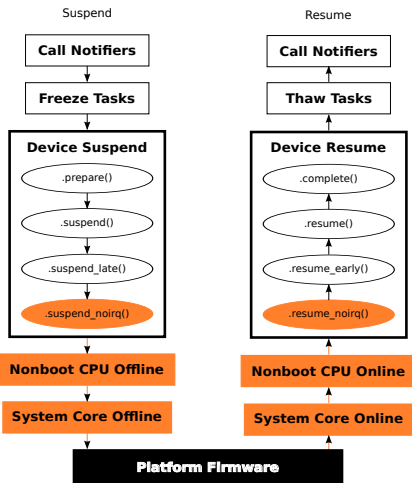
Full System Suspend (With Platform Support)



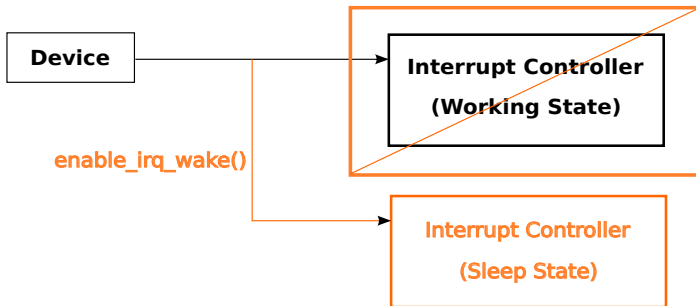
Suspend-to-Idle (S2I)



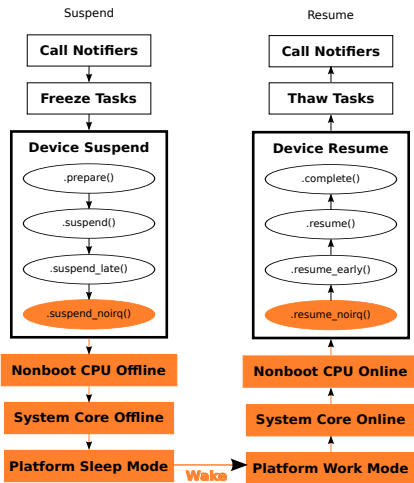
Full System Suspend On x86 PC



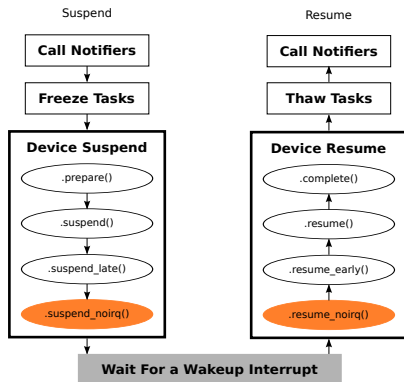
Hardware Support For Full Suspend (Example)



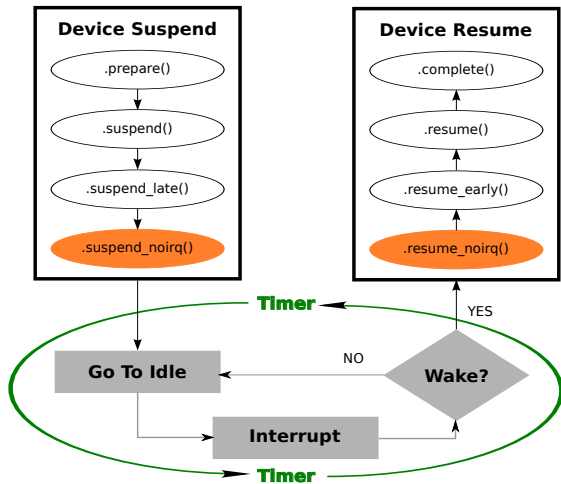
Full Suspend On Platforms With Hardware Support



Objective: Keep Full Suspend And S2I Similar



Suspend-to-Idle And Kernel Timers



Full System Suspend Time Profile (analyze_suspend.py)

wind 3.16.0-rc7-0.7-default+ mem August 13 2014, 02:58:03 AM

Kernel Suspend Time: **1183 ms**

Kernel Resume Time: **3555 ms**

Device Detail

ZOOM IN

ZOOM OUT

ZOOM 1:1



Suspend-to-Idle Time Profile (analyze_suspend.py)

wind 3.16.0-rc7-0.7-default+ freeze August 13 2014, 03:11:12 AM

Kernel Suspend Time: **949 ms**

freeze time: **2808 ms**

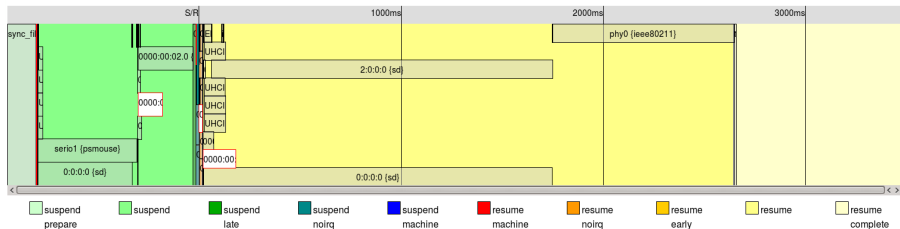
Kernel Resume Time: **3482 ms**

Device Detail

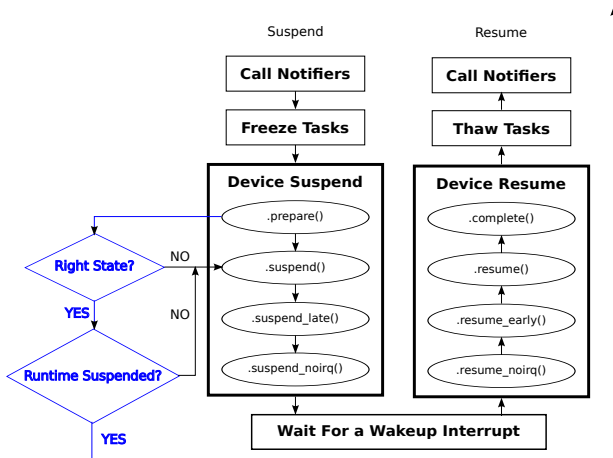
ZOOM IN

ZOOM OUT

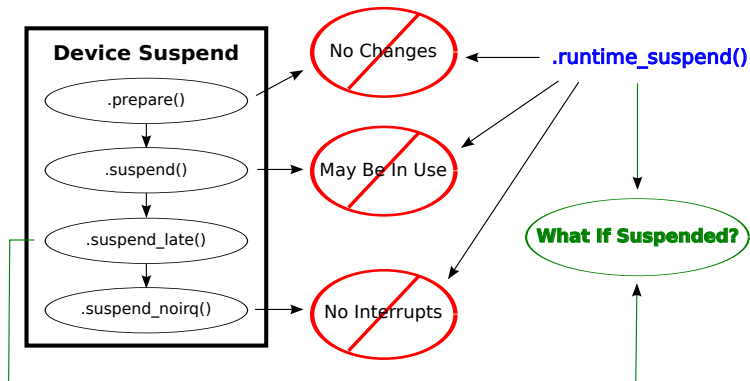
ZOOM 1:1



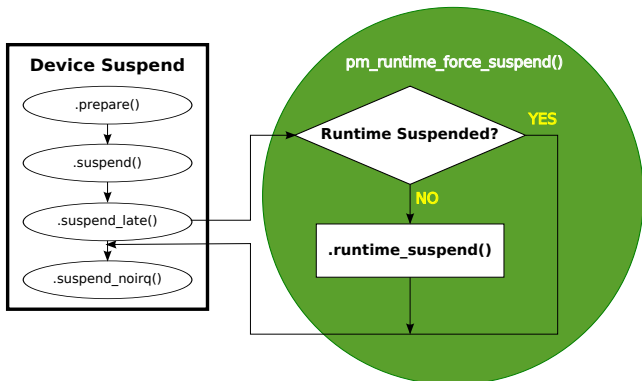
Device Suspend/Resume Avoidance



Can Runtime Suspend Callback Be Reused?



Generic Wrapper PM Callback Routines



References



R. J. Wysocki, *Why We Need More Device Power Management Callbacks* (https://events.linuxfoundation.org/images/stories/pdf/lfcs2012_wysocki.pdf).



R. J. Wysocki, *Power Management in the Linux Kernel – Current Status and Future* (http://events.linuxfoundation.org/sites/events/files/slides/kernel_PM_plain.pdf).

Tools, Documentation And Source Code

- <https://patchwork.kernel.org/patch/5460171/>
- <https://github.com/01org/suspendresume>
- Documentation/power/devices.txt
- Documentation/power/pci.txt
- Documentation/power/states.txt
- Documentation/power/runtime_pm.txt
- include/linux/cpuidle.h
- include/linux/device.h
- include/linux/pm.h
- include/linux/suspend.h
- drivers/base/power/*
- drivers/cpuidle/*
- kernel/power/*

Legal Information

Intel is a trademark of Intel Corporation in the U. S. and other countries.
*Other names and brands may be claimed as the property of others.
Copyright © 2014 Intel Corporation, All rights reserved.

Thanks!

Thank you for attention!