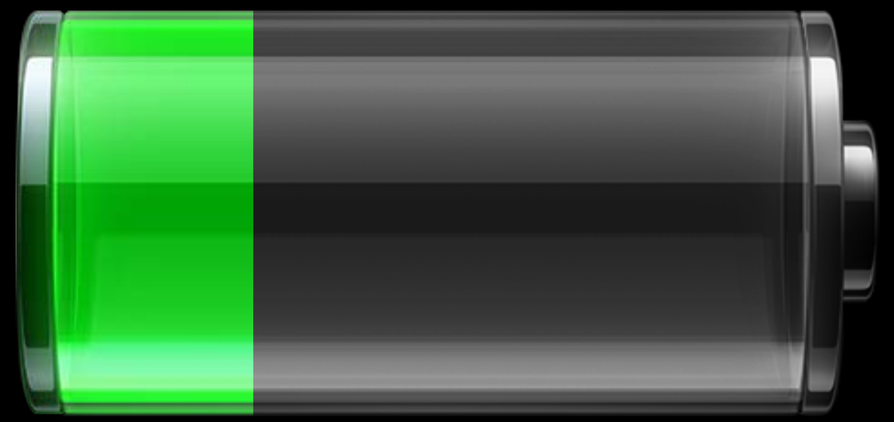
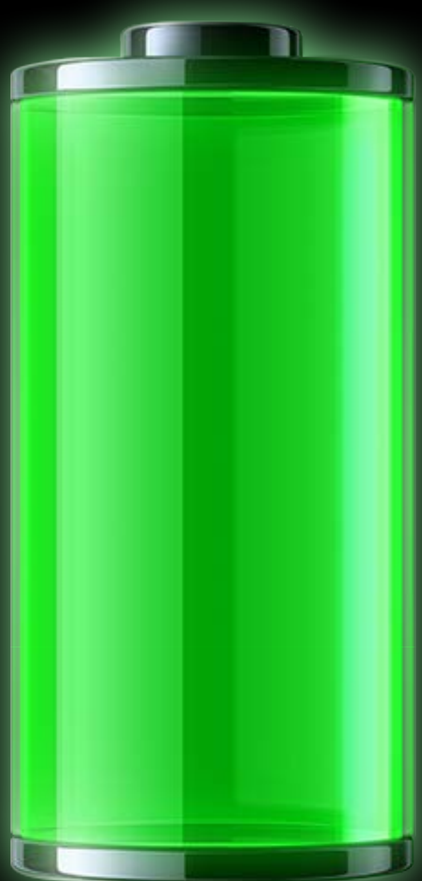
Maximizing Battery Life on OS X

Session 701

Bud Tribble
Vice President of Software Technology

These are confidential sessions—please refrain from streaming, blogging, or taking pictures





Power of Mobility

12
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12
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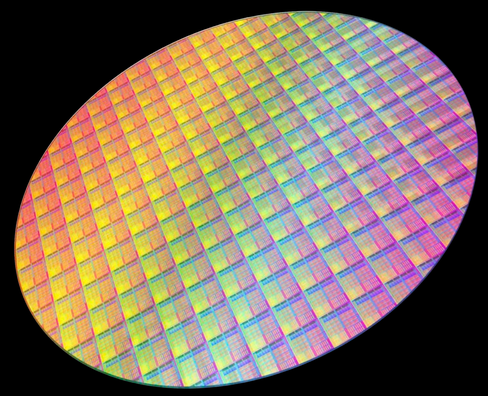
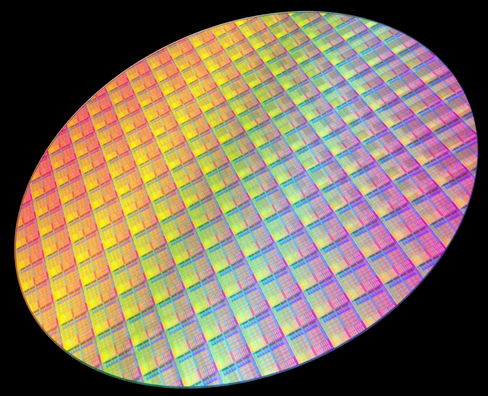
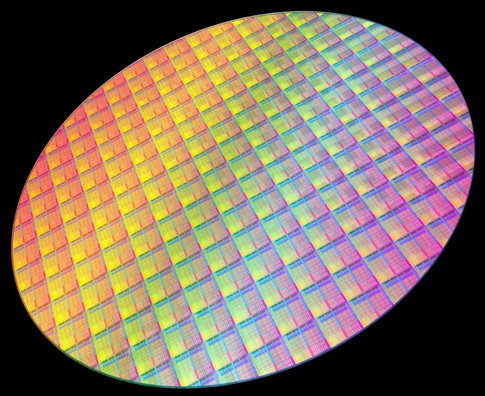
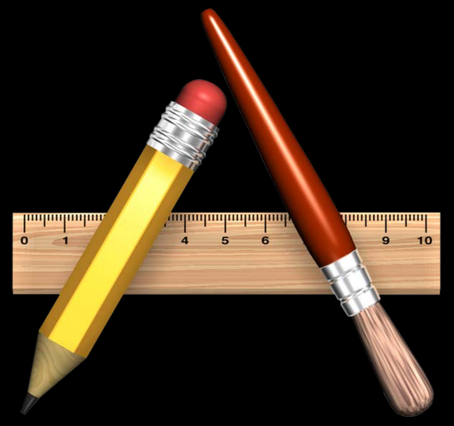
TACKING TO THE FINISH
"THE THIRD DAY CLEARED AND WE JUST FOCUSED... REALLY KEPT OUR SENSES UP FOR THE WIND."
2 COXON WILDE
3 MILTOWN CAPE
4 PENSACOLA IX
5 BOITE GRISE
MacBook Air
MacBook Air








0
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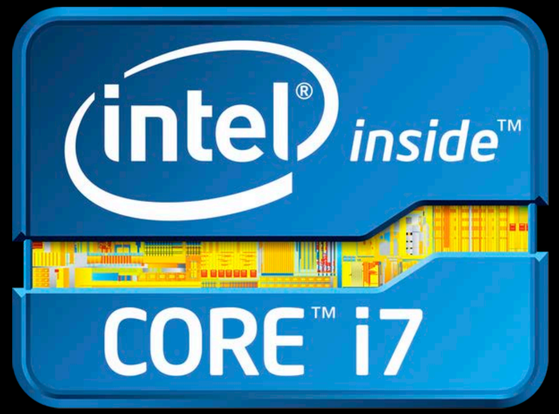
Hardware and Software

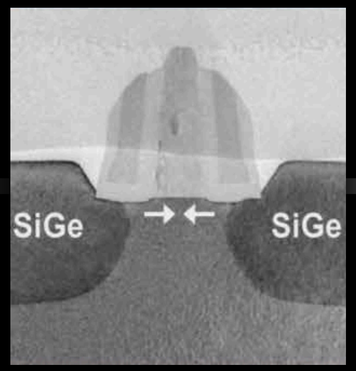
MC68000L8
GN78503


intel
inside
CORE i7

Intel Advancements

Intel Advancements

90 nm
SiGe
Strained Silicon

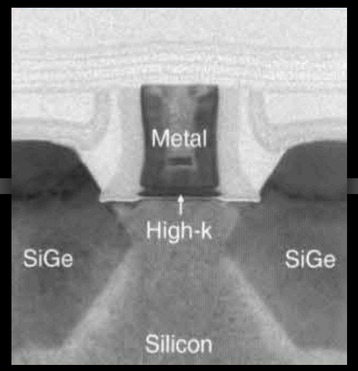


2003

65 nm
2nd Gen. SiGe
Strained Silicon

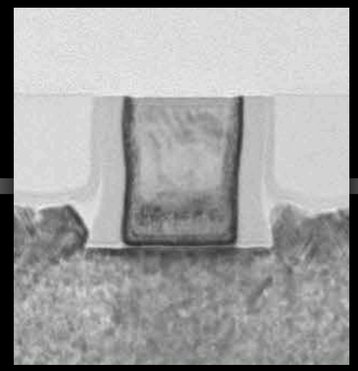
2005

45 nm
Gate-Last
High-k Metal Gate



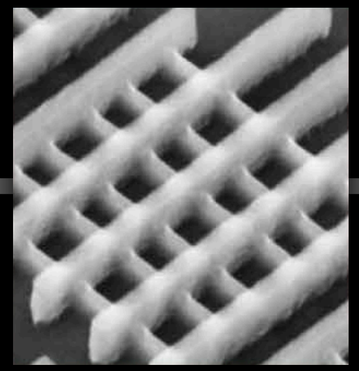
2007

32 nm
2nd Gen. Gate-Last
High-k Metal Gate



2009

22 nm
Tri-Gate



2011

Strained Silicon

High-k Metal Gate

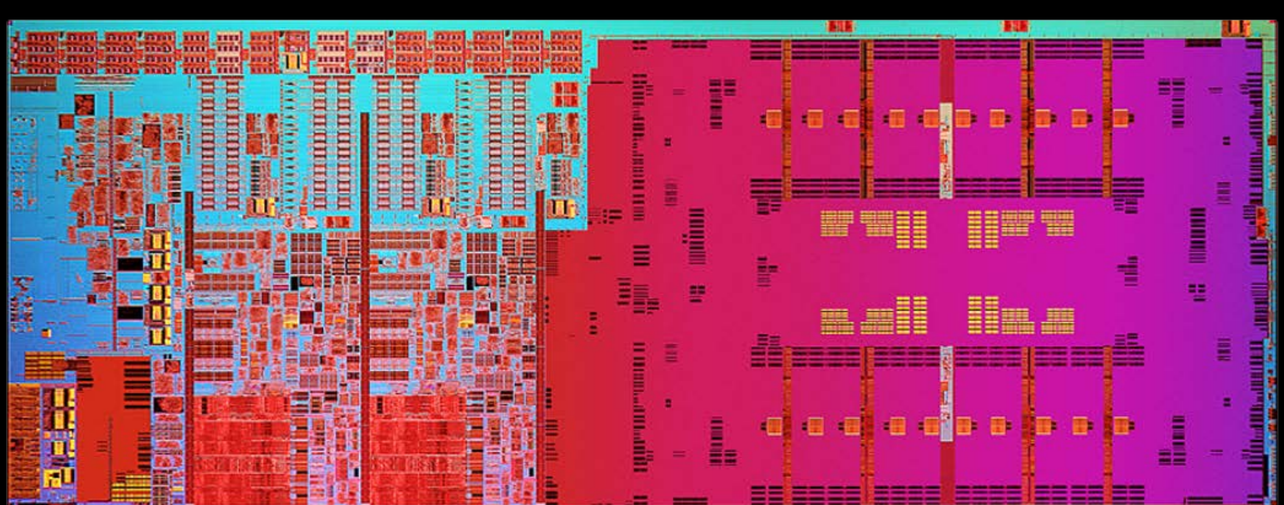
Tri-Gate

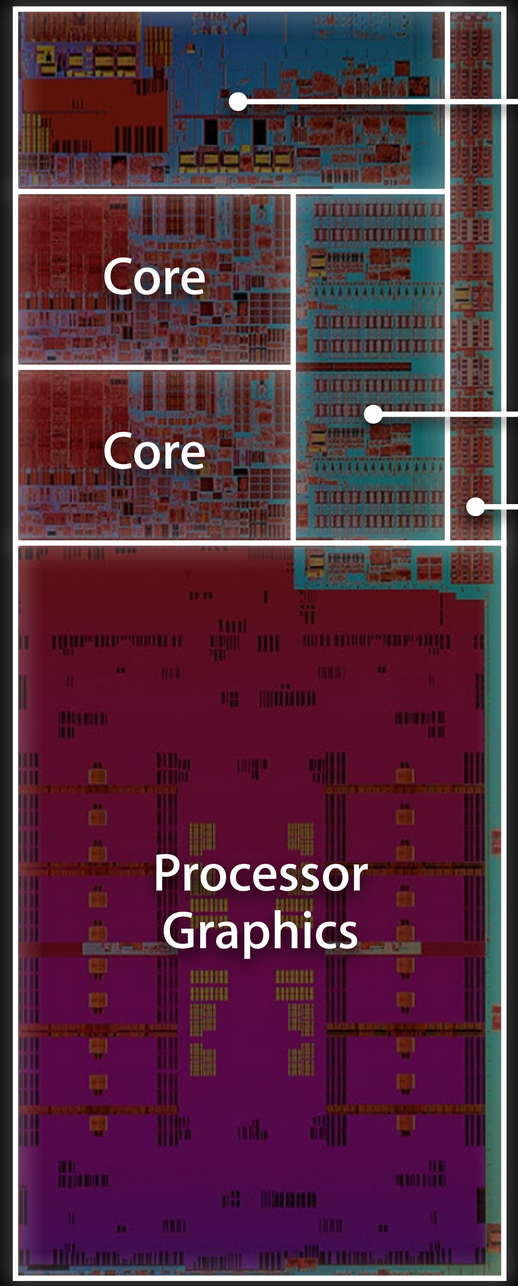
nano-Joules

Instruction

10^{-9} Joules

Instruction



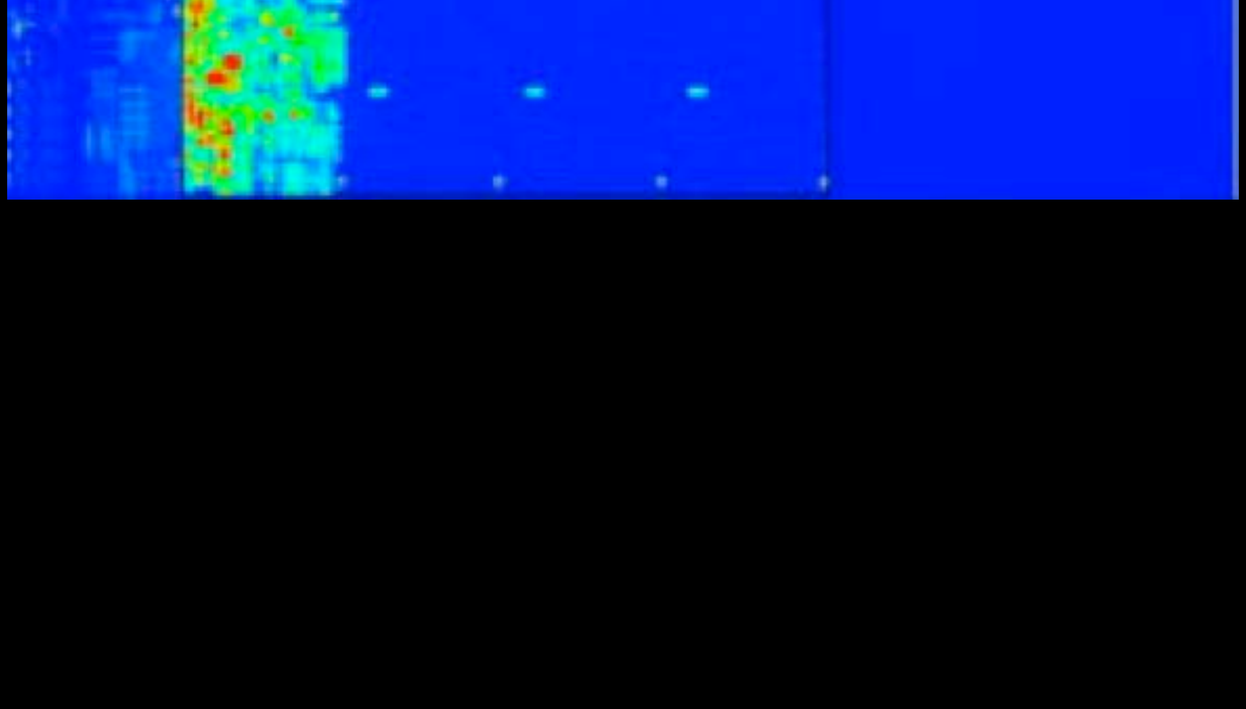


System Agent, Display Engine and Memory Controller

Including Display, PCIe, and DMI IOs

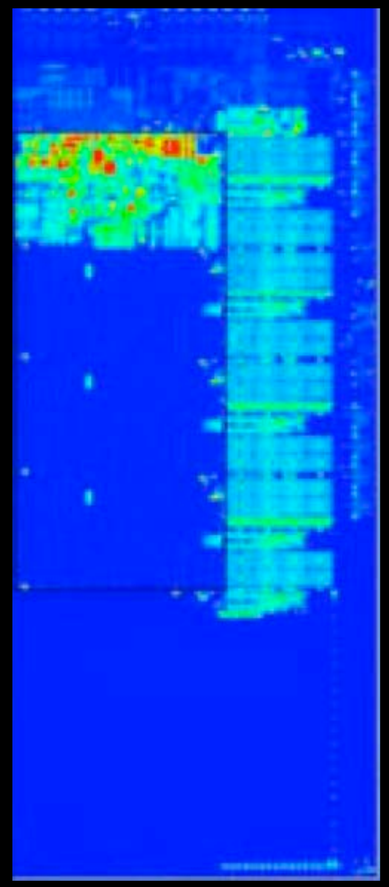
Shared L3 Cache

Memory Controller I/O

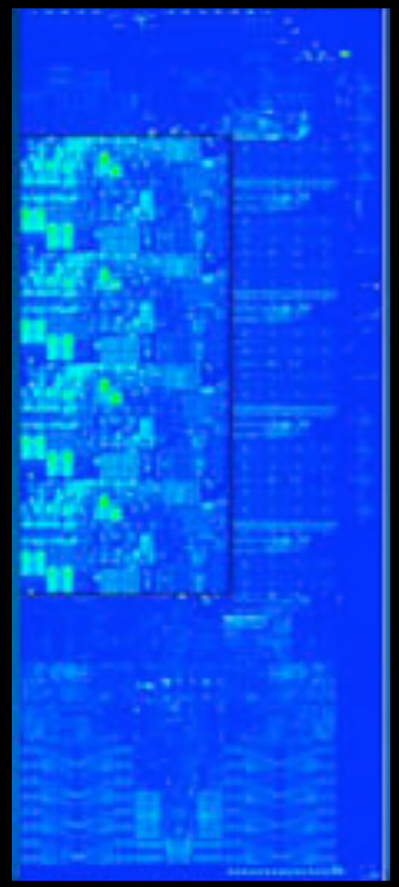


IREM Images

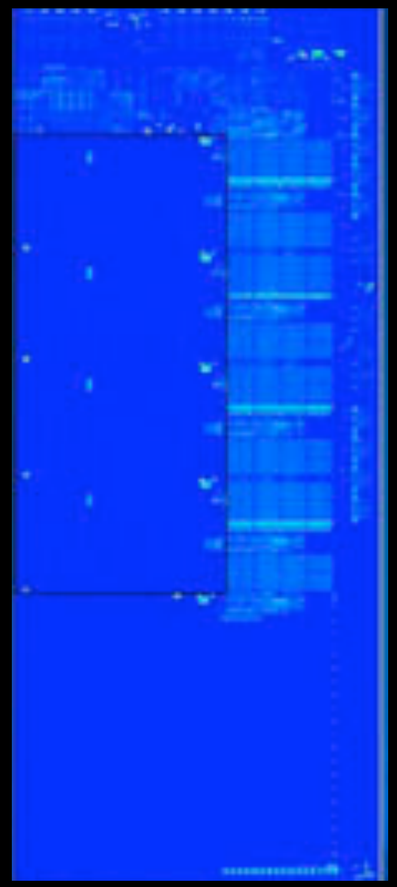
One core in turbo, other three cores power gated



Typical usage of cores and graphics

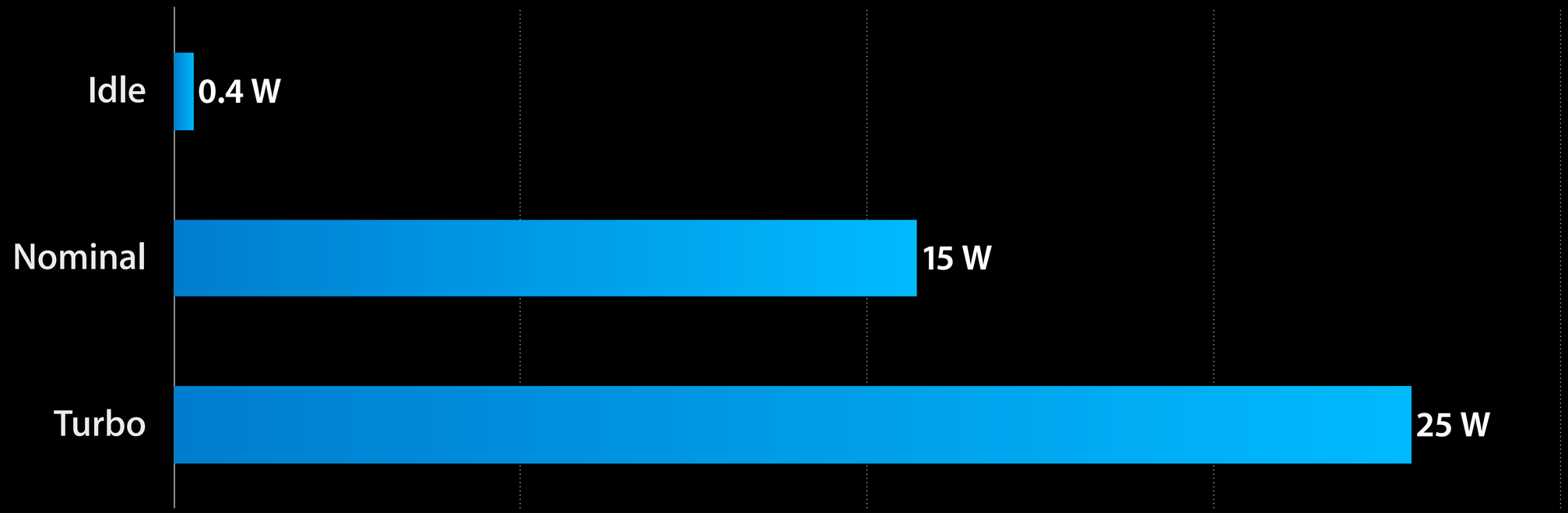


Cores and graphics gated



CPU Power Usage

What can modern chips do?



System Power Usage

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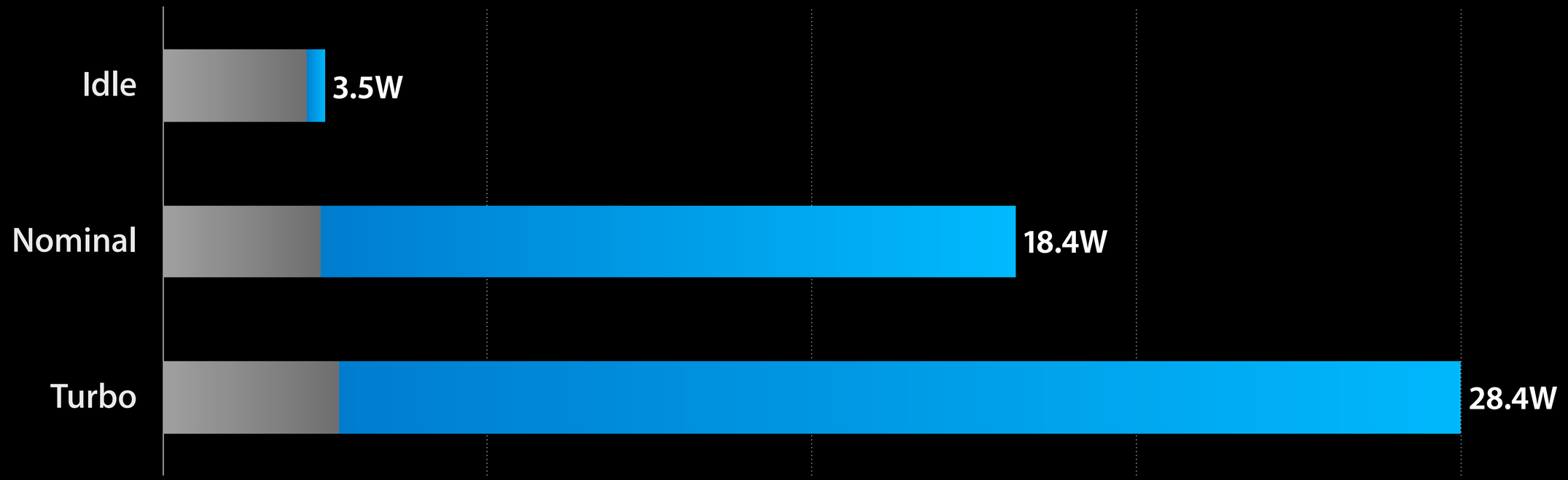


Finder File Edit View Go Window Help
Mon 9:41 AM
Visit Norway - Official Travel Guide to Norway - visitnorway.com
www.visitnorway.com
NORWAY
Home Booking About Norway Where to go What to do Where to stay Getting here and around
Fjord Norway
Western Norway is famous for easily accessible fjords and mountains. The area offers activities such as hiking, glacier walking, fishing and cycling.

Normal User Activity

Typing

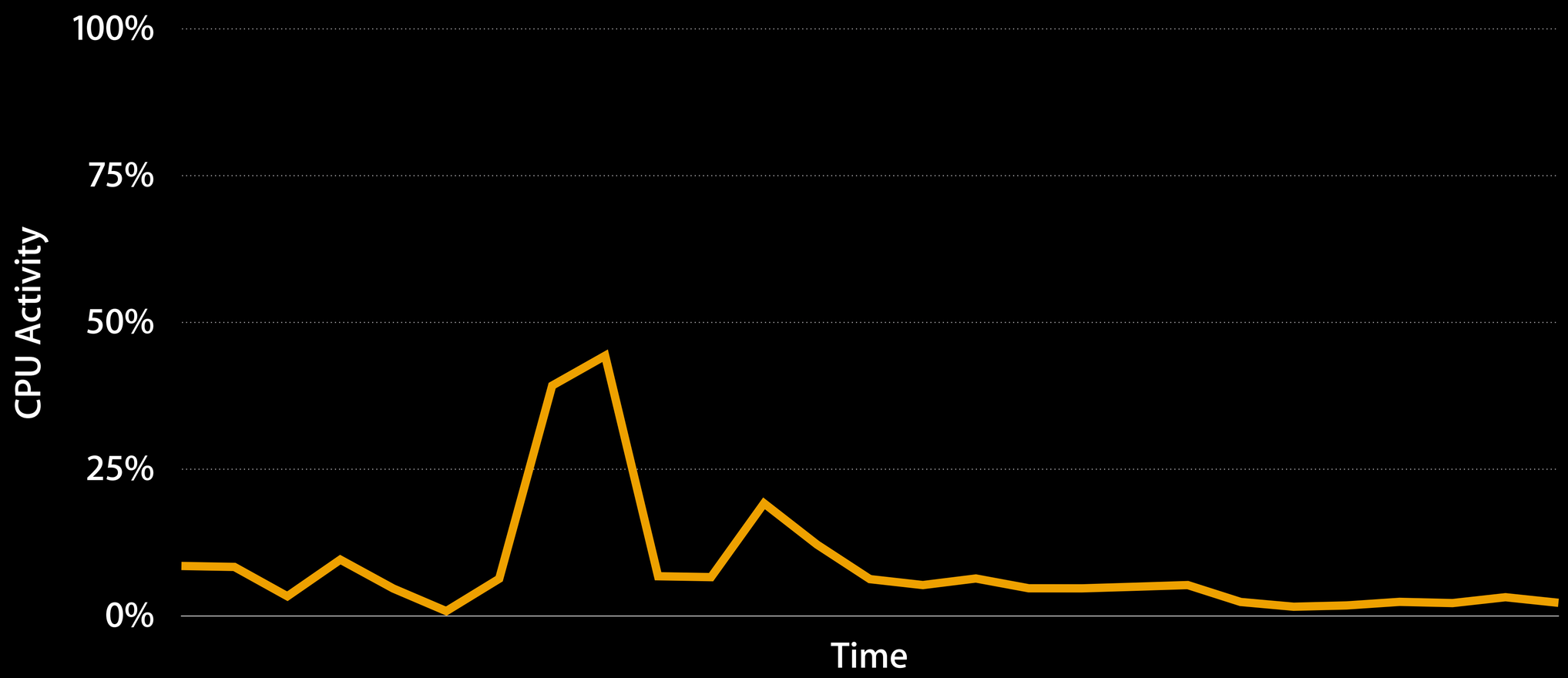
- 50 WPM
- 1 key every 0.24 seconds

Staying Idle

Visiting apple.com in Safari

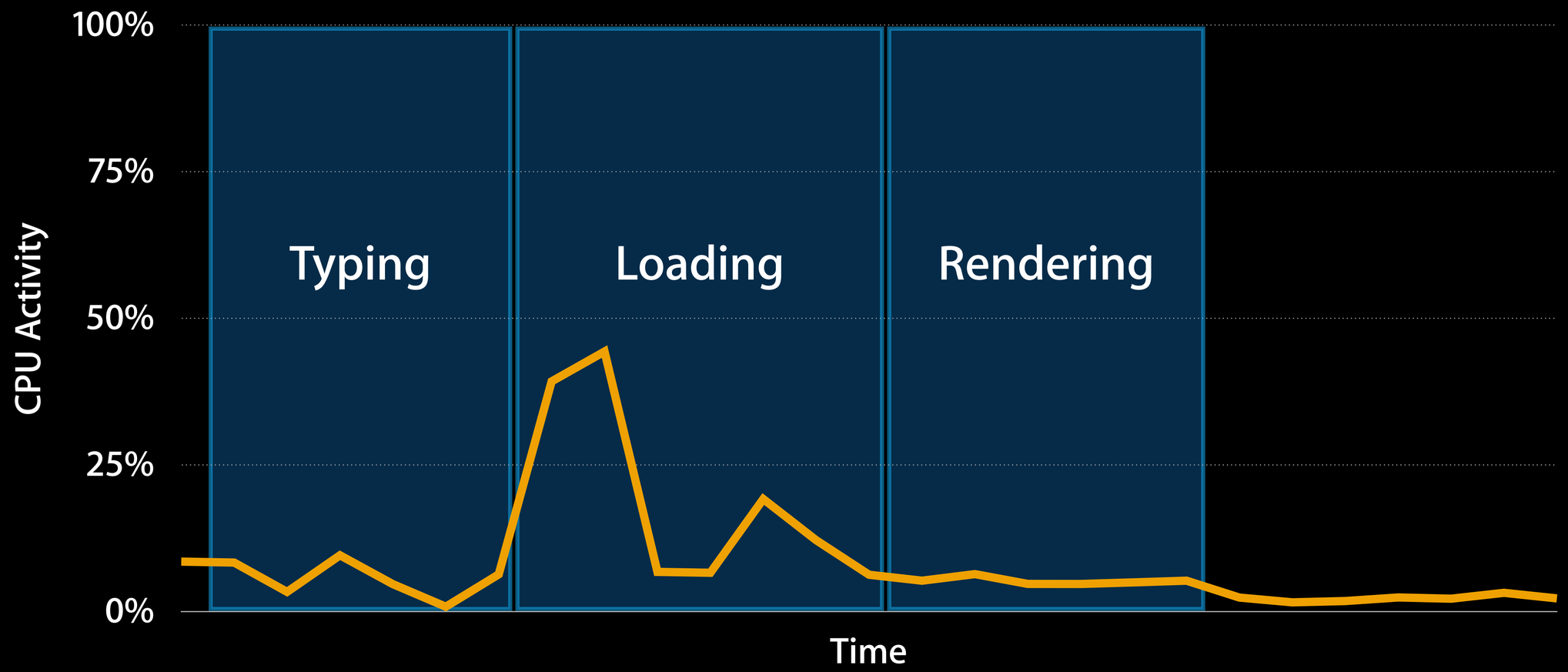
Staying Idle

Visiting apple.com in Safari

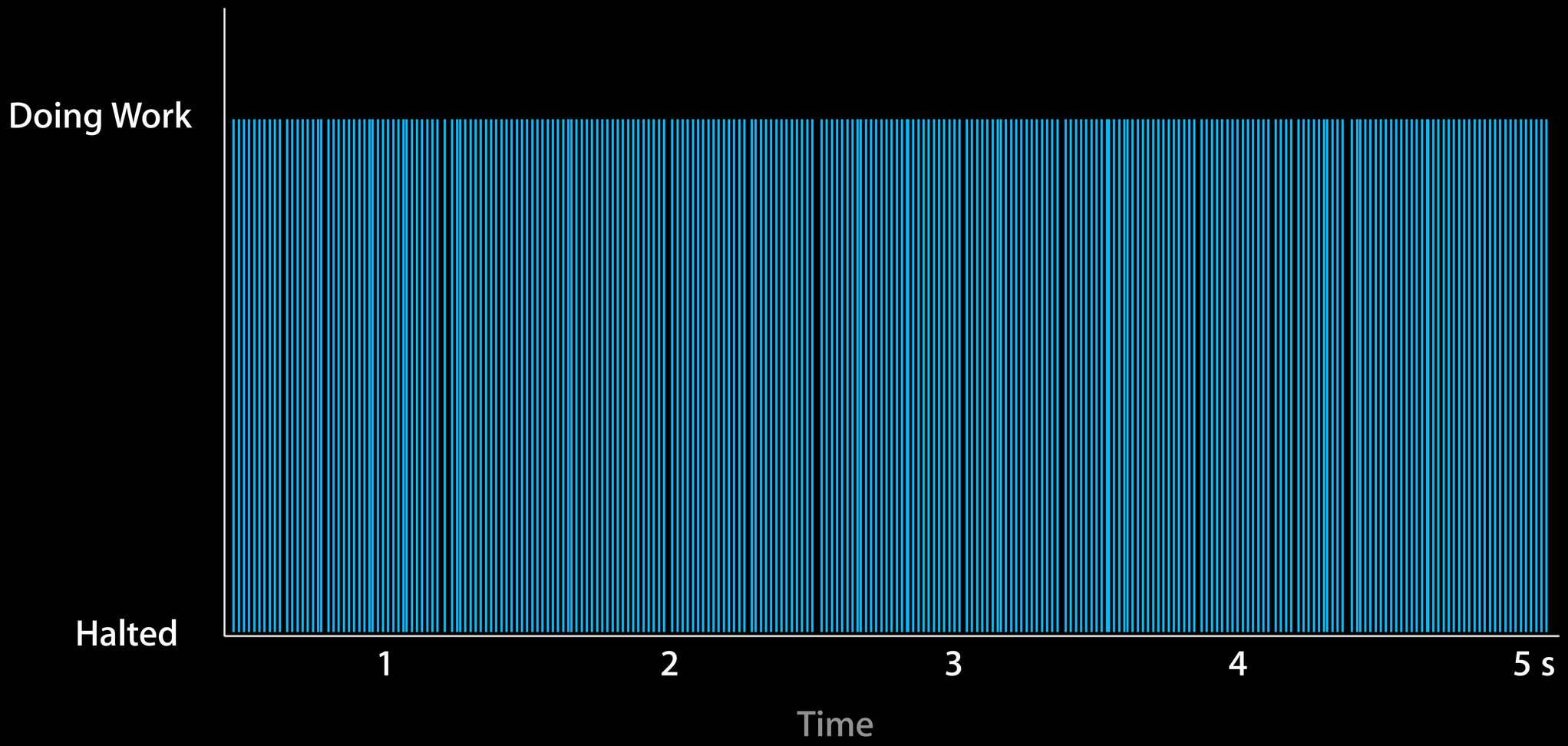


Staying Idle

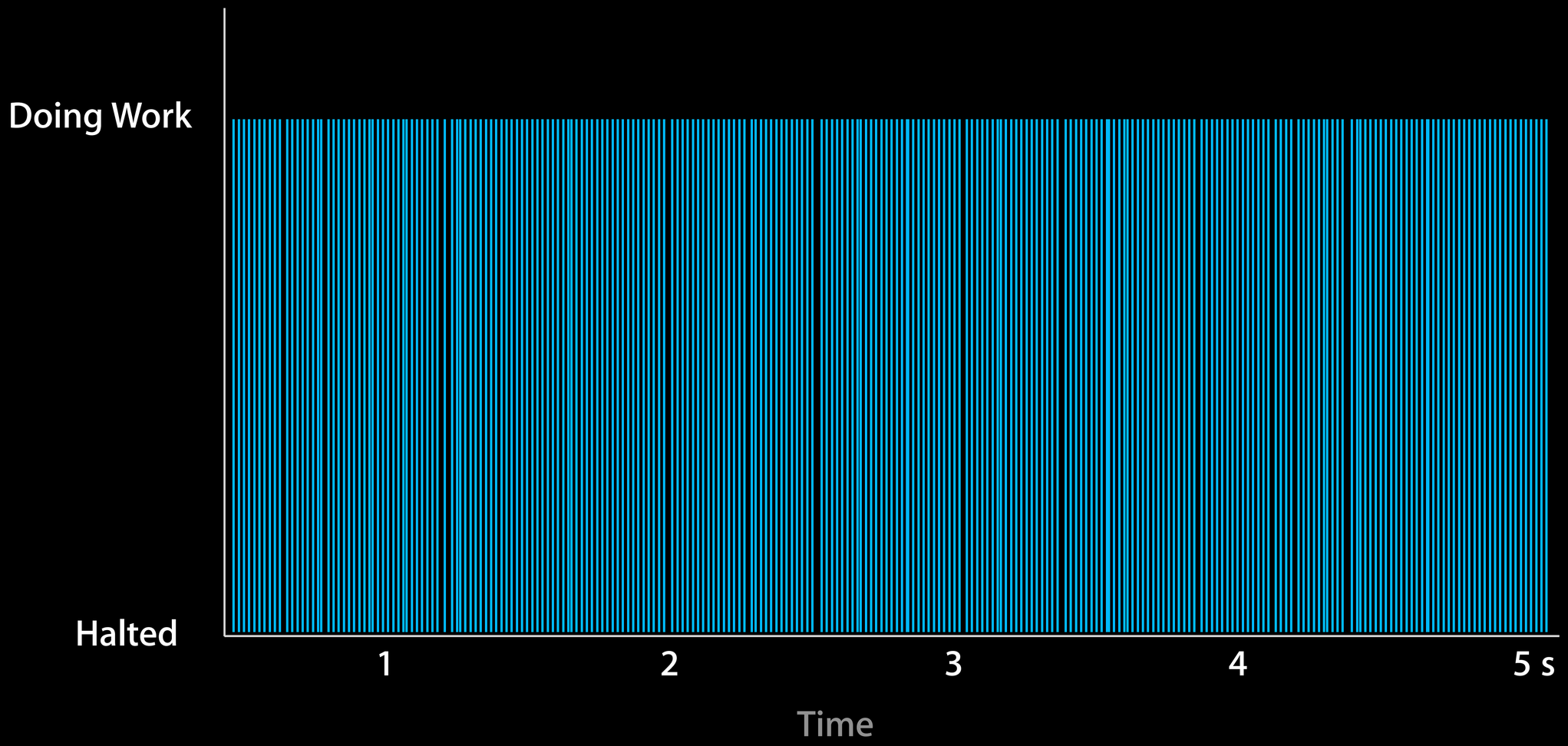
Visiting apple.com in Safari



Typical System Activity



Typical System Activity



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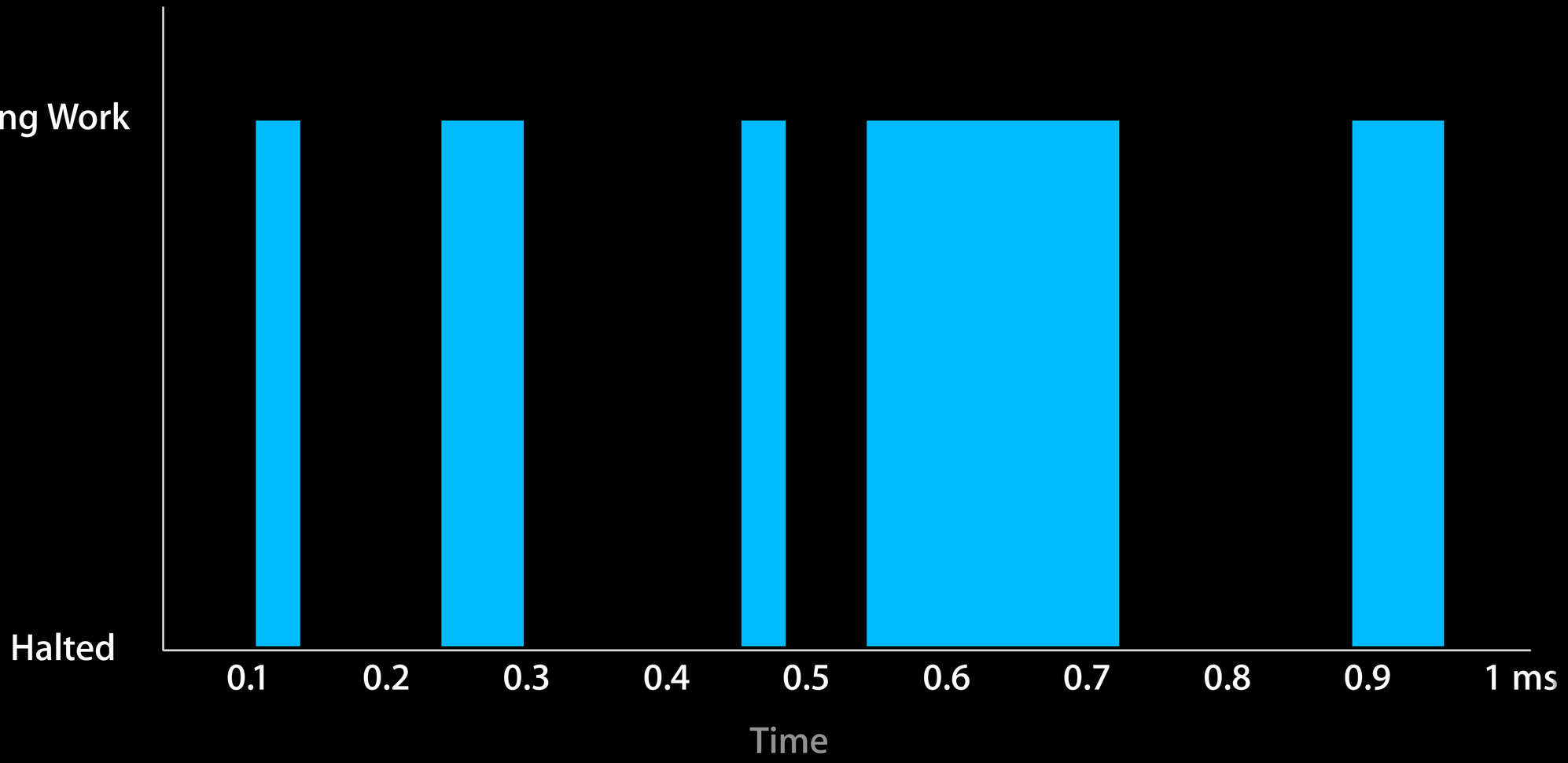
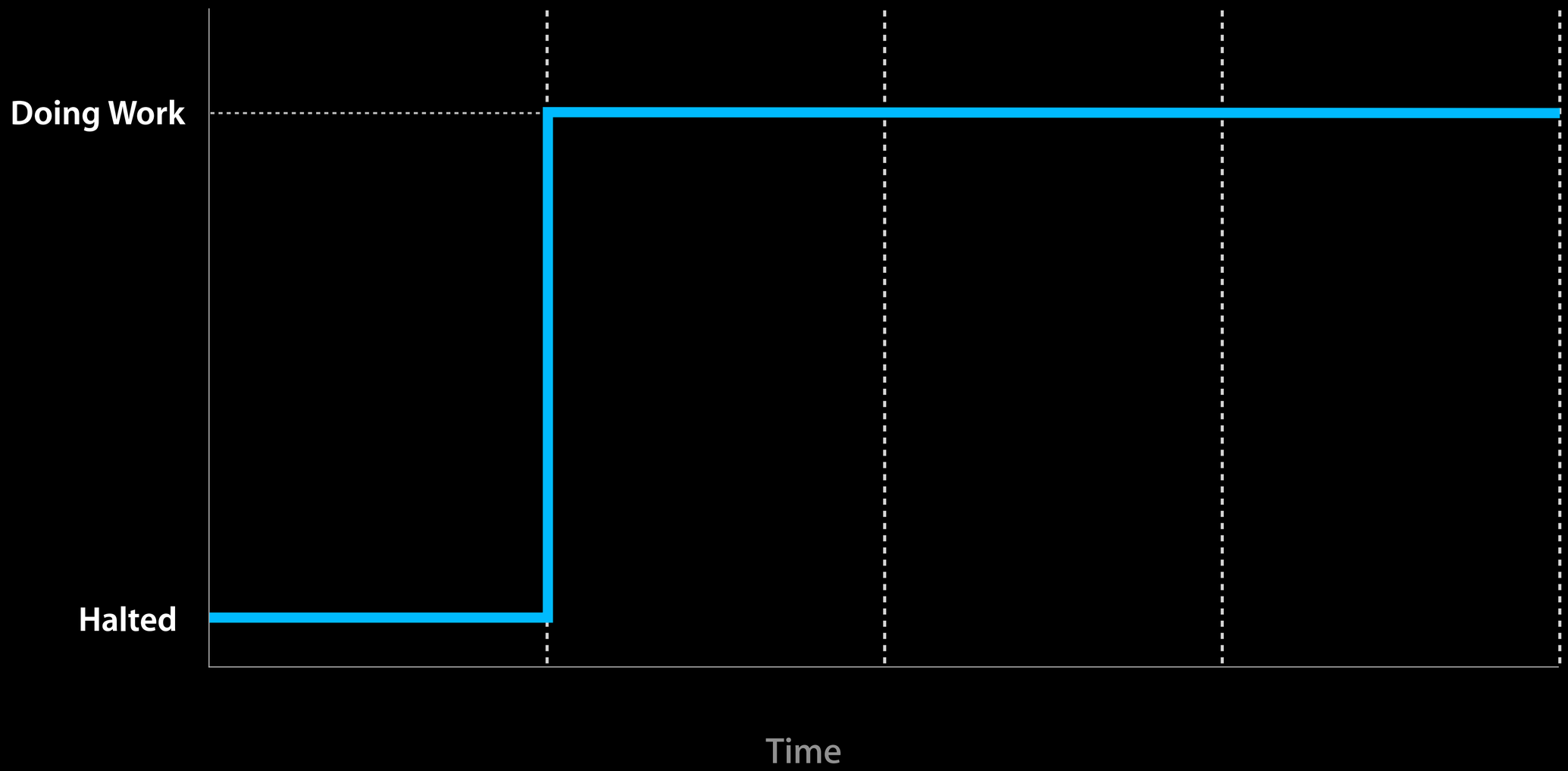
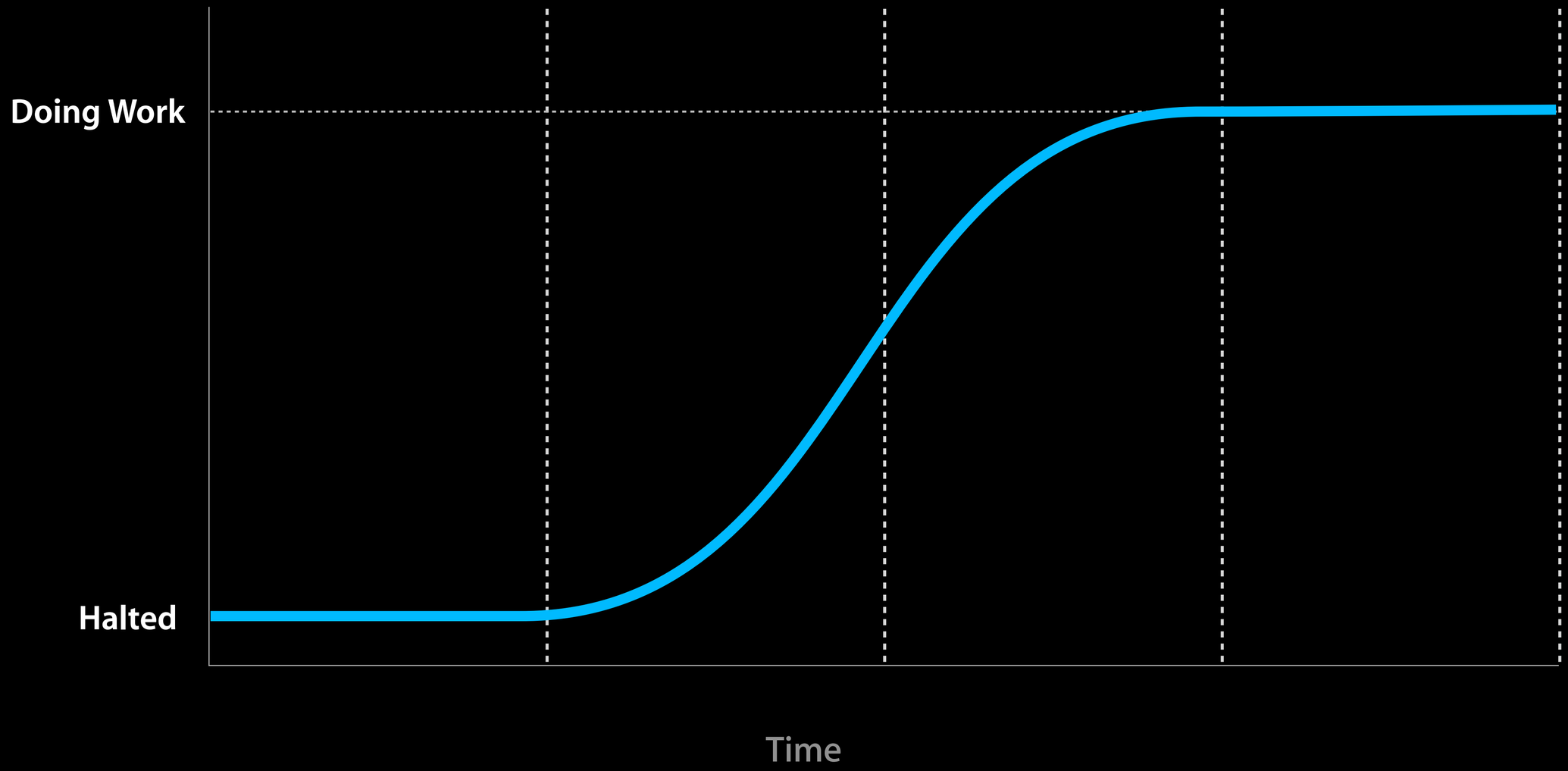
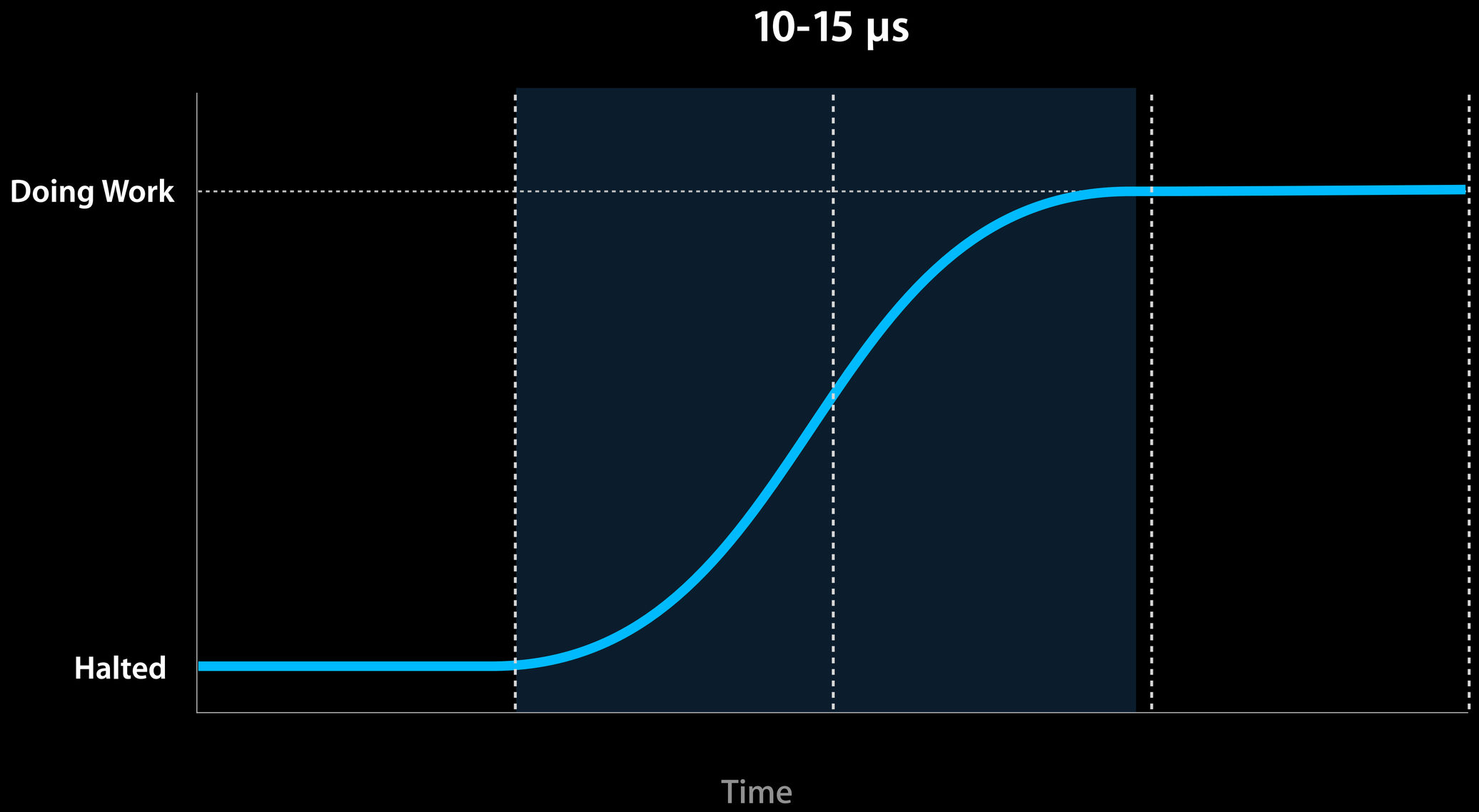
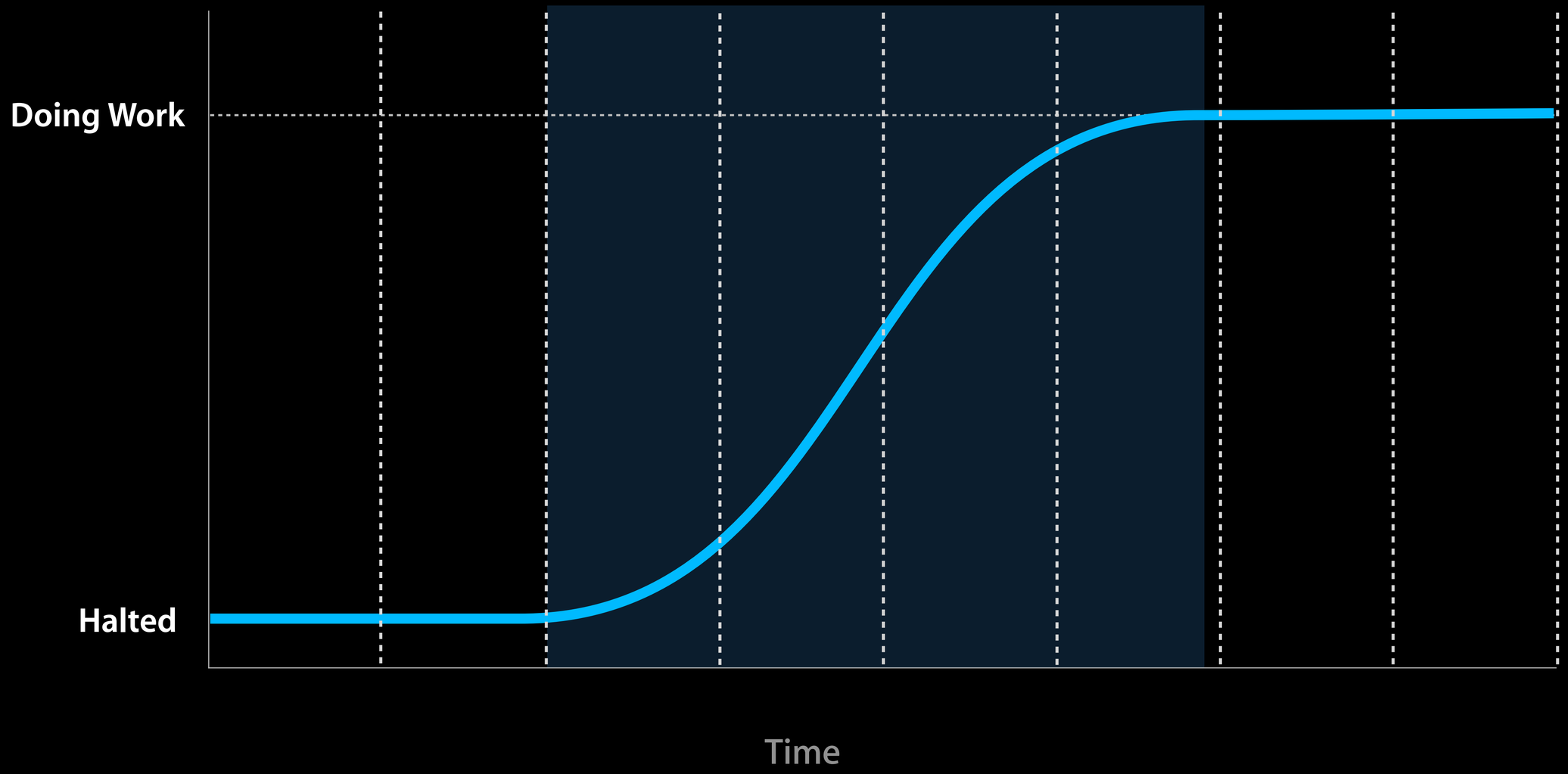
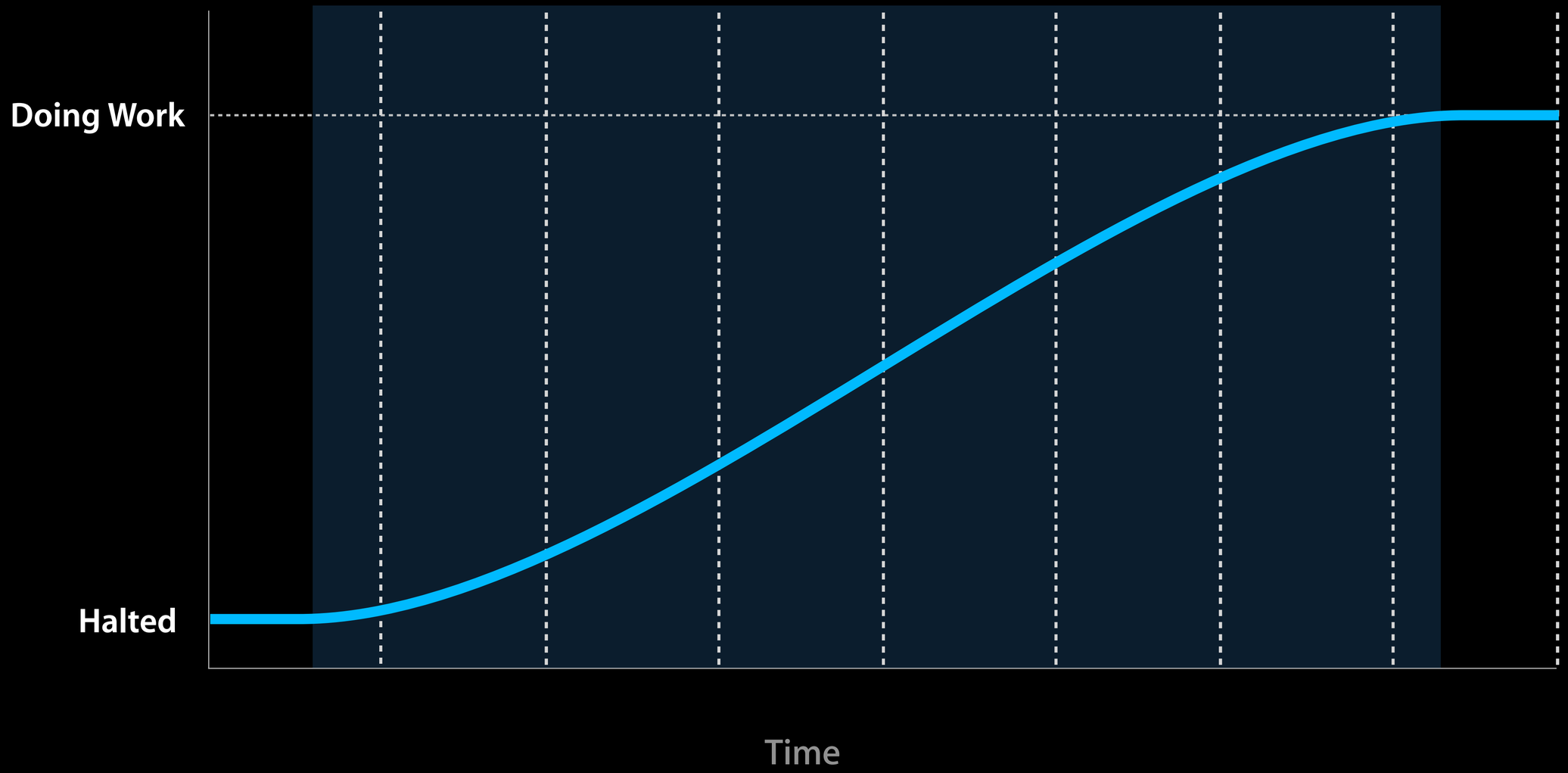


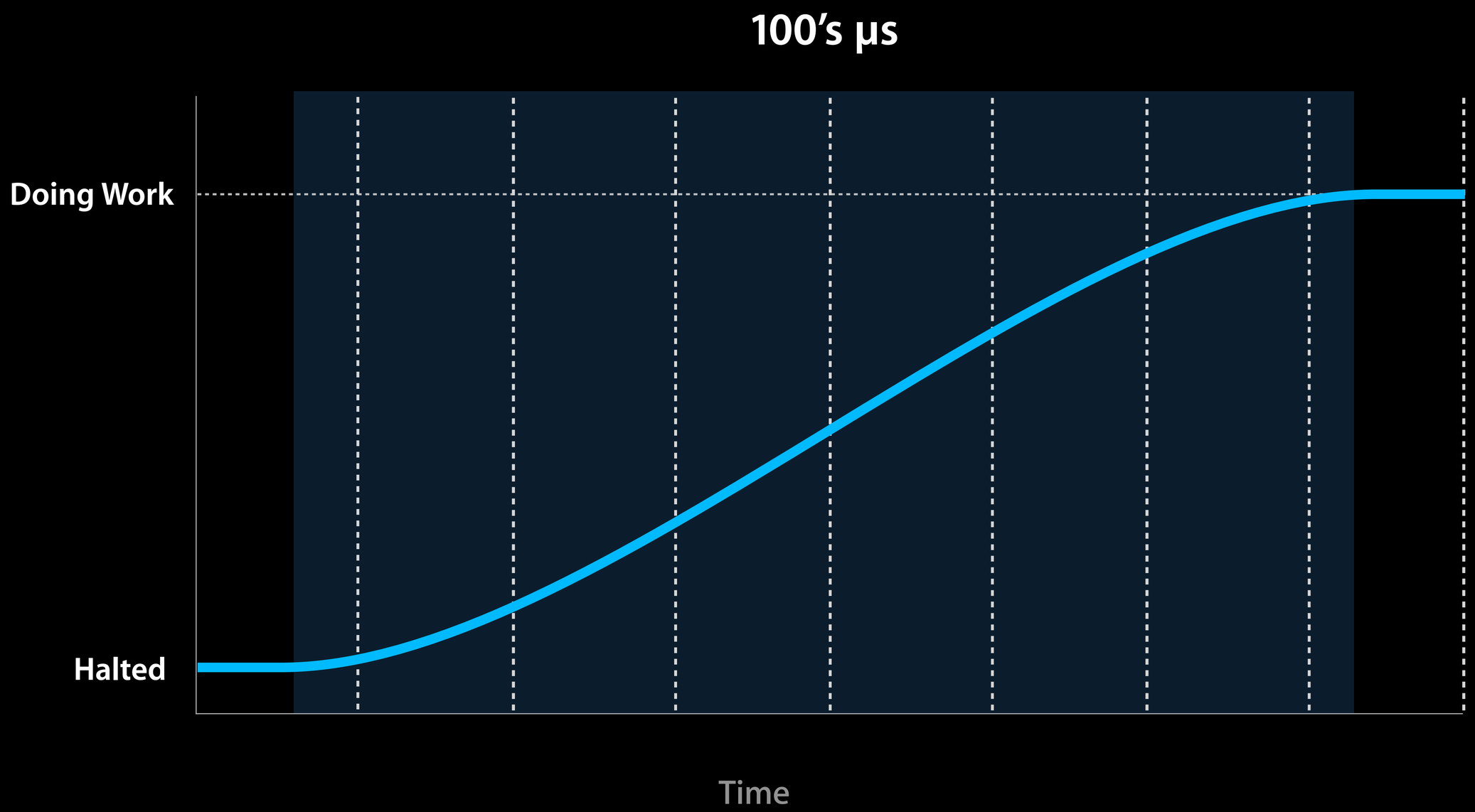

Doing Work
Halted
Time

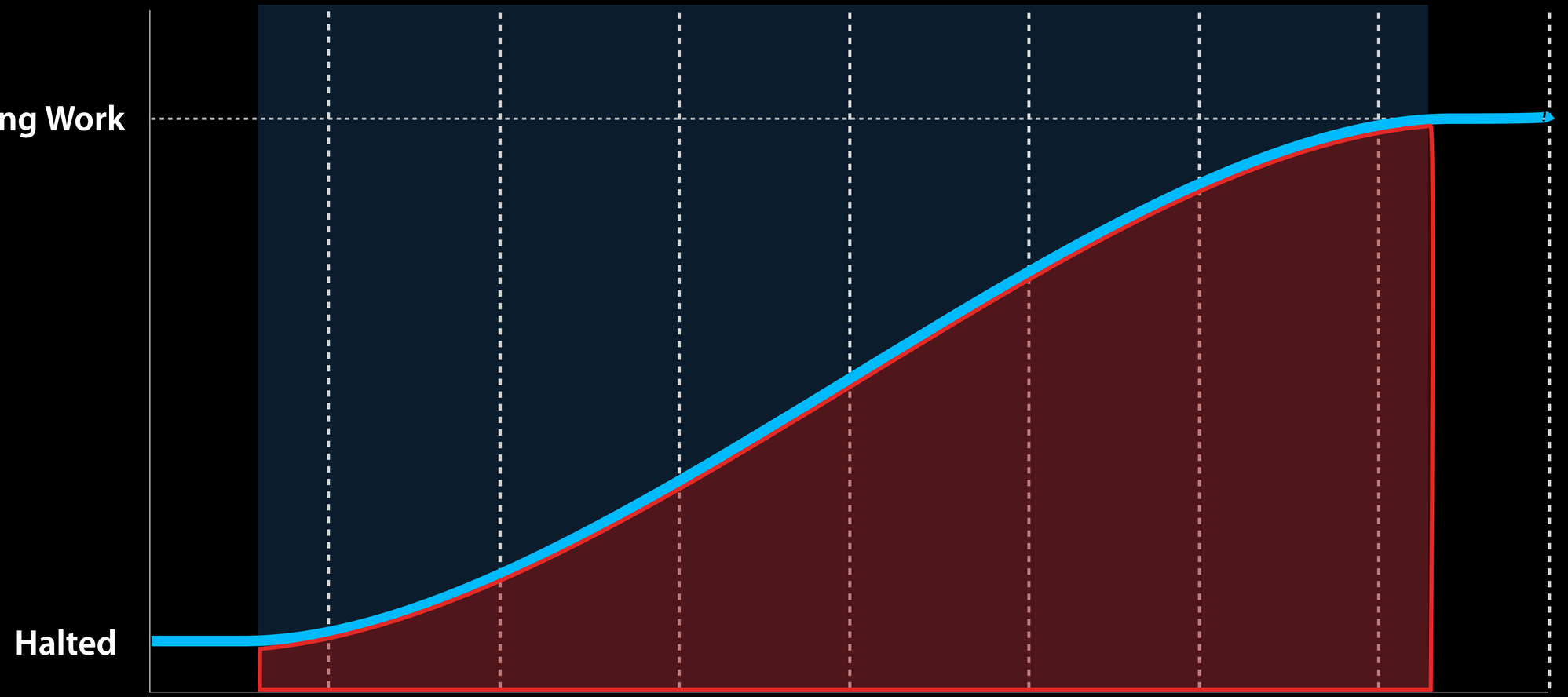

Doing Work
Halted
Time

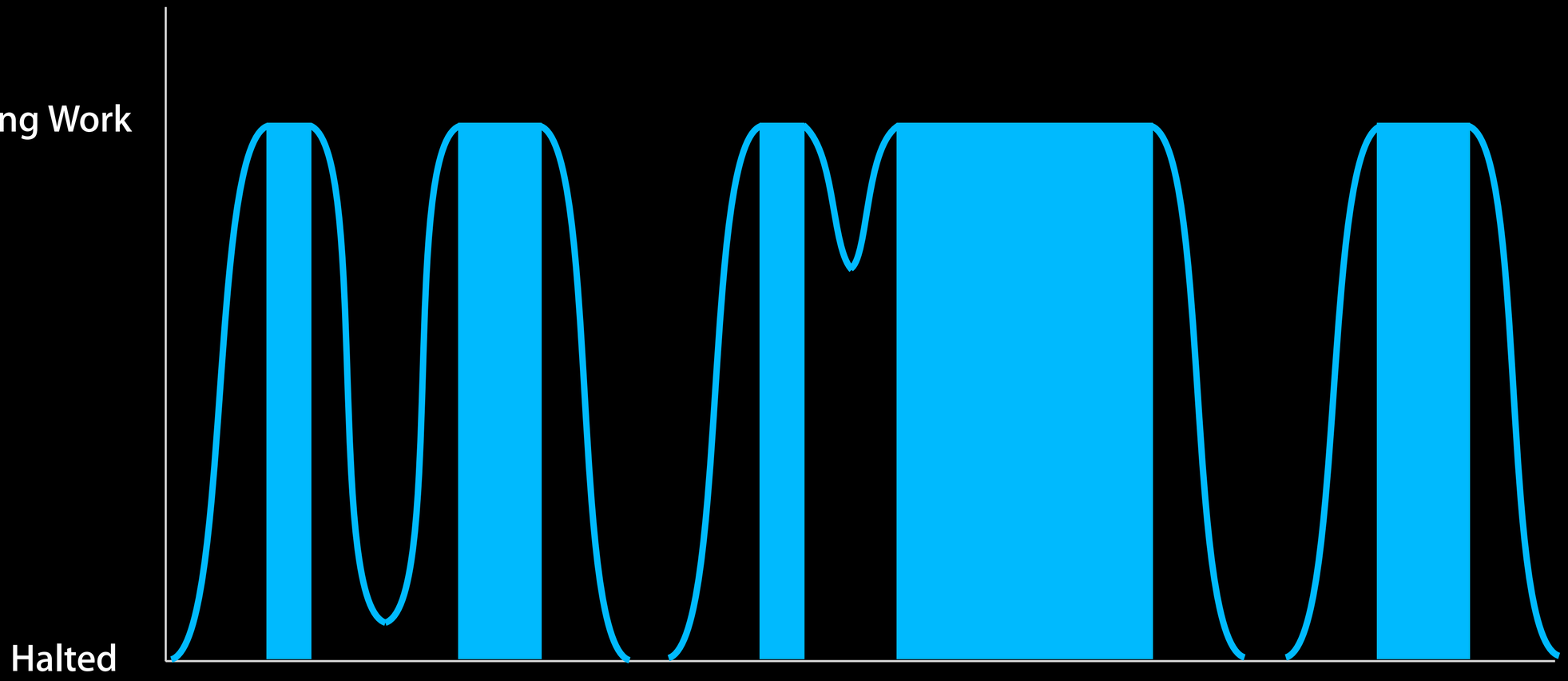

10-15 µs
Doing Work
Halted
Time


Doing Work
Halted
Time


Doing Work
Halted
Time


100’s µs
Doing Work
Halted
Time


Doing Work
Halted
Time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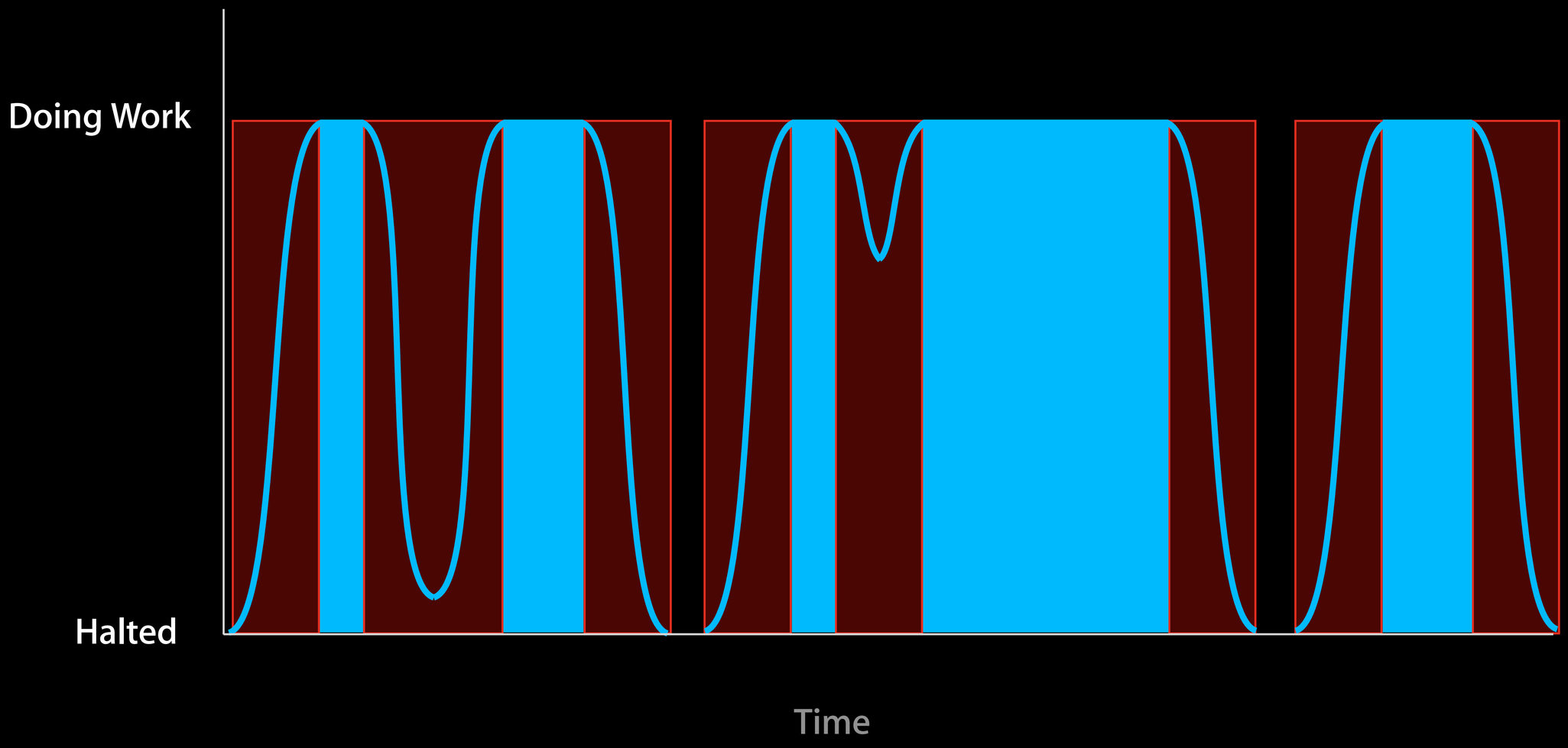
Halted
Time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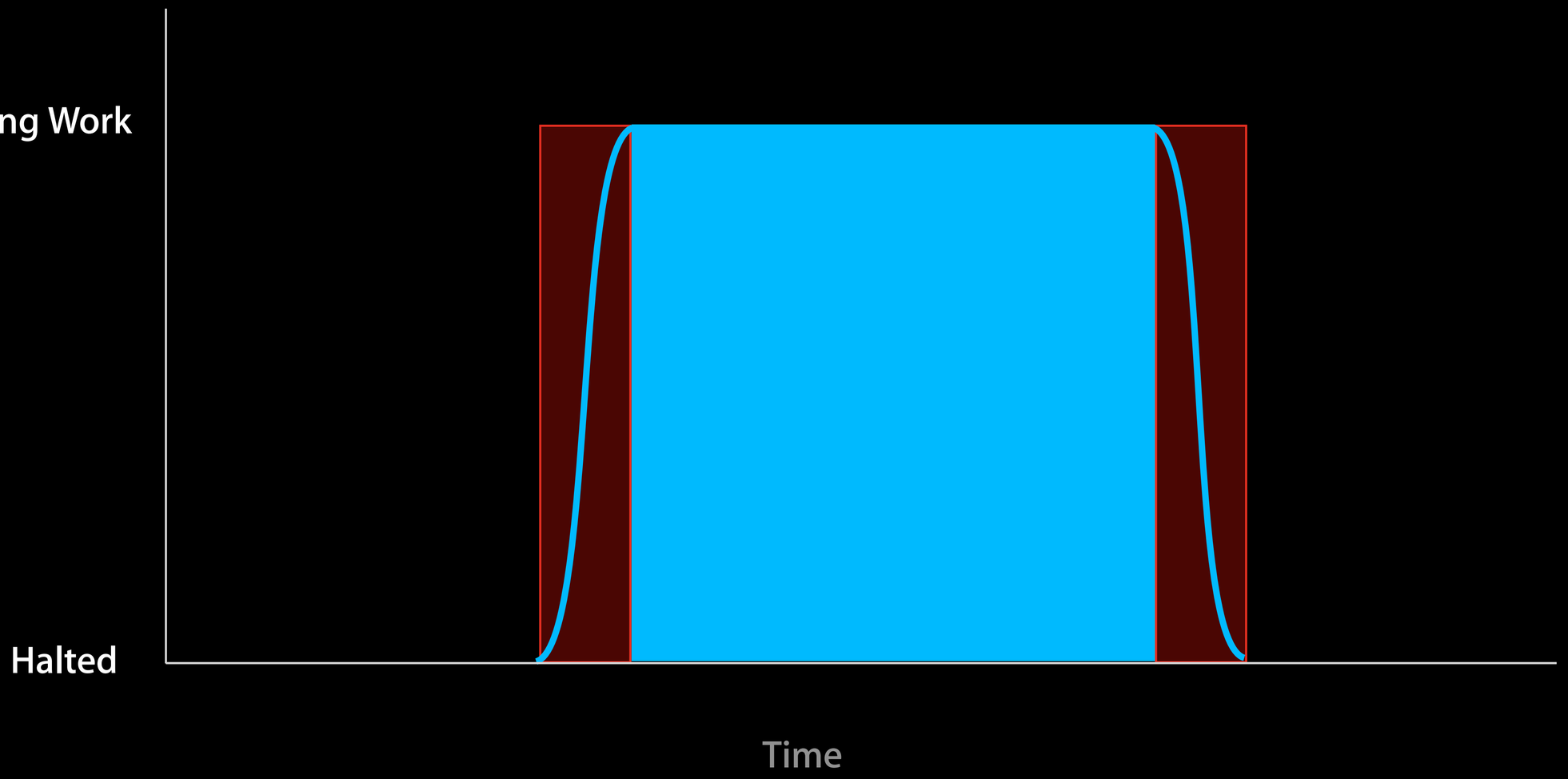
Doing Work
Halted
Time

Review

- Idle during interactive use
- Modern chips can take advantage of this
- Batch work together
- Maximize idle time and minimize transitions

Focus on Energy

- Making energy impact visible
- System and app strategies for energy efficiency
- What you can do

Finder File Edit View Go Window Help

Tue 9:41 AM

5:37 Remaining
Power Source: Battery

Apps Using Significant Energy

Xcode

Energy Hog

Show Percentage
Open Energy Saver Preferences…

Finder File Edit View Go Window Help

Tue 9:41 AM

5:37 Remaining
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Finder File Edit View Go Window Help

Tue 9:41 AM

Activity Monitor (Applications in last 8 hours)

CPU | Memory | Energy | Disk | Network

App Name	Energy Impact	Avg Energy Impact	App Nap	User
Energy Hog	100.0	73.34	No	john
Activity Monitor	19.9	0.60	No	john
Finder	1.5	0.62	No	john
Spotlight	1.1	7.97	–	–
Safari	0.2	0.08	Yes	john
Time Machine	0.0	0.05	–	–
iTunes	0.0	0.21	Yes	john
iPhoto	0.0	0.28	Yes	john
Maps	0.0	0.07	Yes	john
Contacts	0.0	0.03	Yes	john
Xcode	0.0	0.21	Yes	john
Calendar	0.0	0.05	Yes	john
Reminders	0.0	0.05	Yes	john
Notes	0.0	0.03	Yes	john
Photo Booth	0.0	0.15	Yes	john
Preview	–	0.36	–	–
Terminal	–	0.06	–	–
App Store	–	0.05	–	–

ENERGY IMPACT

Remaining charge:	91%
Time remaining:	3:10
Time on battery:	0:28

BATTERY (Last 12 hours)

Finder File Edit View Go Window Help

Tue 9:41 AM

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Notes	0.0	0.03	Yes	john
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Terminal	–	0.06	–	–
App Store	–	0.05	–	–

ENERGY IMPACT

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ENERGY IMPACT

BATTERY (Last 12 hours)

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Finder File Edit View Go Window Help

Tue 9:41 AM

Drawing.xcodeproj

Drawing 〉 My Mac 64-bit

Running Drawing : Drawing No Issues

Energy Report

Drawing
PID 1438, Running

CPU 3%

Memory 8.2 MB

Energy Impact High

Energy

Utilization

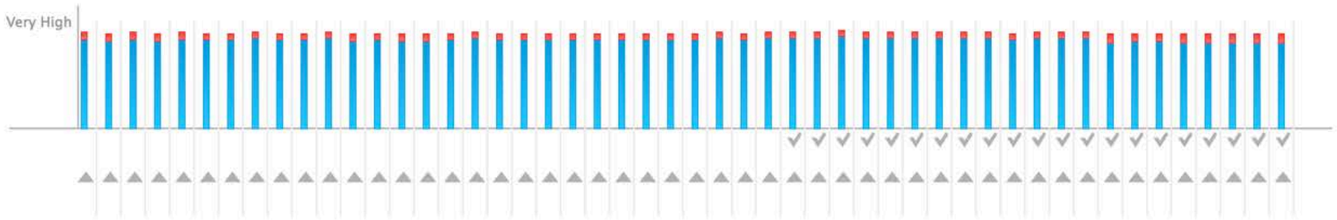
High

App Nap

60 Wakes Last Second

58 Avg Per Second

Energy Impact



App Nap

To allow inactive applications to remain running while minimizing their impact on battery life, the system may lower execution priority and rate limit timers.

Track App Nap

Idle Prevention

Maximizing CPU idle time is an important part of energy efficiency. Timers can prevent CPU idle and should be avoided when other alternatives are available.

Find Timers

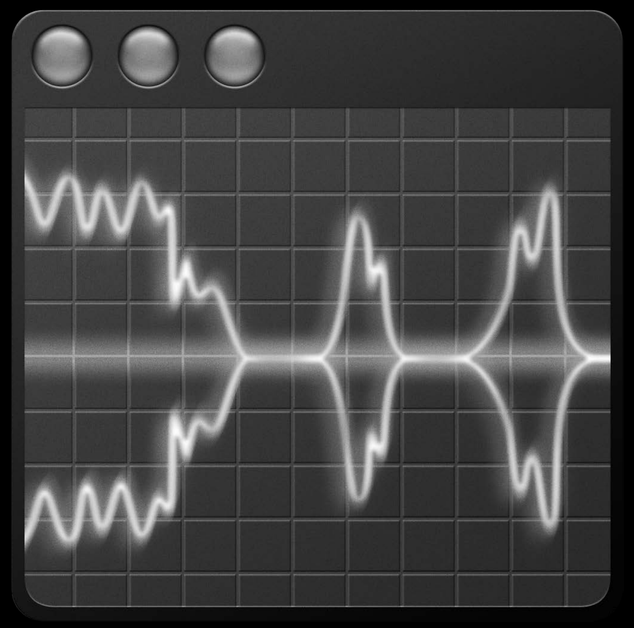
Find Polling

CPU Wake Overhead

Micro Time Profile

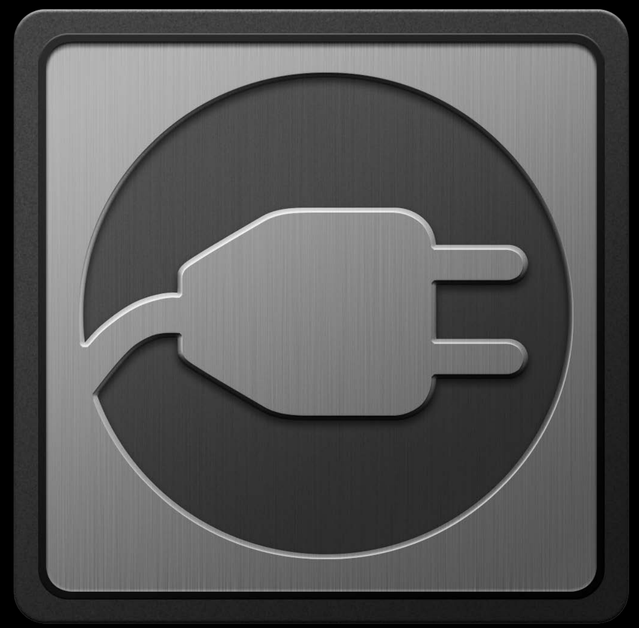
Drawing

Strategies for Energy Efficiency

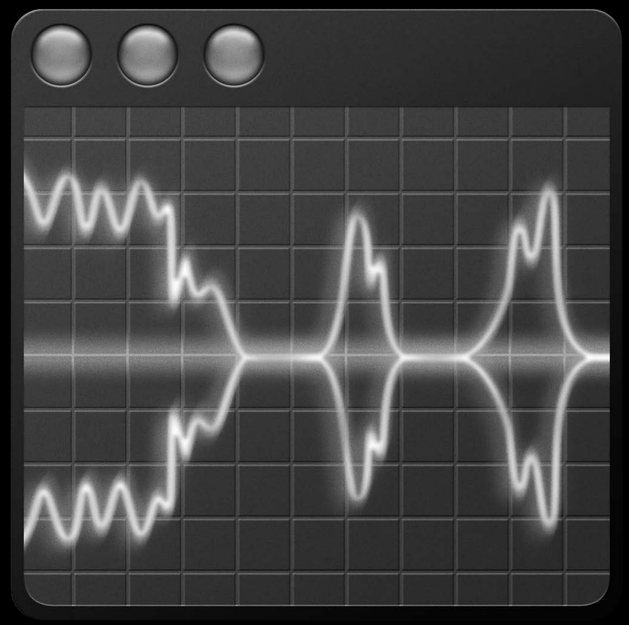


App Nap

Centralized Task Scheduling



Power Saver



App Nap

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Mon 9:41 AM

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Standard Hybrid Satellite

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Junipero Serra Fwy S

280

Junipero Serra Fwy S

N De Anza Blvd

Caffè Macs

Infinite Loop

Larry Way

Randy Ln

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Reminde

Reminders

- Call George
- Buy milk
- Give presentation

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May 29, 2013 11:50 AM

Details

n this past weekend and her finished
in the championship, Lilly's team
atch. The final score was 2-1. Lilly
lot of scoring chances. This was
joyed it. She's plans to tryout for her
ut making the switch to goalie!

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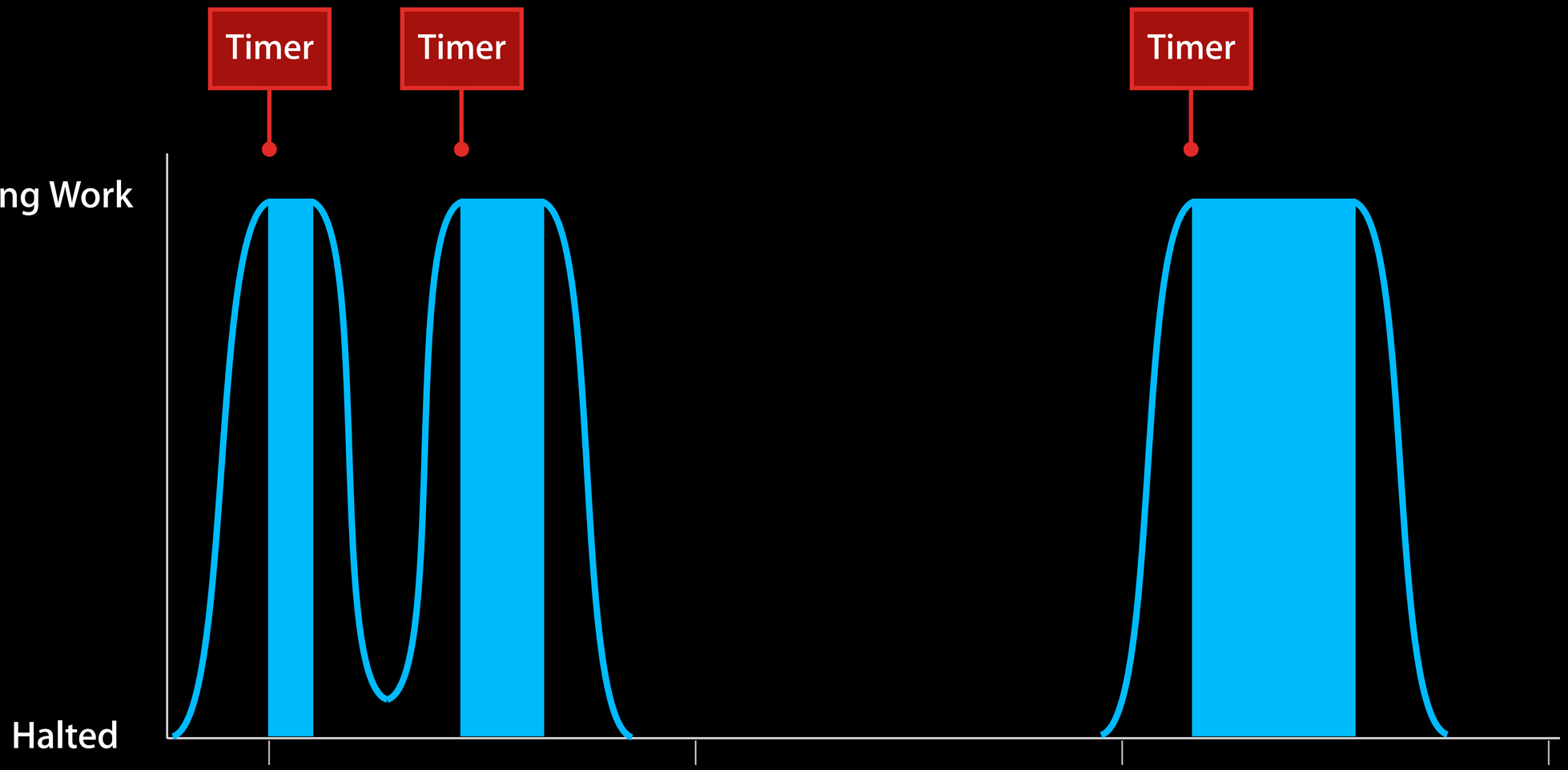
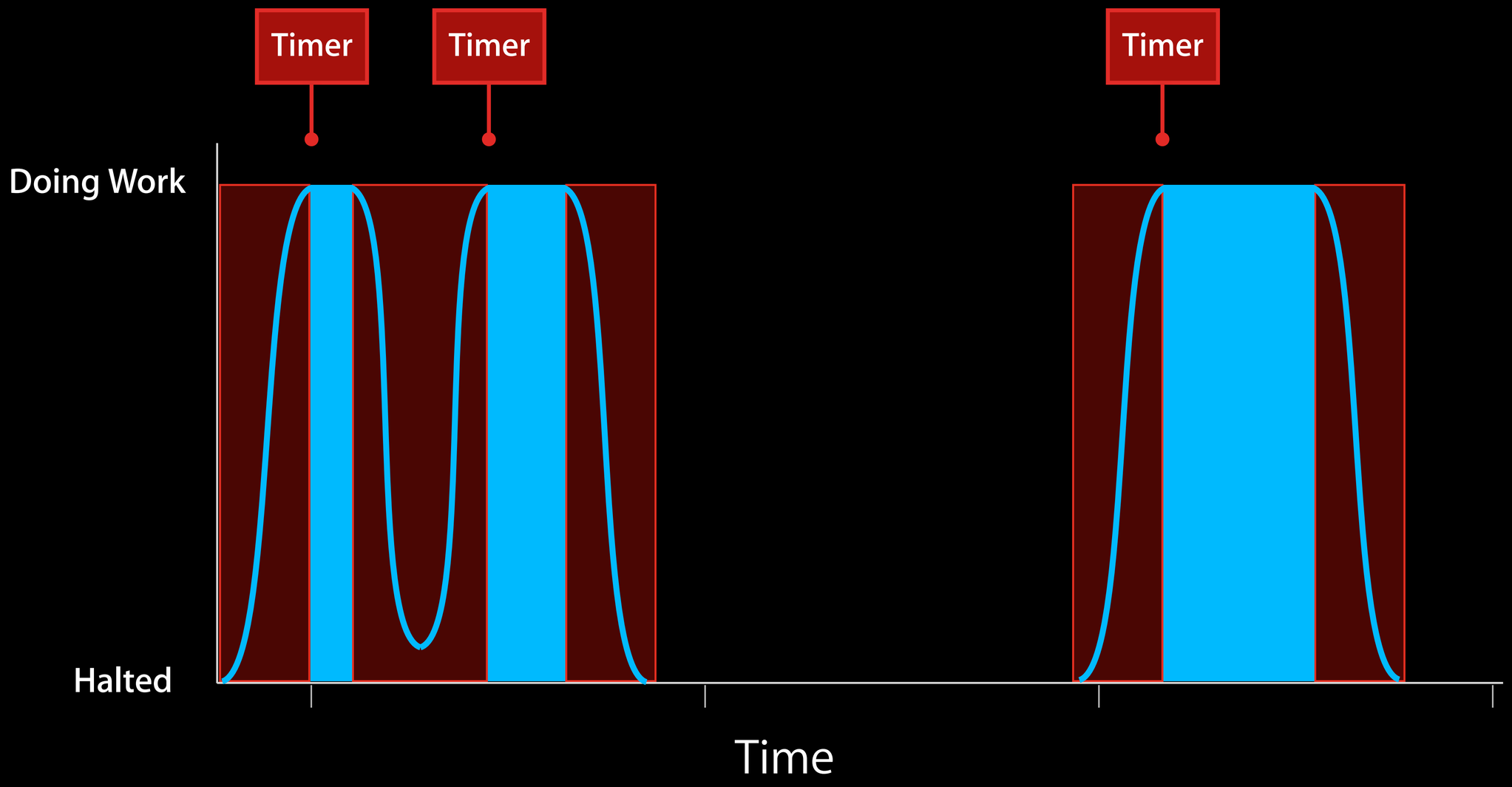
App Nap

- CPU and IO prioritization
- Timer coalescing
- Timer rate limiting
- App Nap API
  - App visibility
  - Hinting to the system

Timer Coalescing



Timer Coalescing



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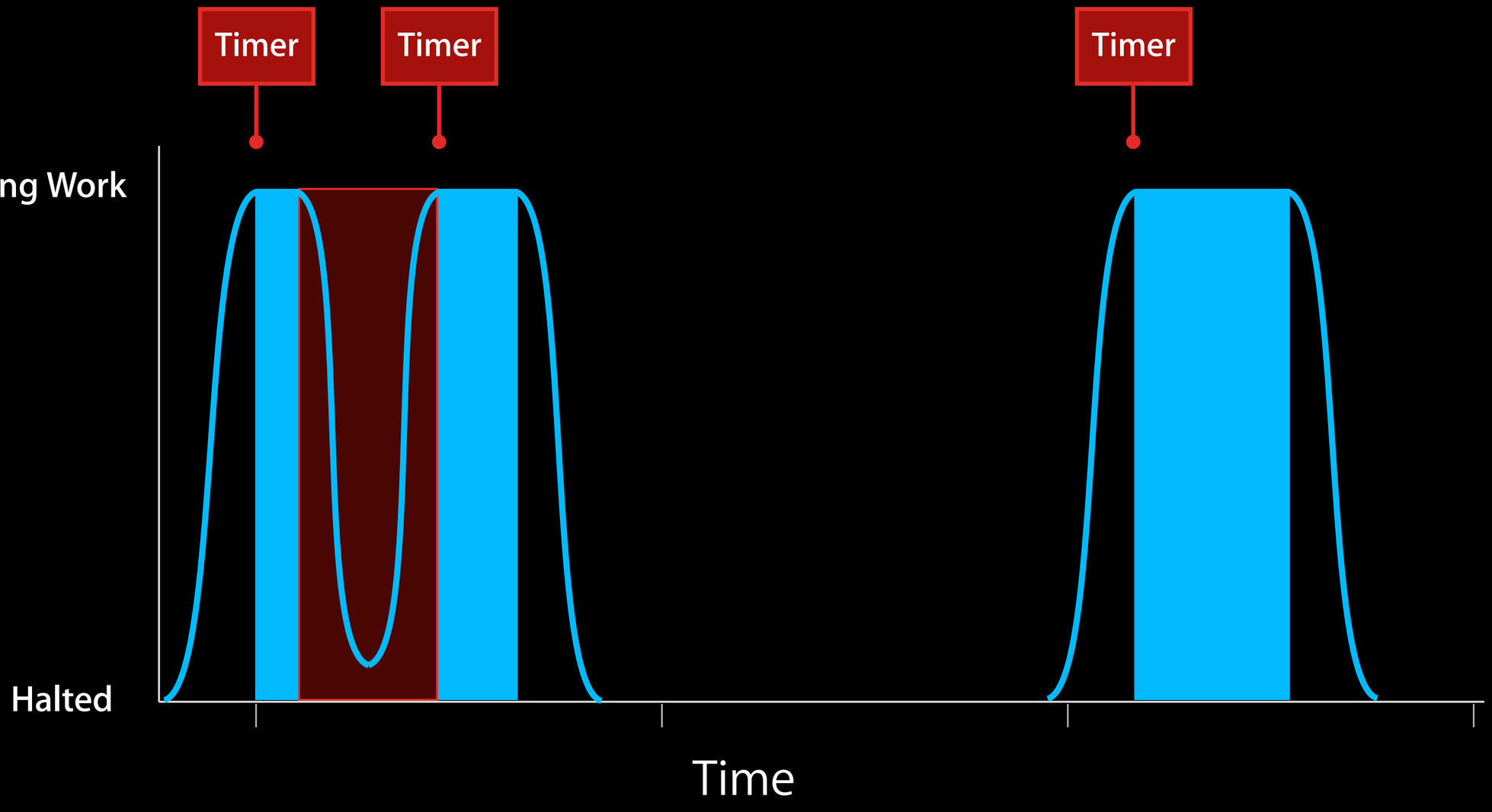
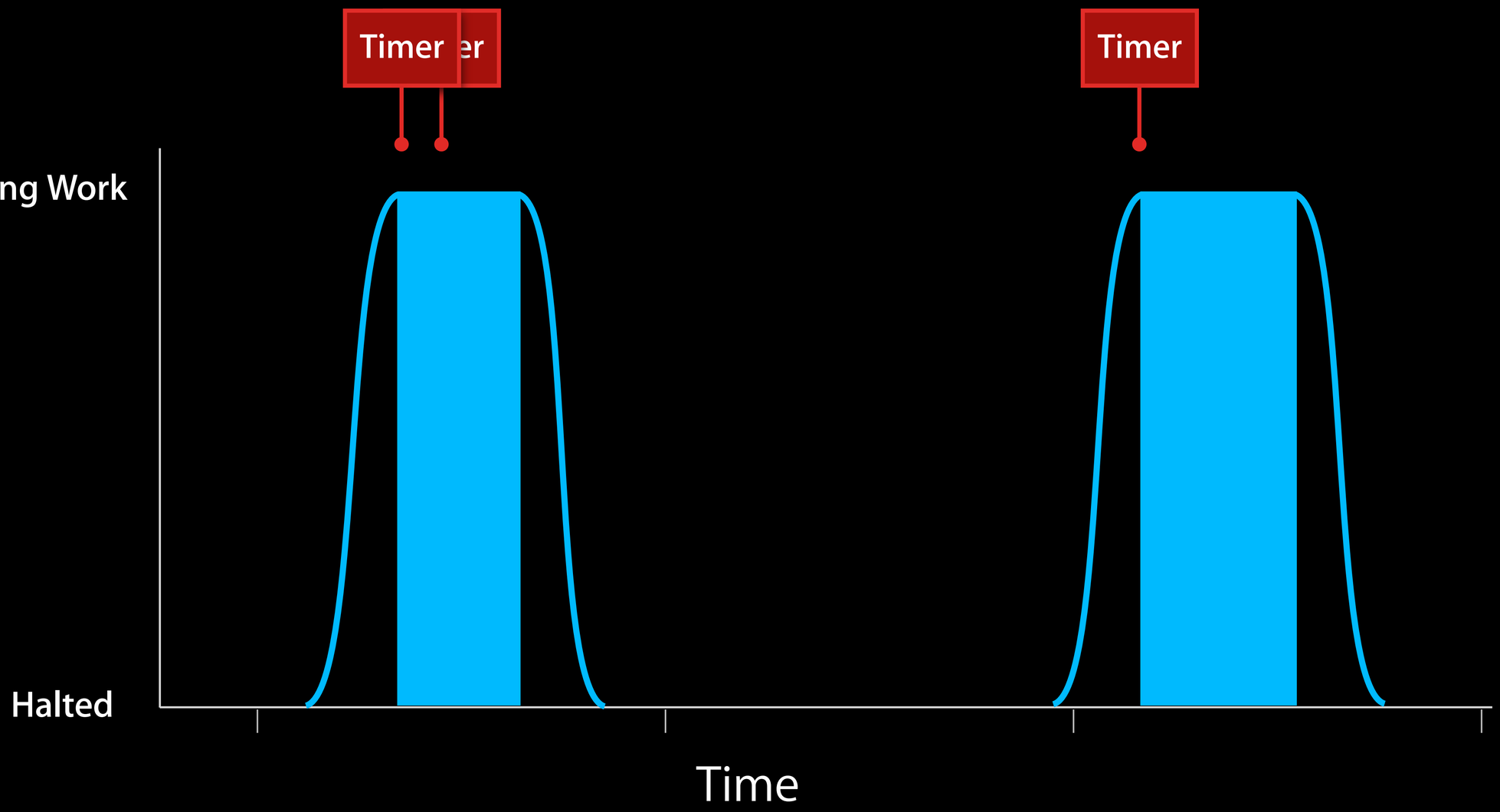


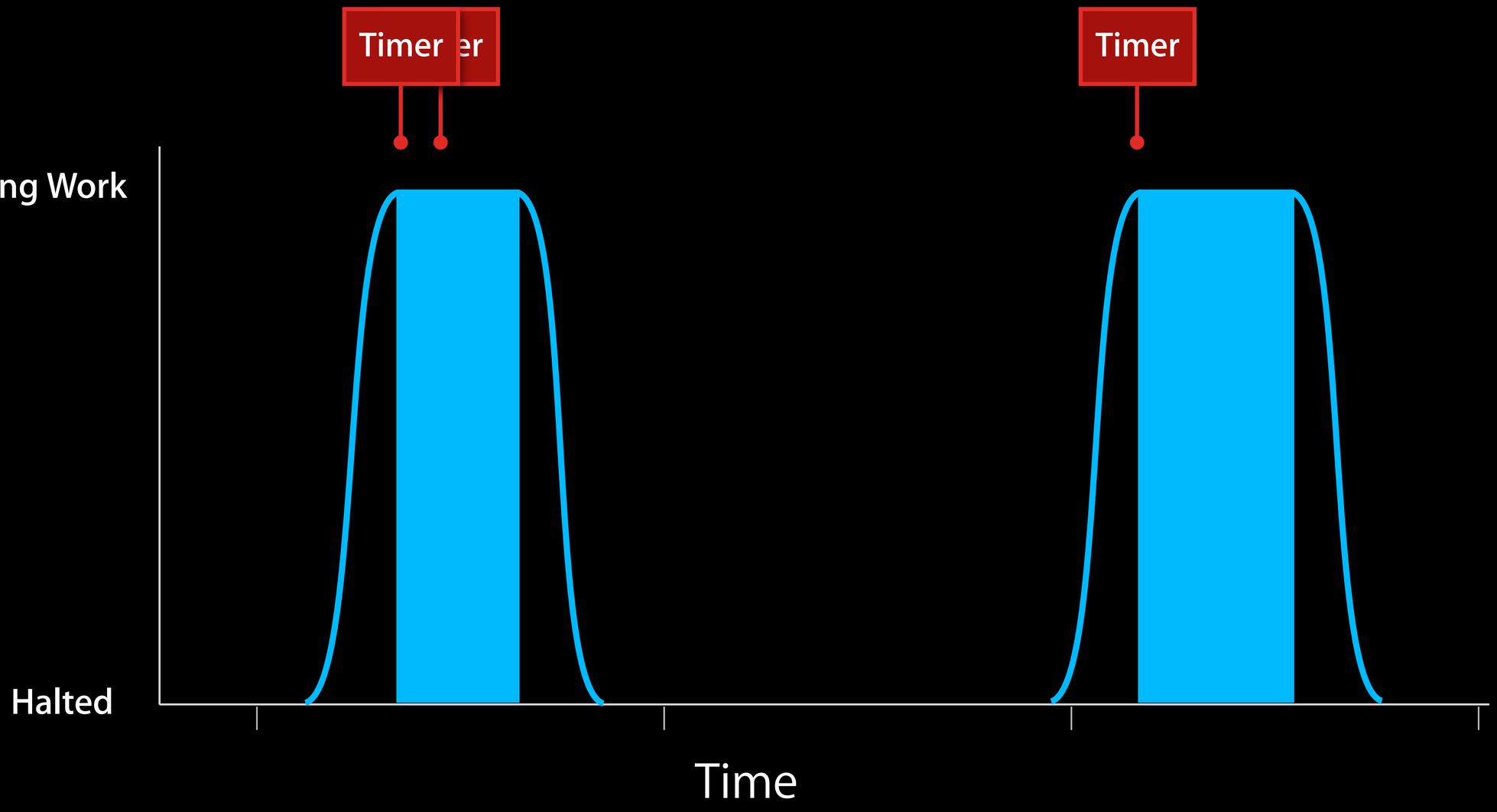
Timer Coalescing



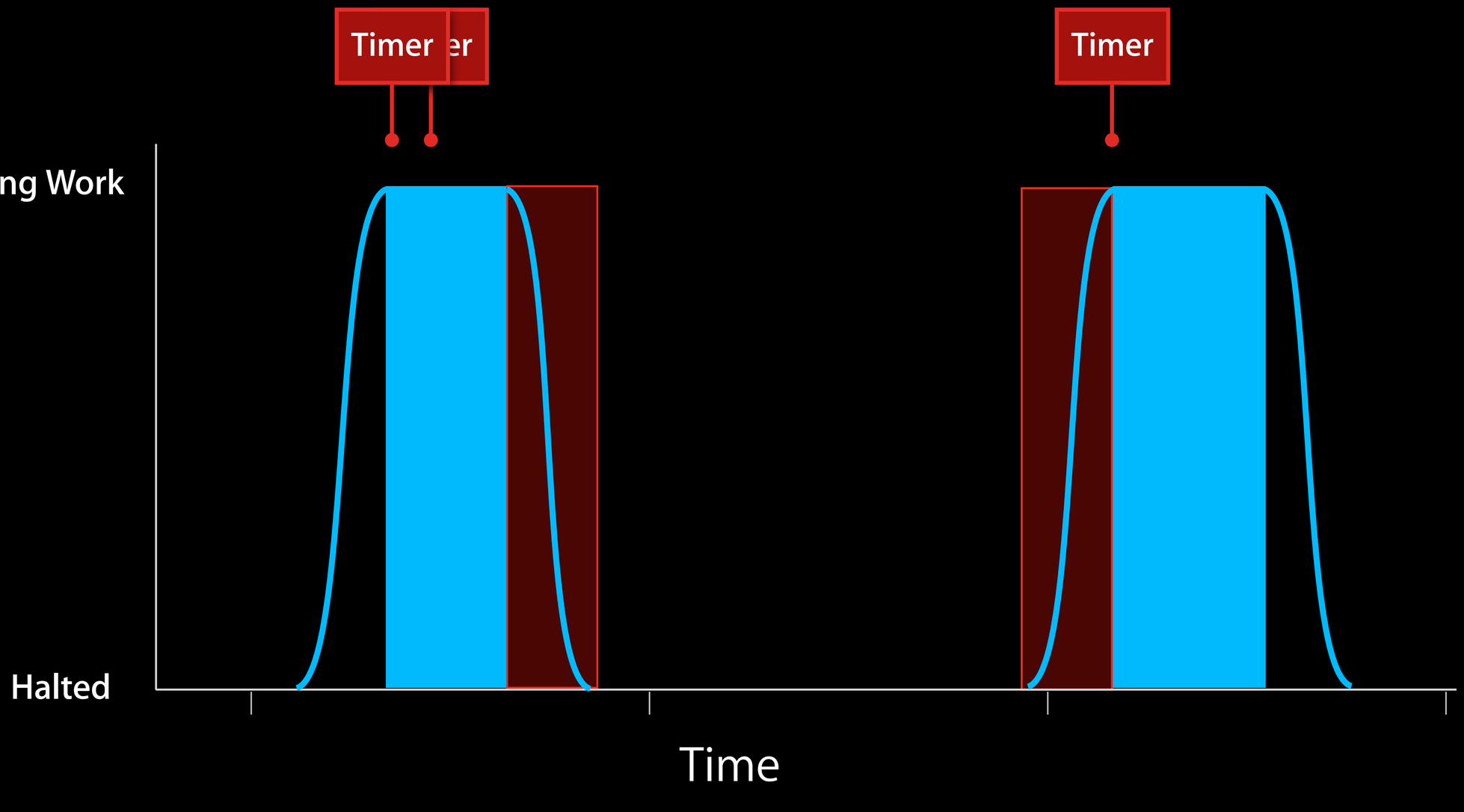
Timer Tolerance

- New API for NSTimer and Dispatch Timers
- Focus on high-frequency timers
  - More often than once per second

Timer Tolerance



Timer Tolerance



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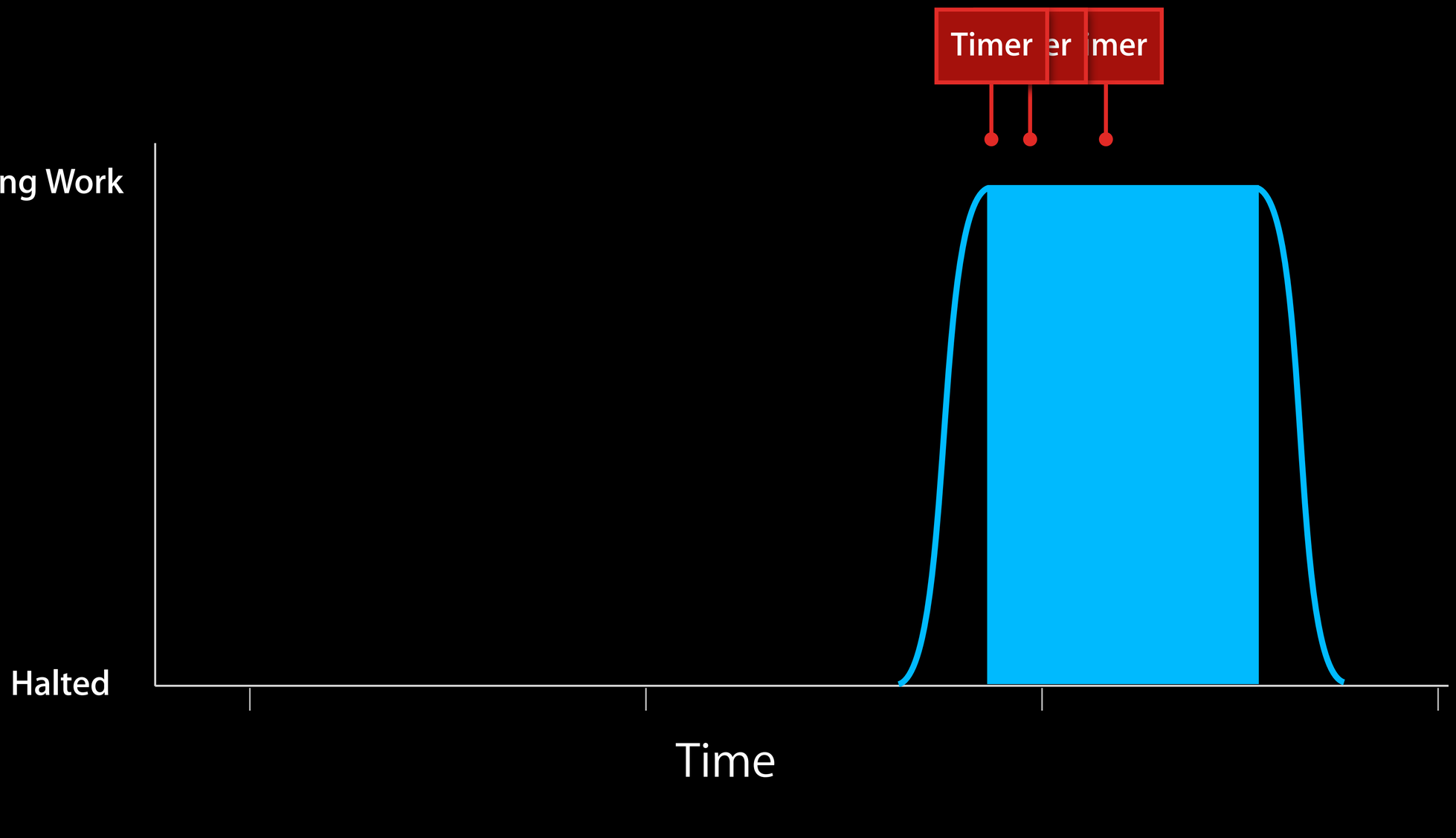

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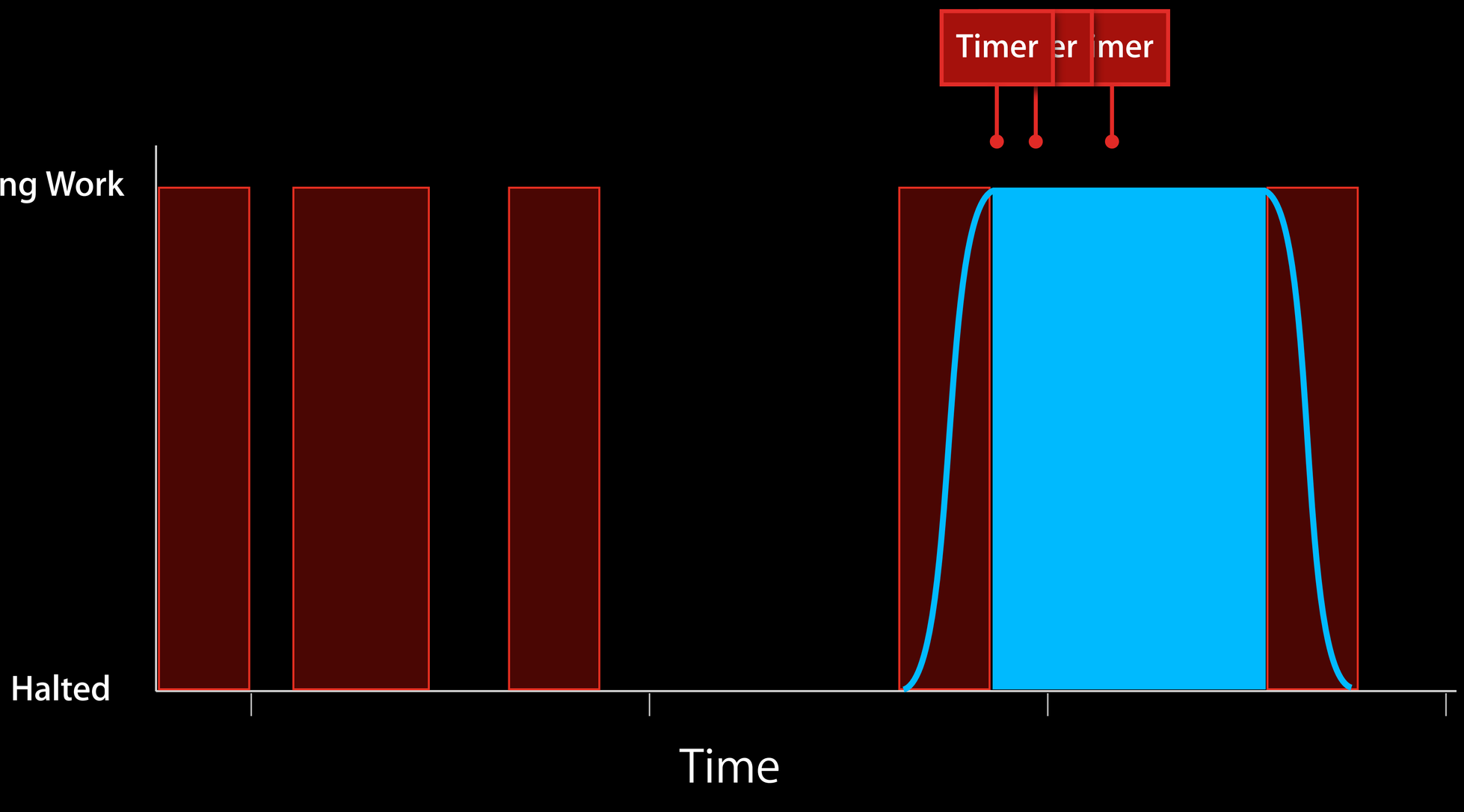

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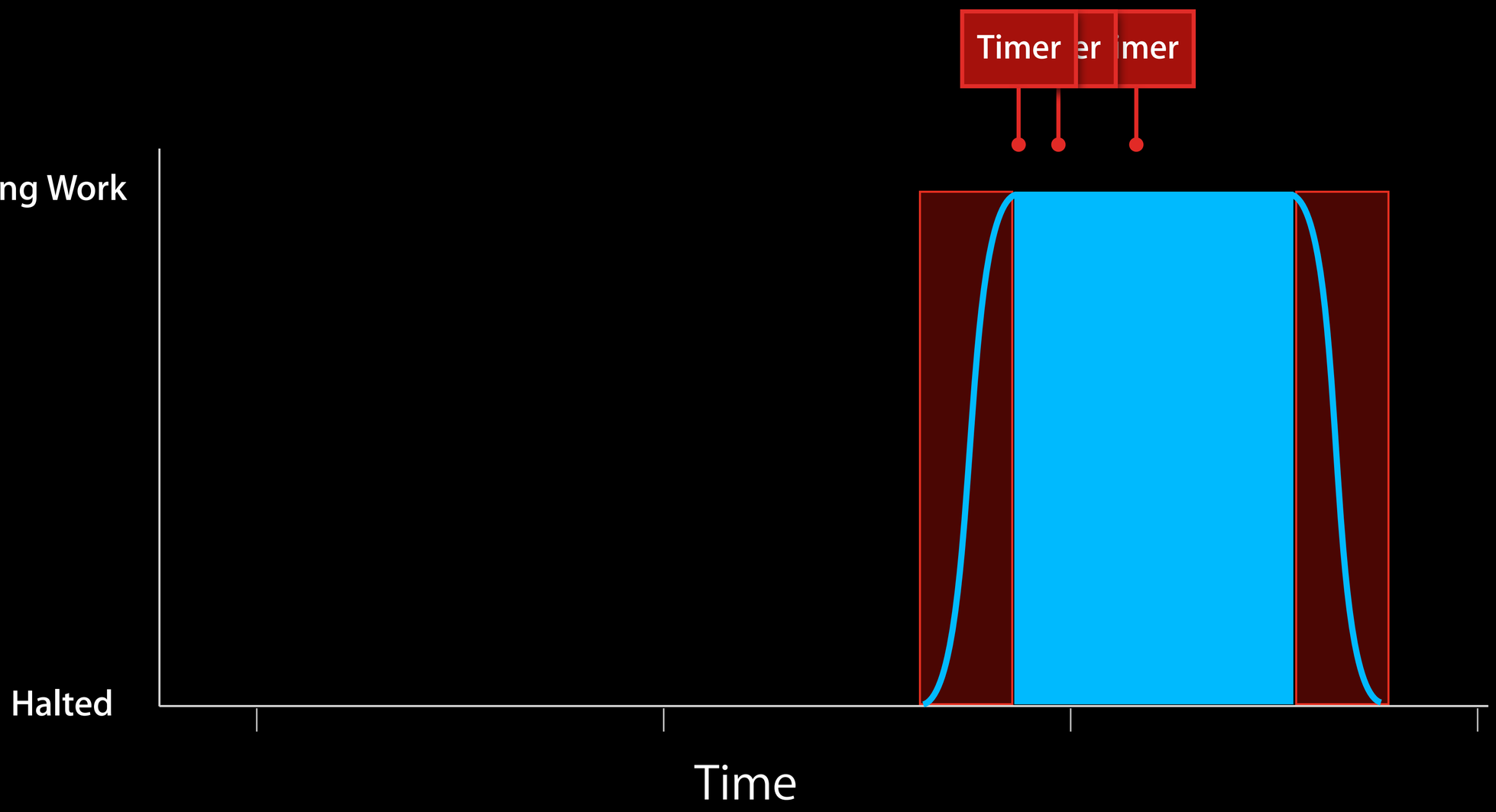
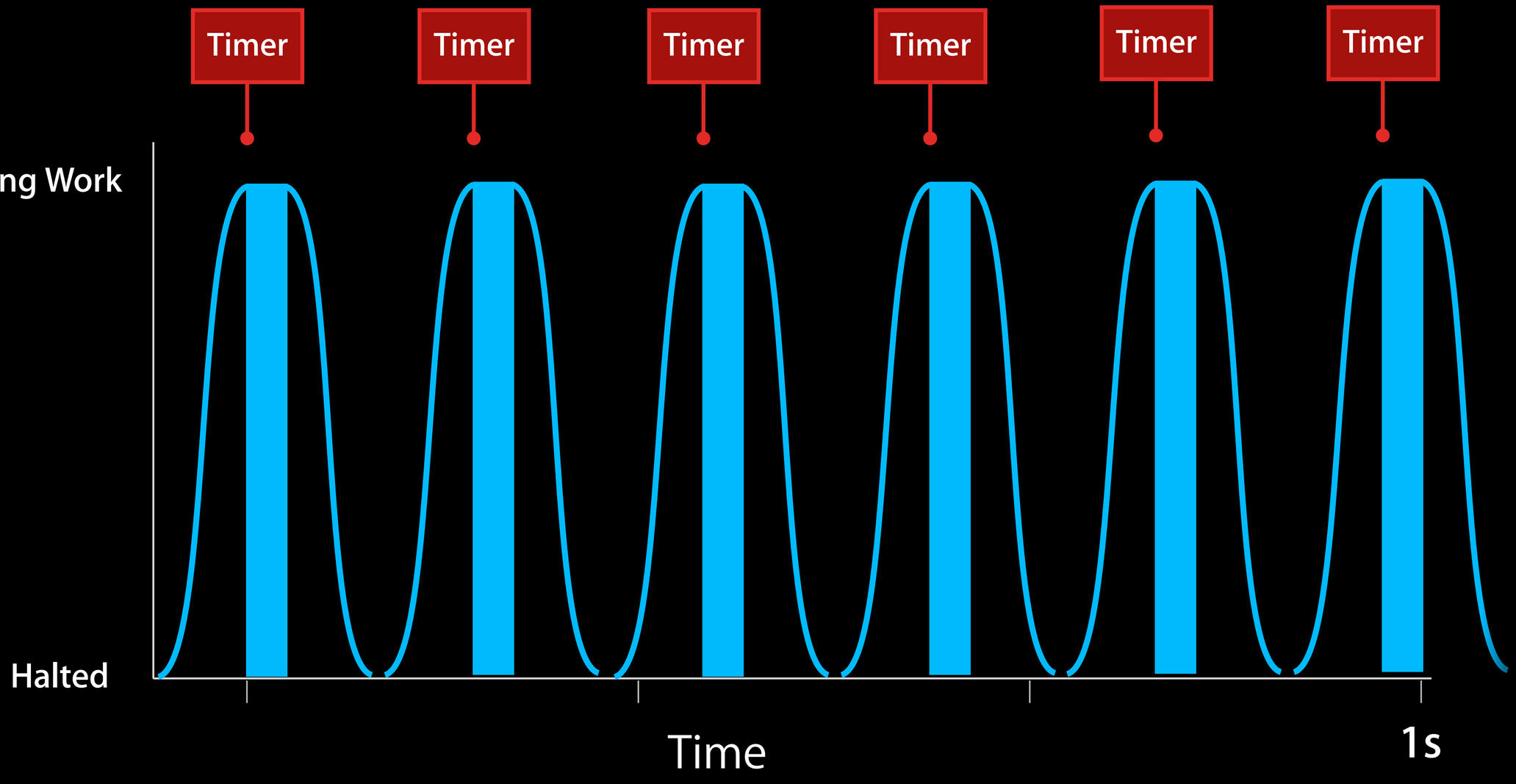


Timer Rate Limiting



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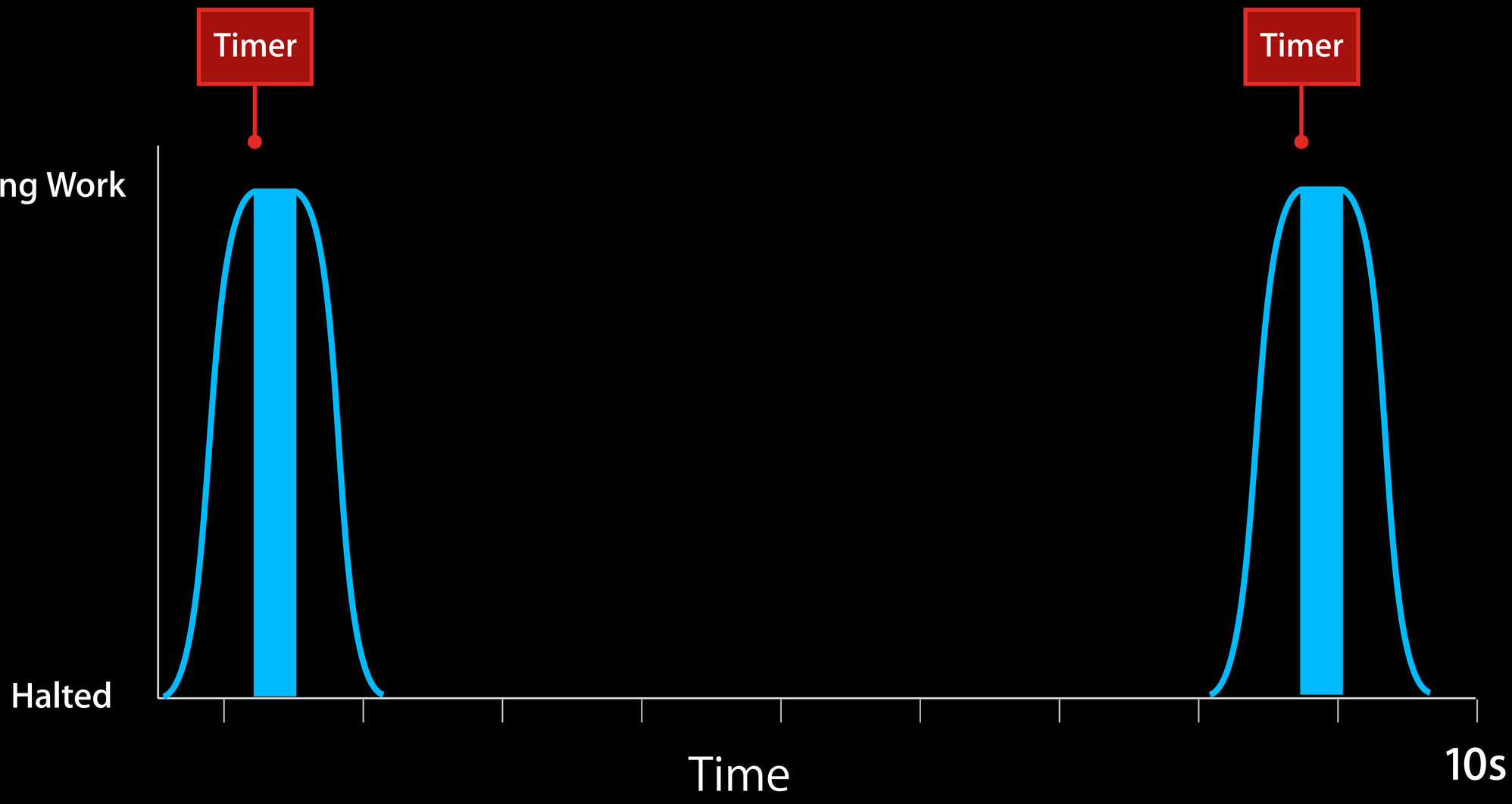

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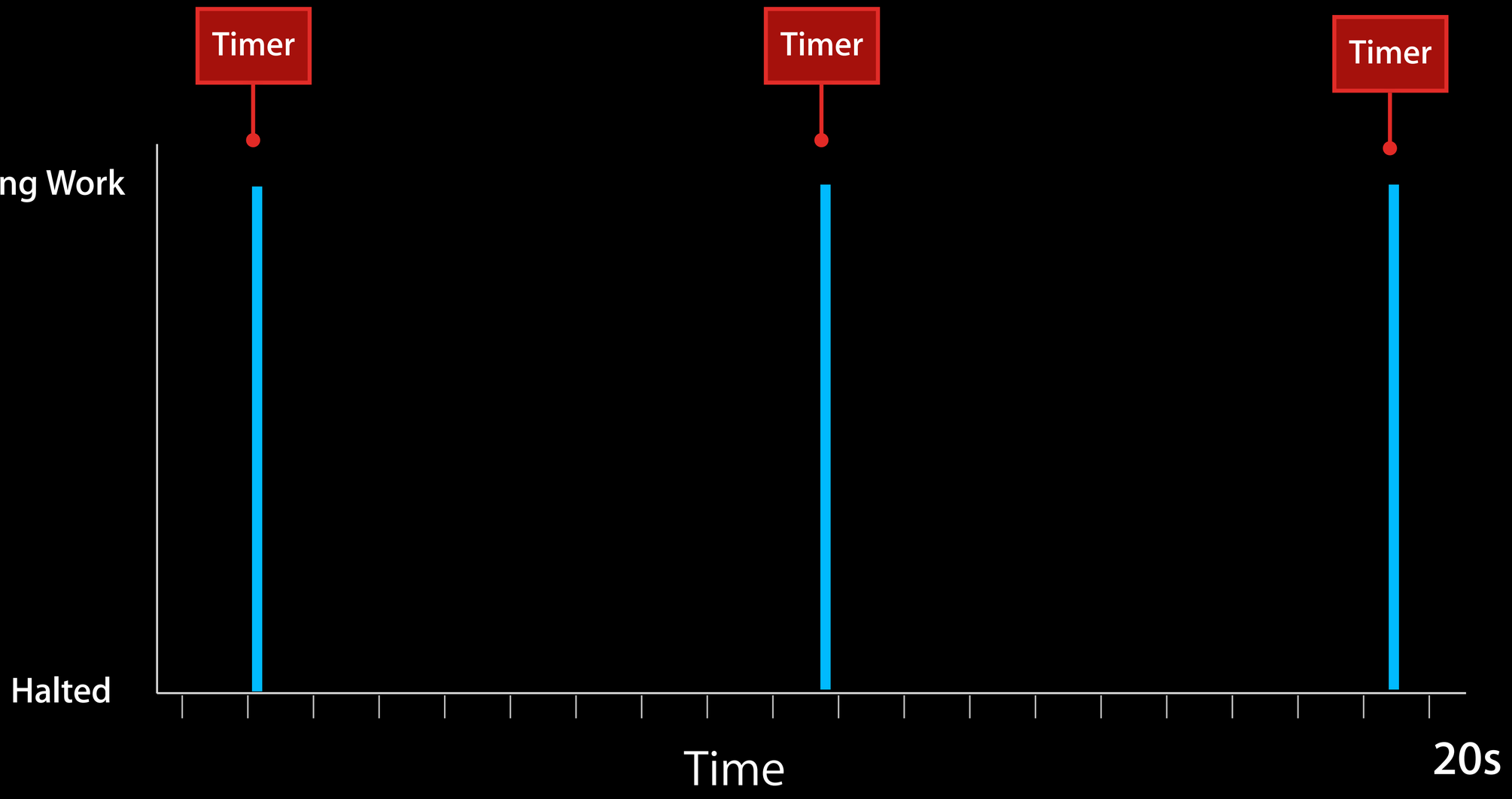

App Nap API

App visibility

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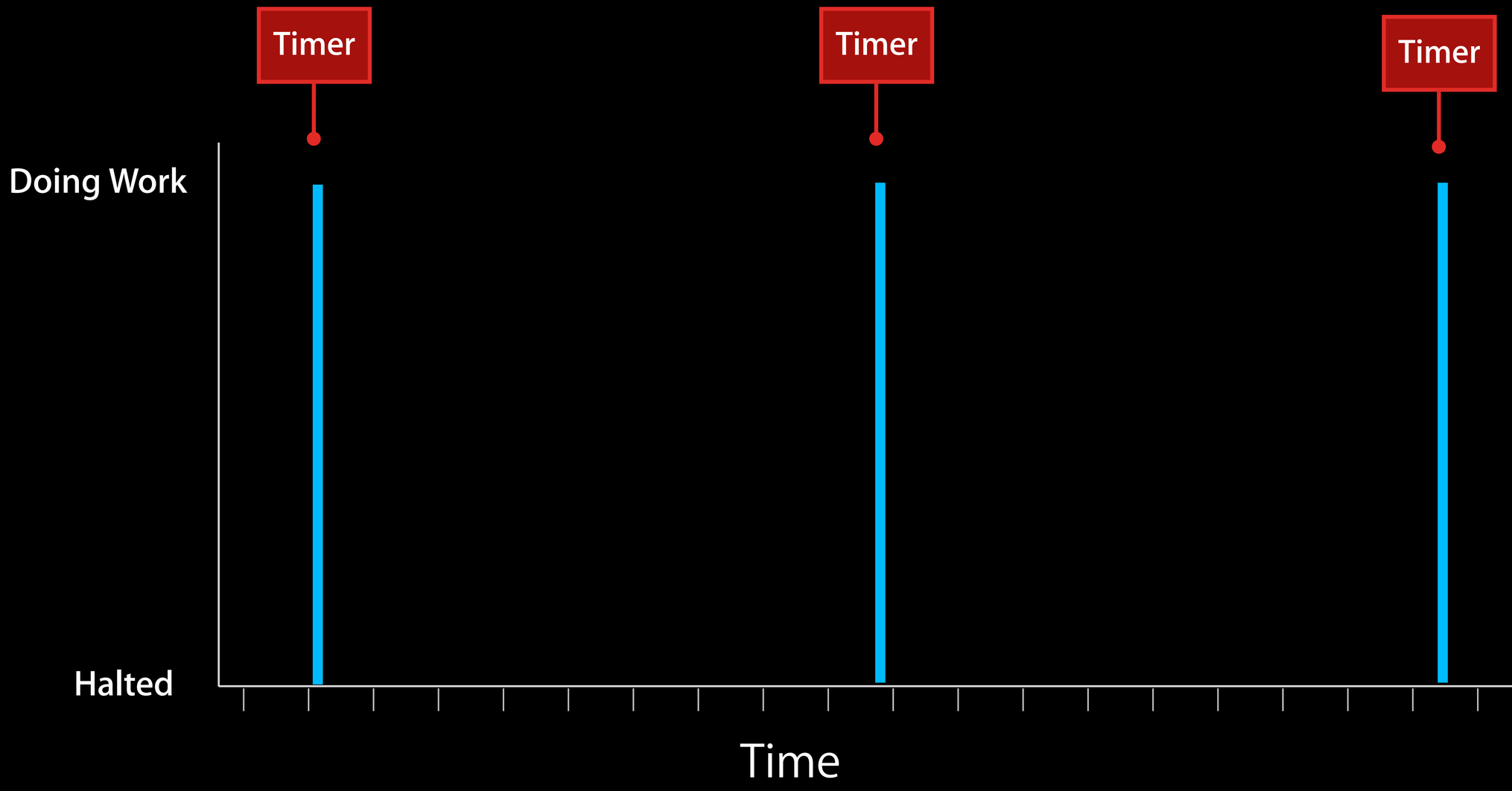
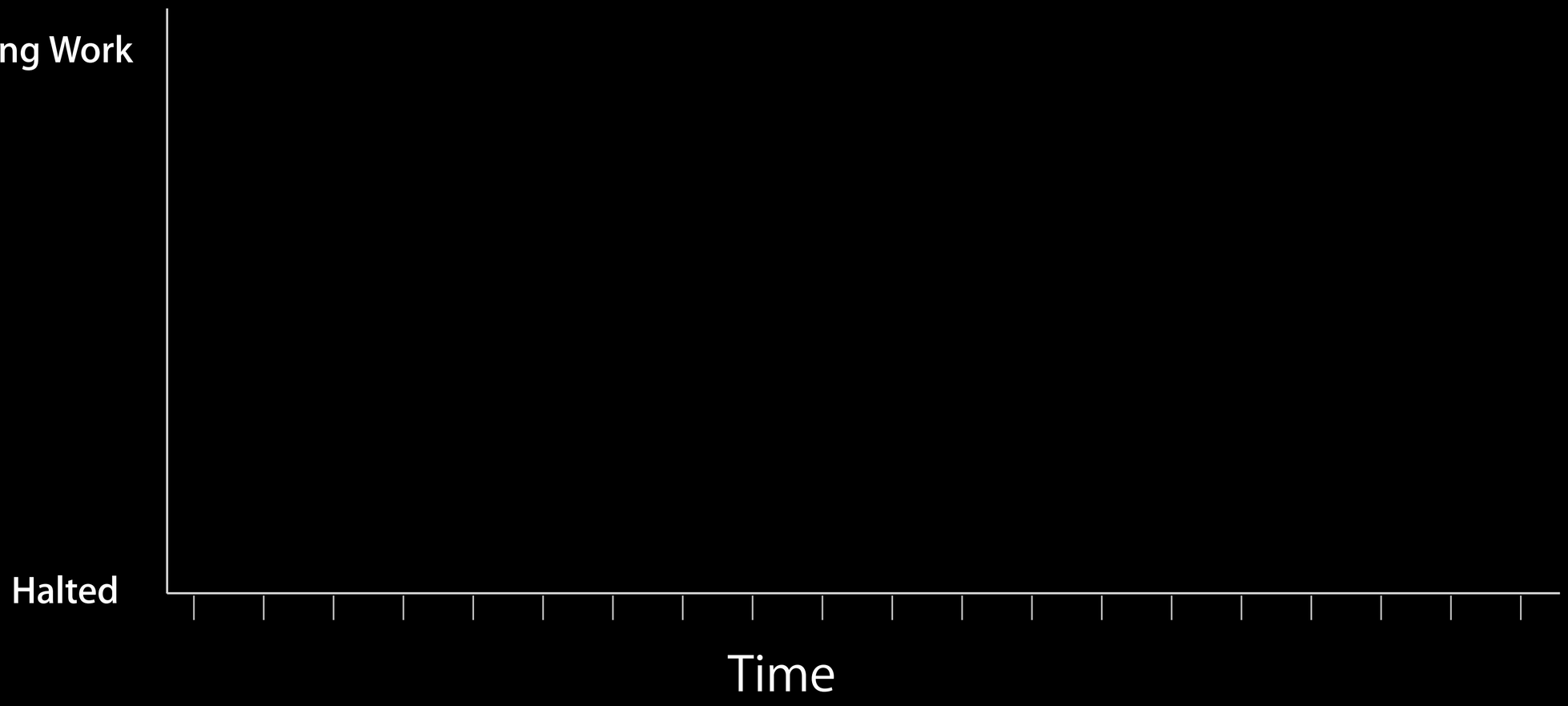
App Visibility



App Visibility



App Nap

Related sessions

Improving Power Efficiency with App Nap	Pacific Heights Wednesday 10:15AM
Energy Best Practices	Marina Thursday 10:15AM

Centralized Task Scheduling

Centralized Task Scheduling

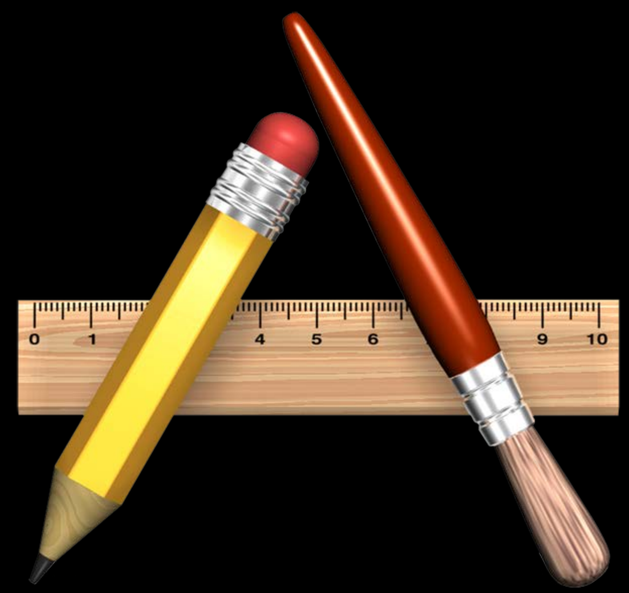
Centralized Task Scheduling

- You tell us
  - Can your work be time shifted?
  - By how long?

Centralized Task Scheduling

Centralized Task Scheduling

Centralized Task Scheduling



Centralized Task Scheduling

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Energy Best Practices	Marina Thursday 10:15AM	
Efficient Design with XPC	Russian Hill Tuesday 2:00PM	

Power Saver

Safari

- App Nap
- Power Saver

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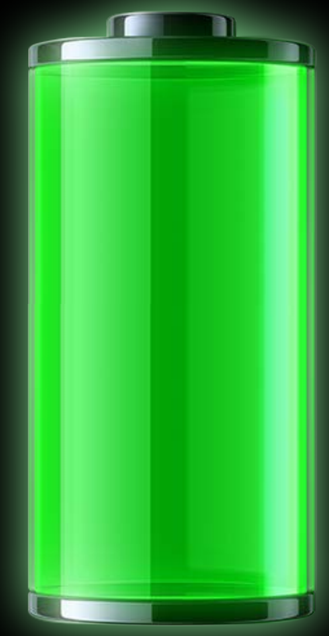

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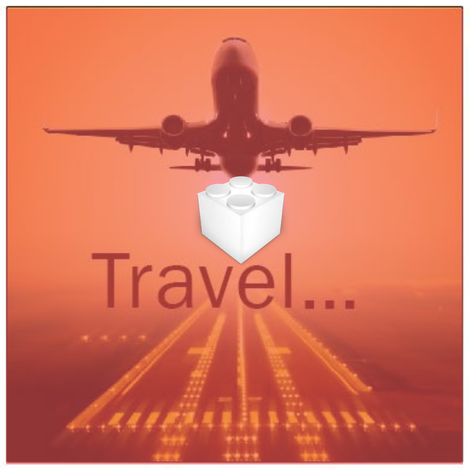

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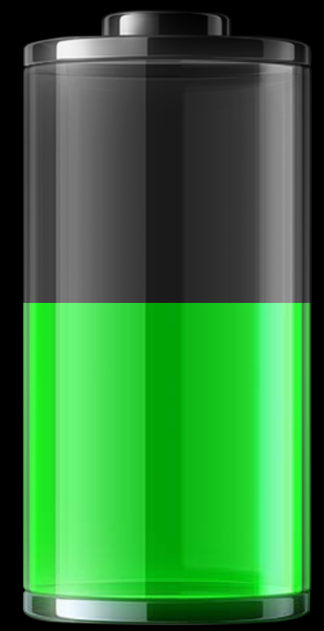

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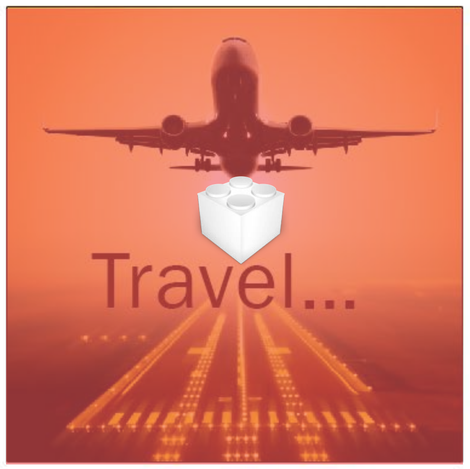

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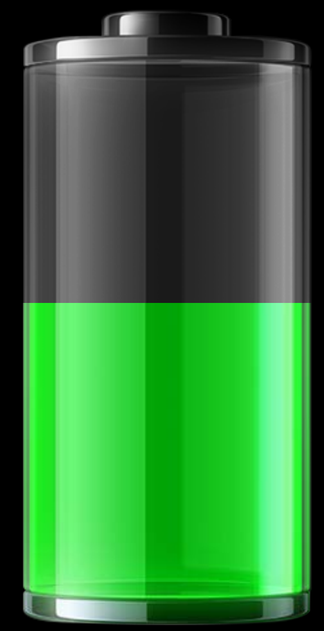

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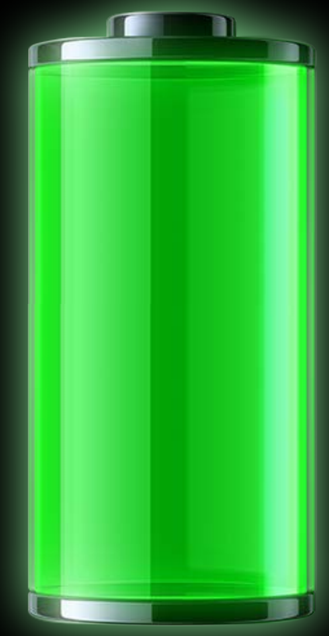
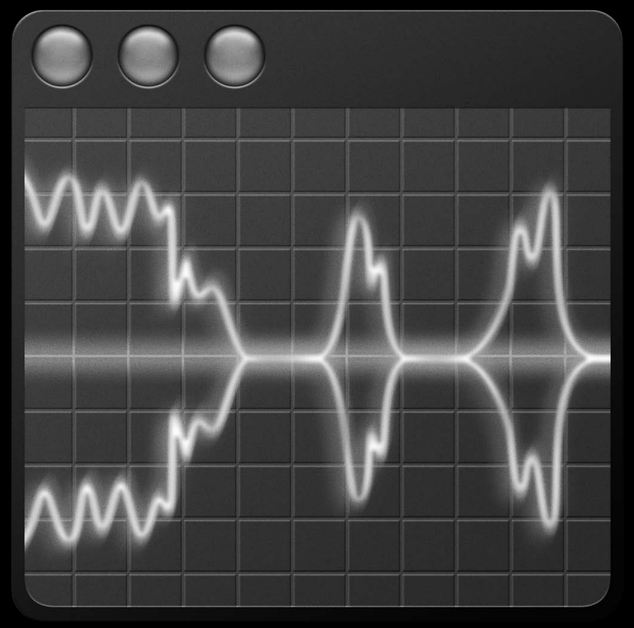


Safari

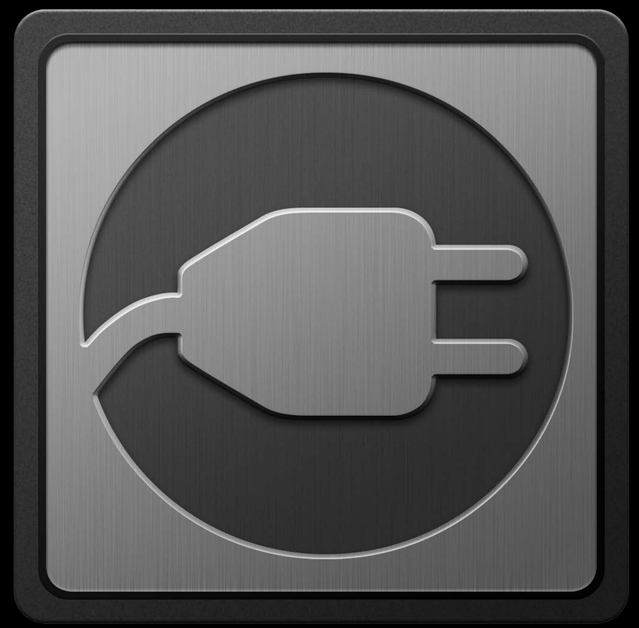
Related session

Power and Performance: Optimizing Your Website for Great Battery Life and Responsive Scrolling	Russian Hill Wednesday 9:00AM



App Nap

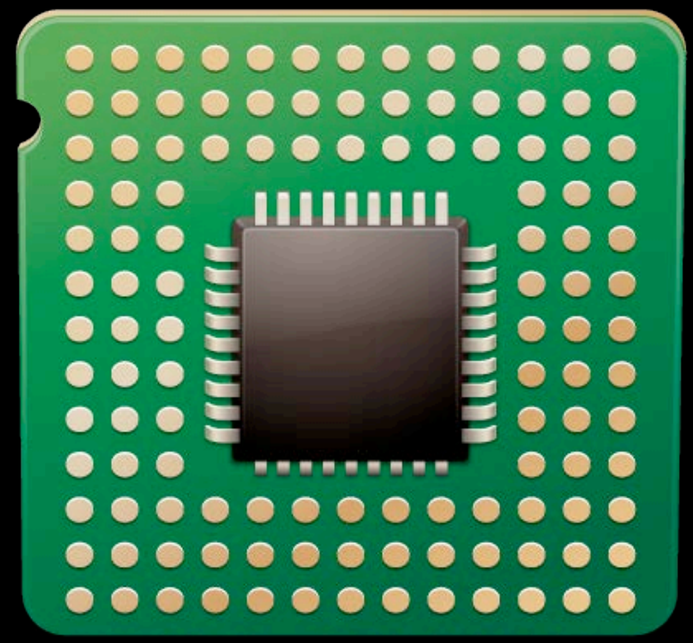
Centralized Task Scheduling



Energy Saver

What Can You Do?

- Use efficient algorithms
- Watch for Energy Impact in Activity Monitor
- Measure your application with Xcode
- Avoid high frequency timers
- Set timer tolerances
- Adopt Centralized Task Scheduling



Related Sessions

Building Efficient OS X Apps	Nob Hill Tuesday 4:30PM	
Efficient Design with XPC	Russian Hill Tuesday 2:00PM	
Power and Performance: Optimizing Your Website for Great Battery Life and Responsive Scrolling	Russian Hill Wednesday 9:00AM	
Improving Power Efficiency with App Nap	Pacific Heights Wednesday 10:15AM	
Energy Best Practices	Marina Thursday 10:15AM	

Labs

Power and Performance for OS X Apps	Core OS Lab A Wednesday 9:00AM
Cocoa and Foundation Lab	Frameworks Lab A Wednesday 11:30AM
Power and Performance for OS X Apps	Tools Lab A Thursday 4:30PM

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