

Diversity in Smartphone Energy Consumption

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Take-aways

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Motivation

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Mobile
applications

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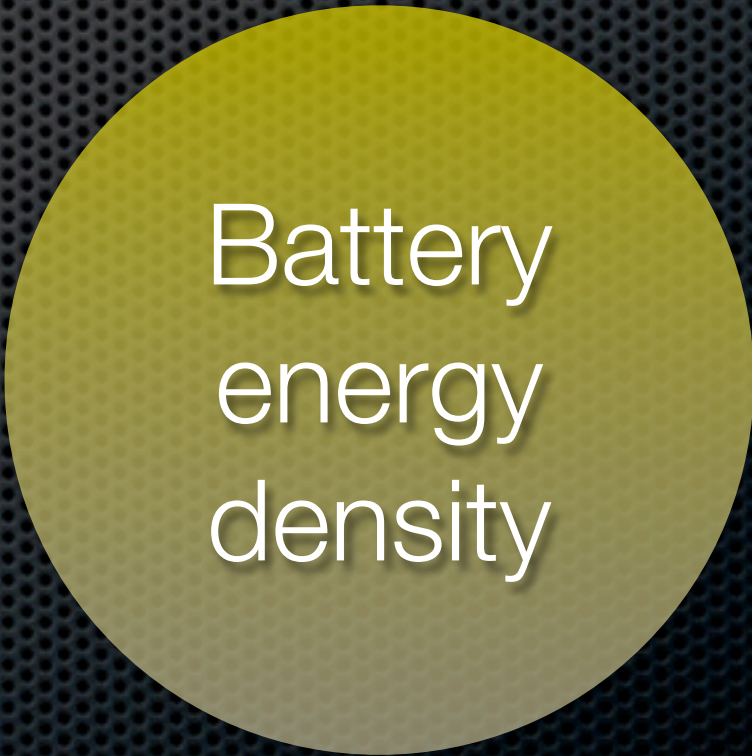
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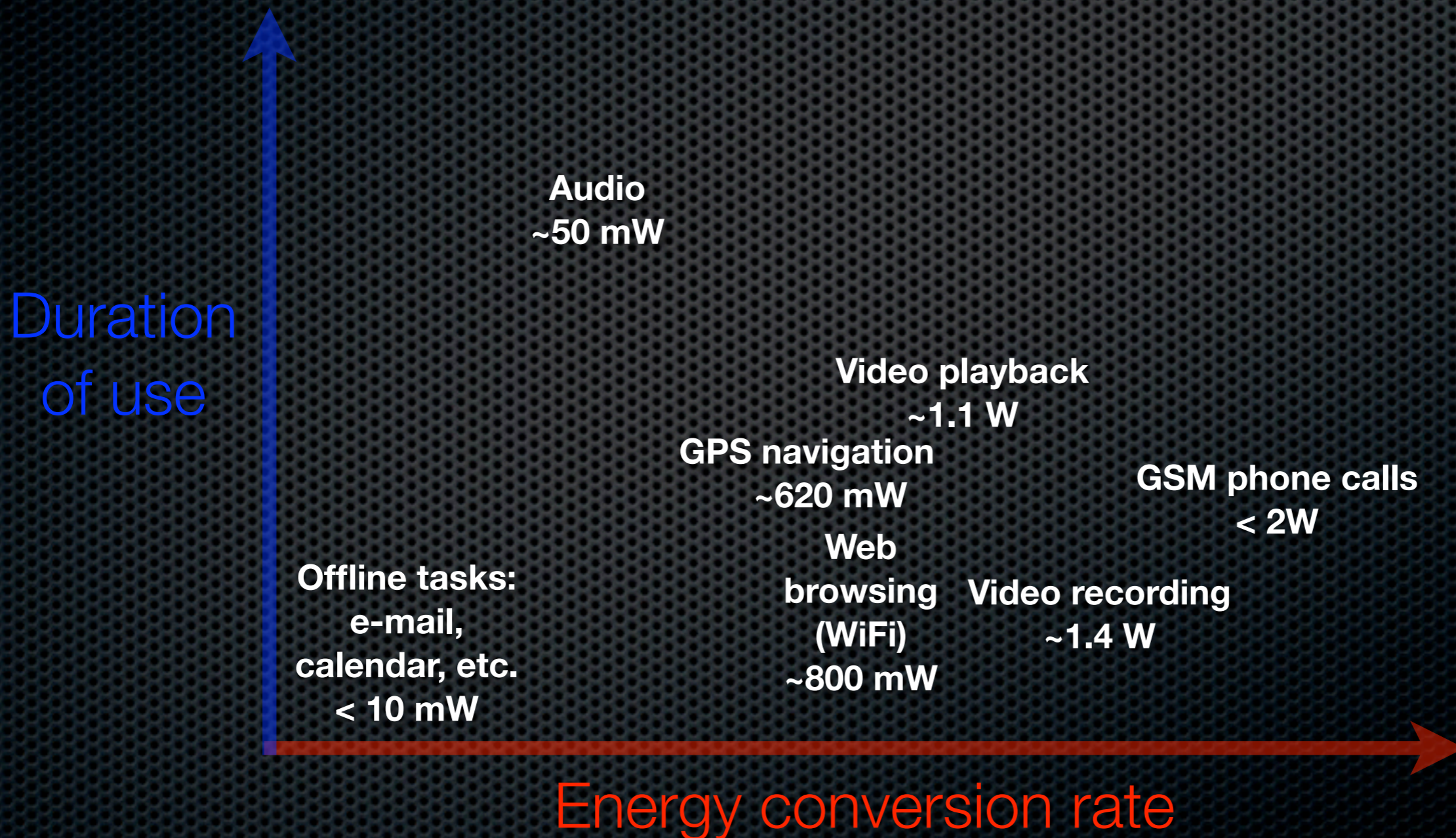


Mobile
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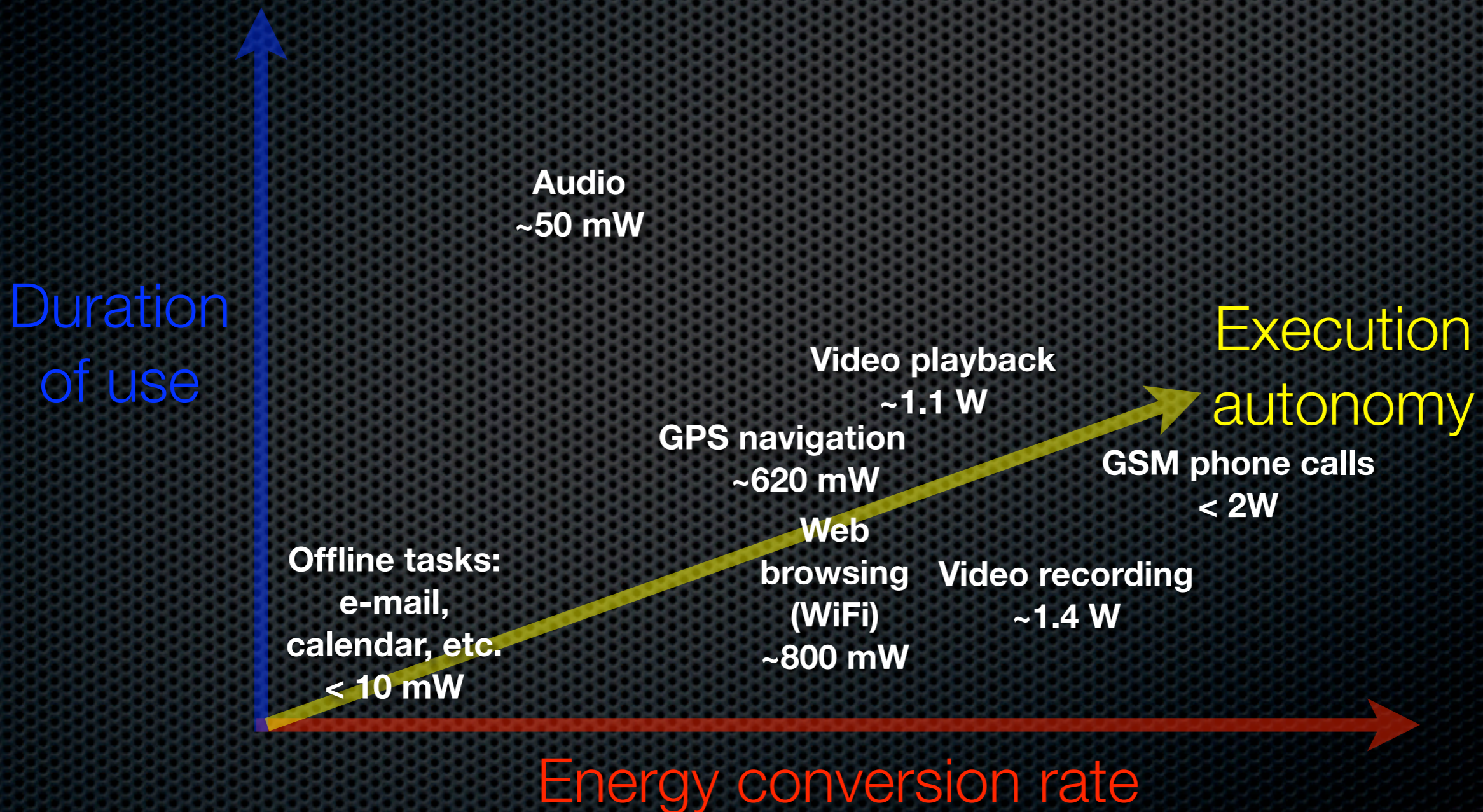


Battery
energy
density

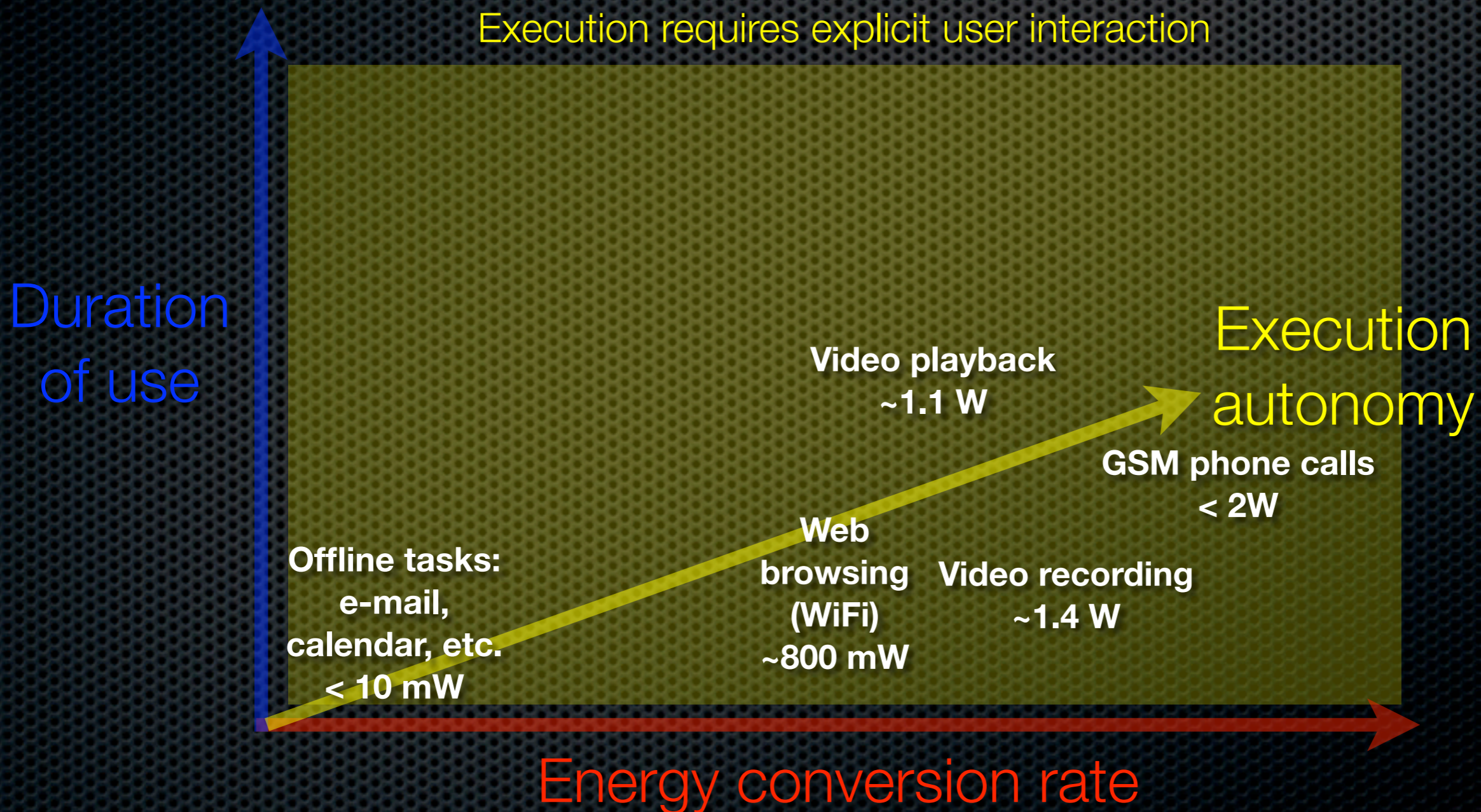
Execution continuum



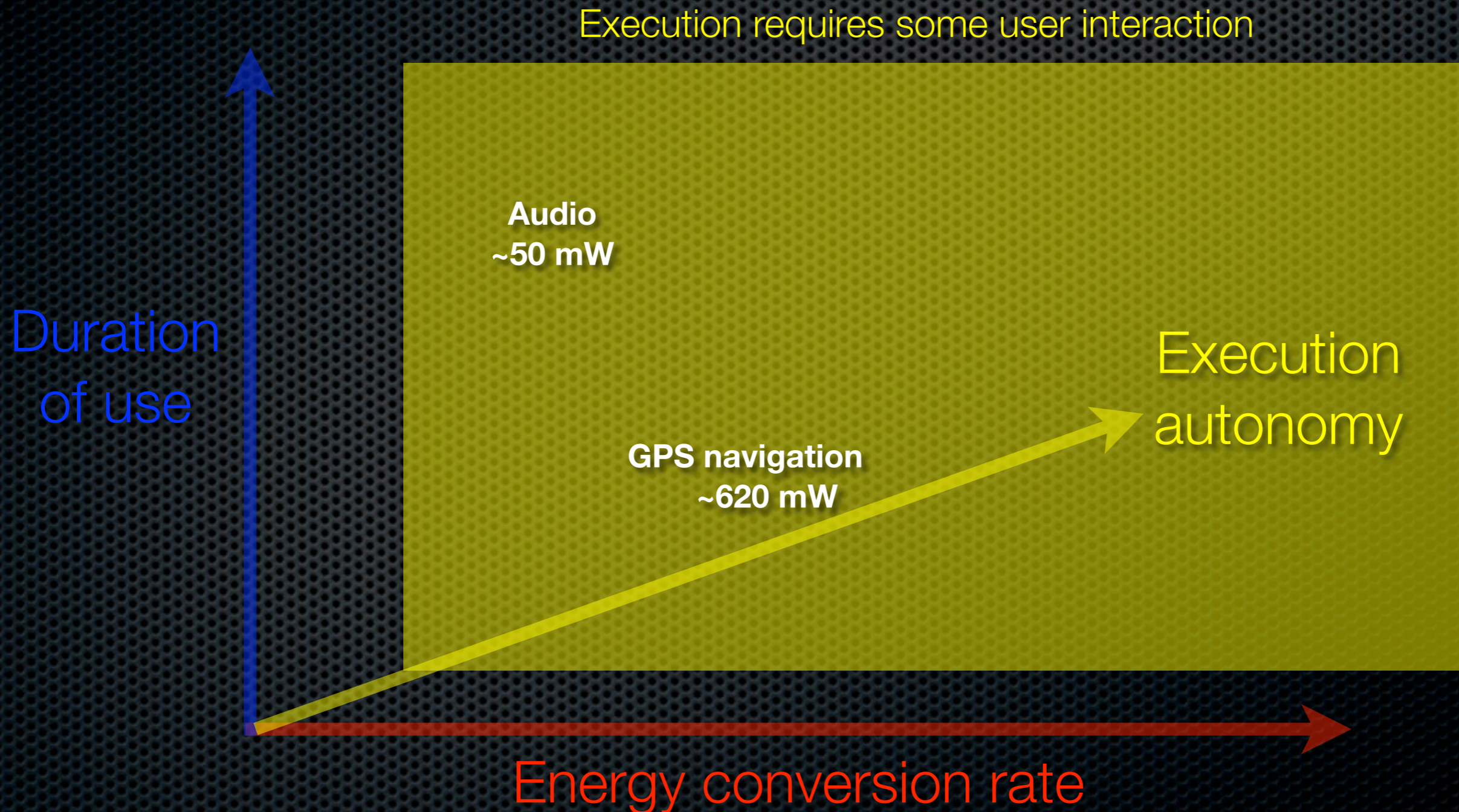
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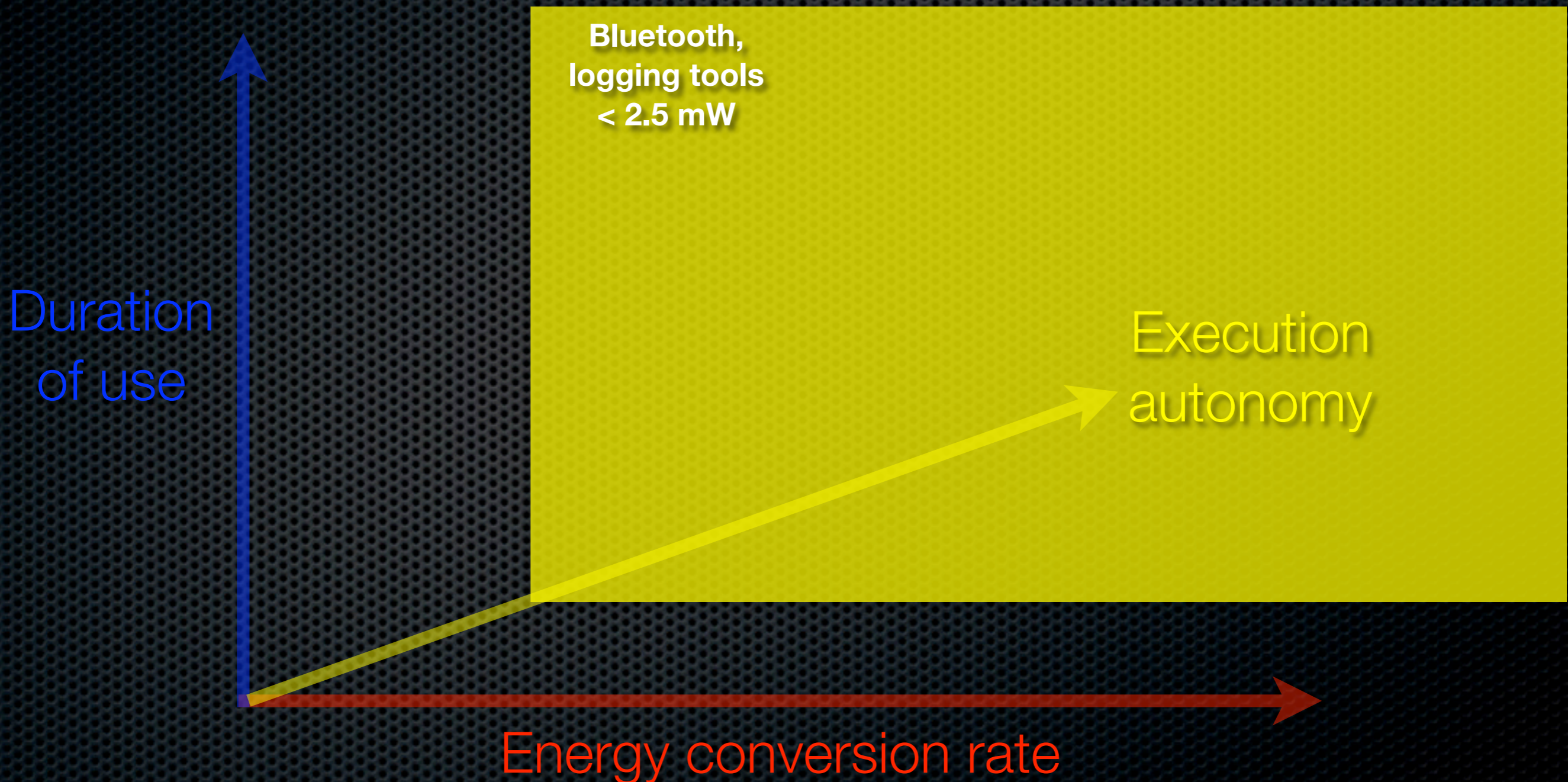


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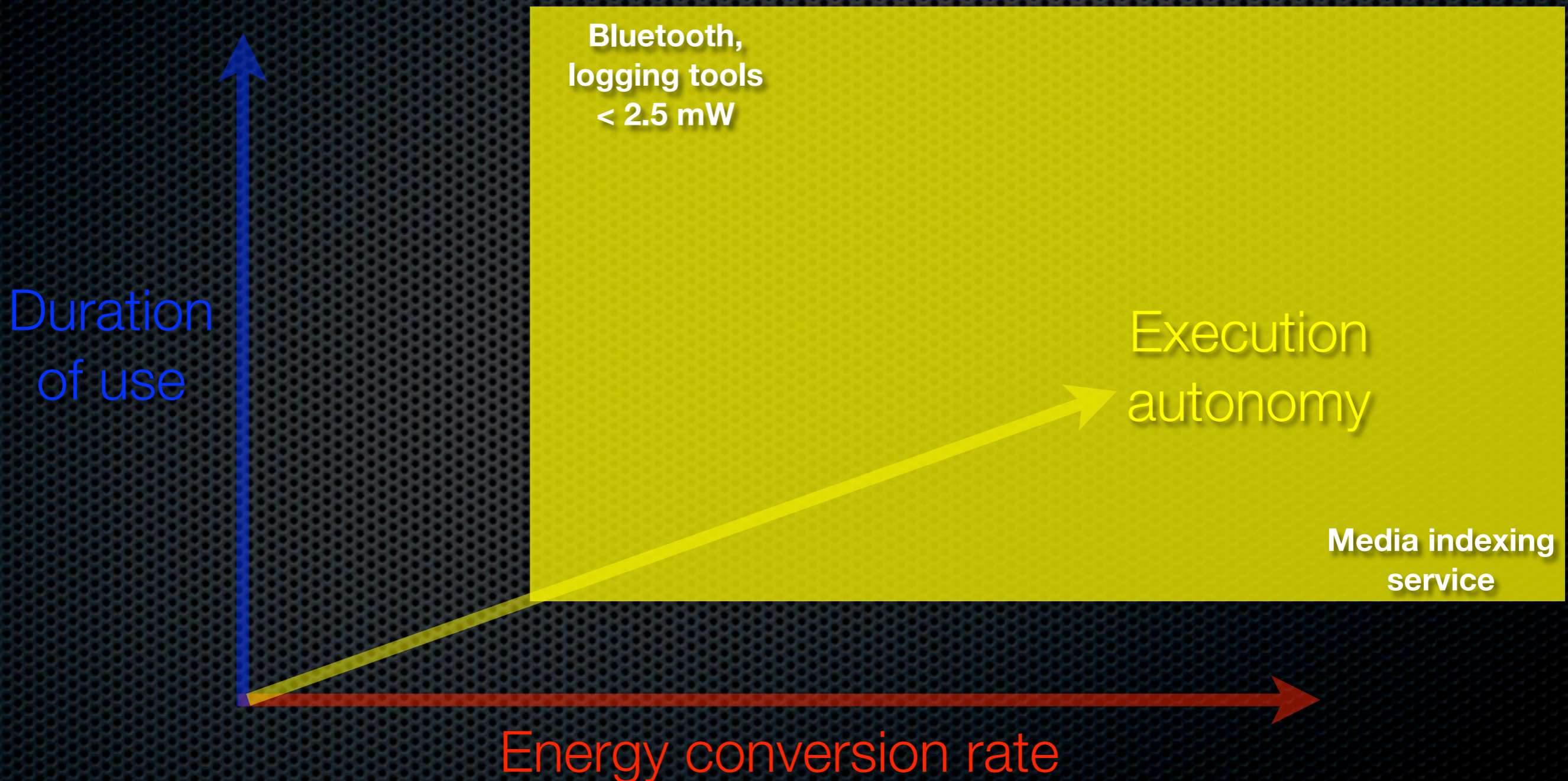
Execution continuum

Execution requires little or no user interaction



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The next frontier in mobile applications:
MyTube, PocketBay, etc.

Duration
of use

Execution
autonomy

Energy conversion rate

The next frontier in mobile applications

The next frontier in mobile applications

- ✦ Wireless opportunistic communication

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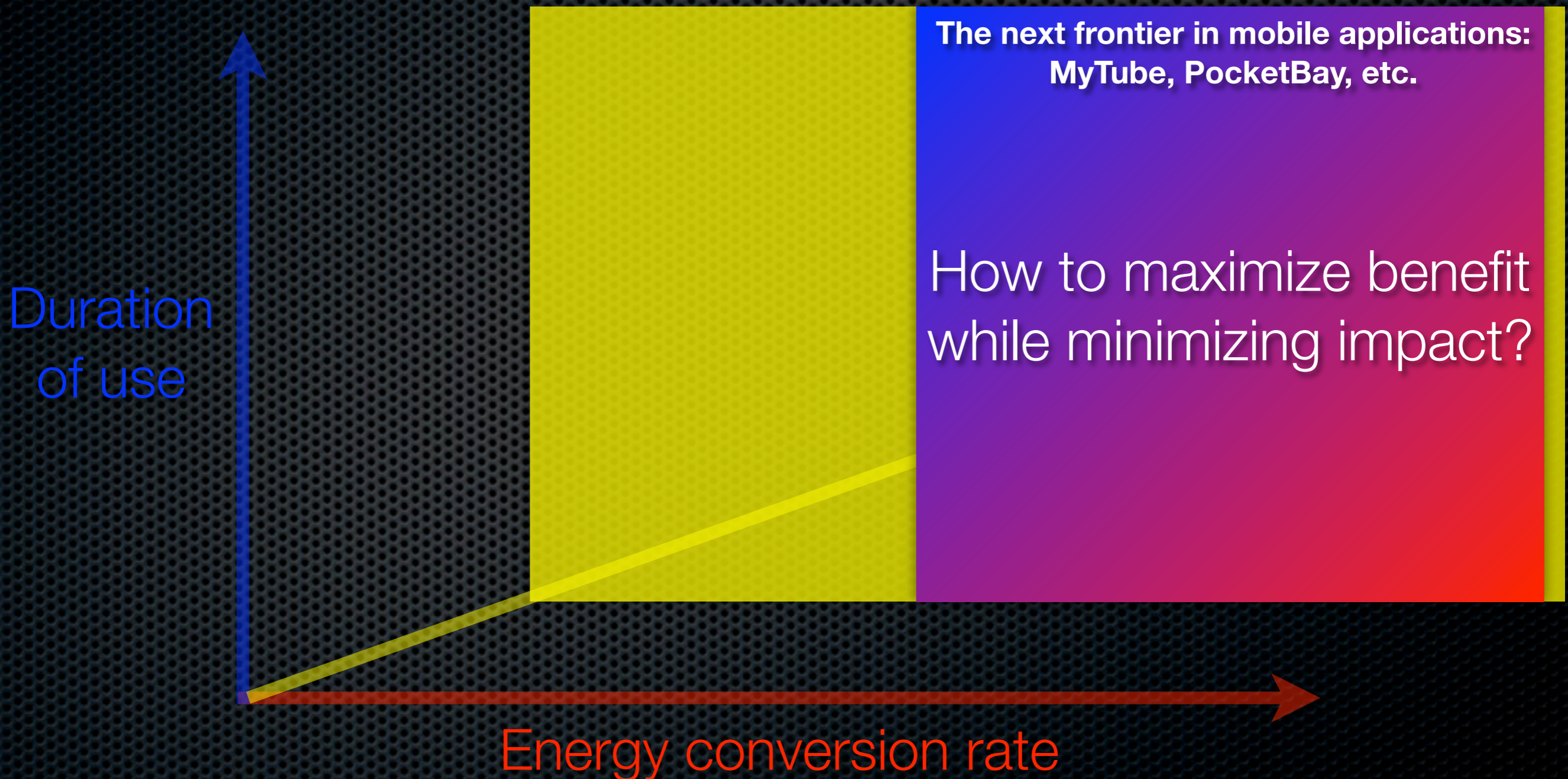
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The next frontier in mobile applications

- ✦ Wireless opportunistic communication
 - ✦ **requires autonomous execution**
- ✦ Continuous execution maximize connection opportunities
- ✦ Unfettered energy consumption can deplete finite energy resources
 - ✦ **Unacceptable**

Execution continuum

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Smartphone usage study

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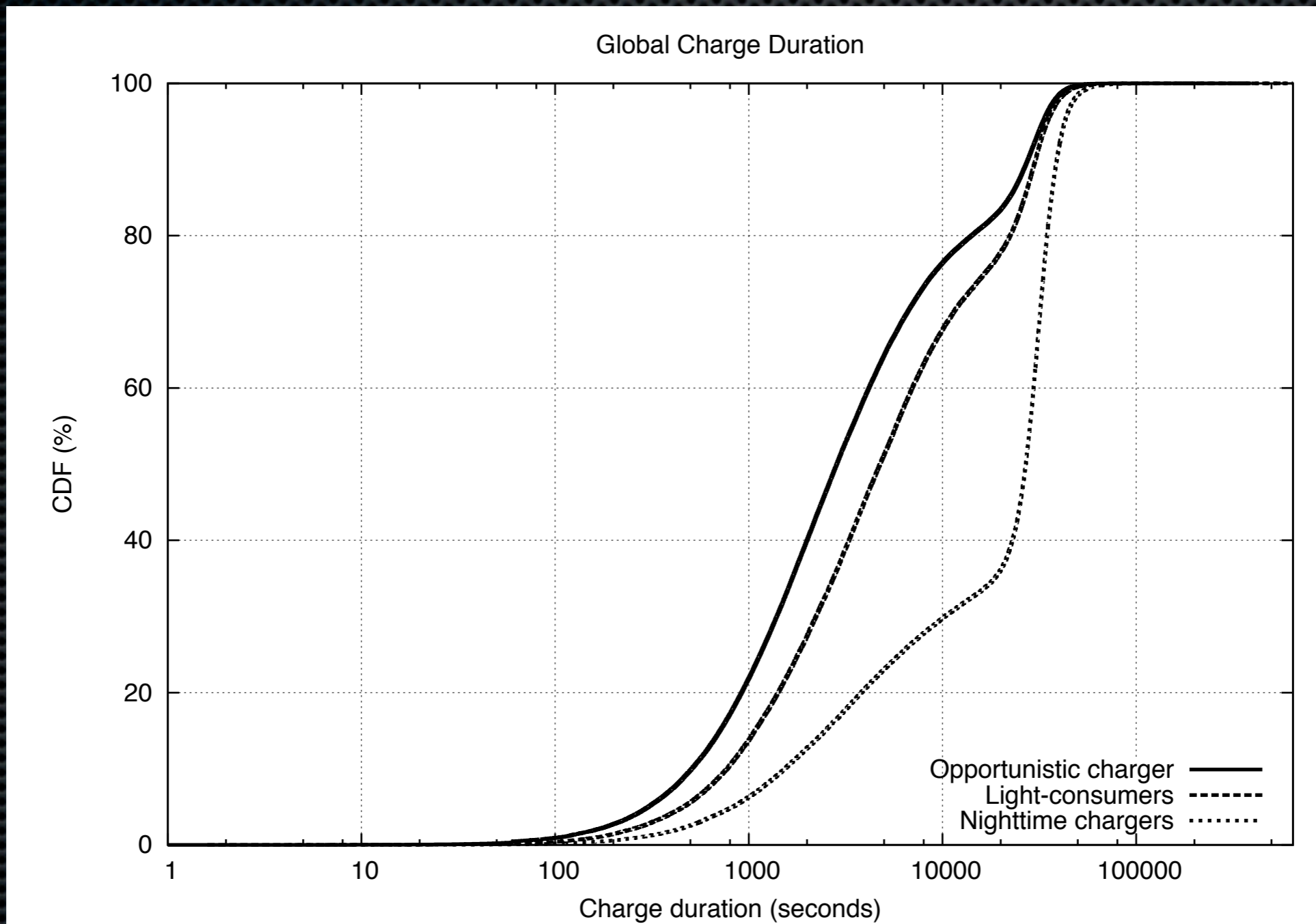
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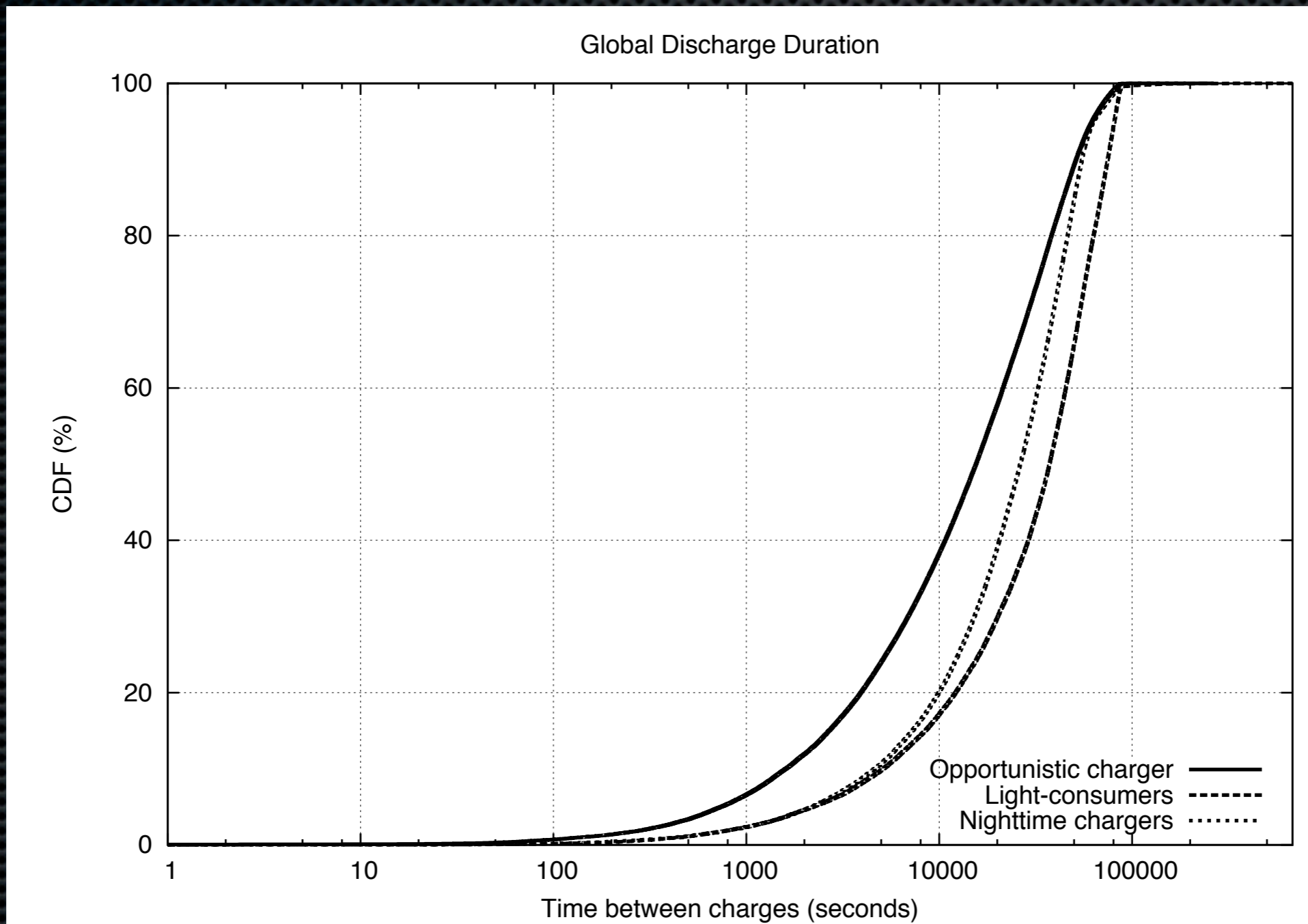
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 - ✦ battery level throughout the day
 - ✦ charge/discharge rate

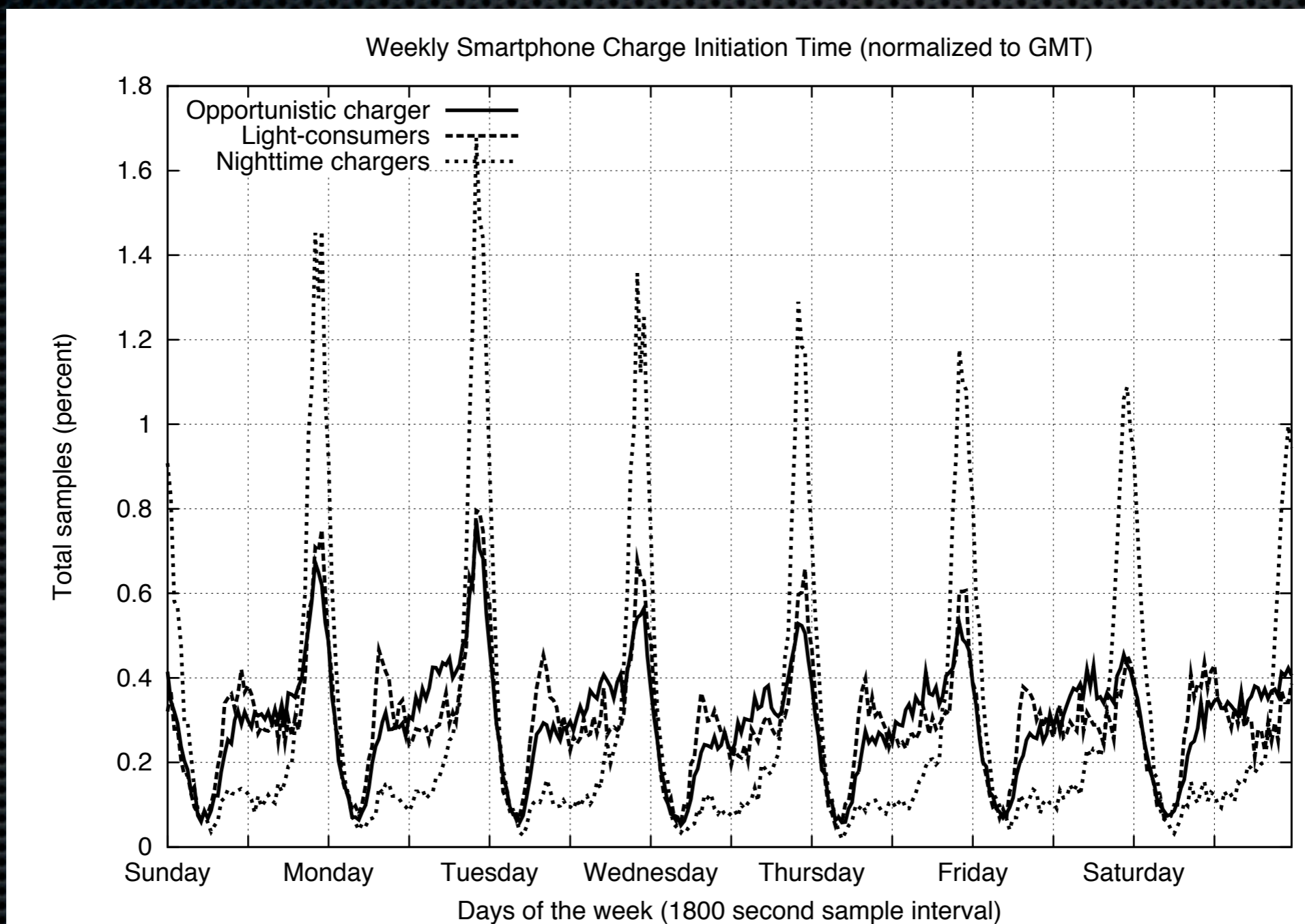
Charge duration



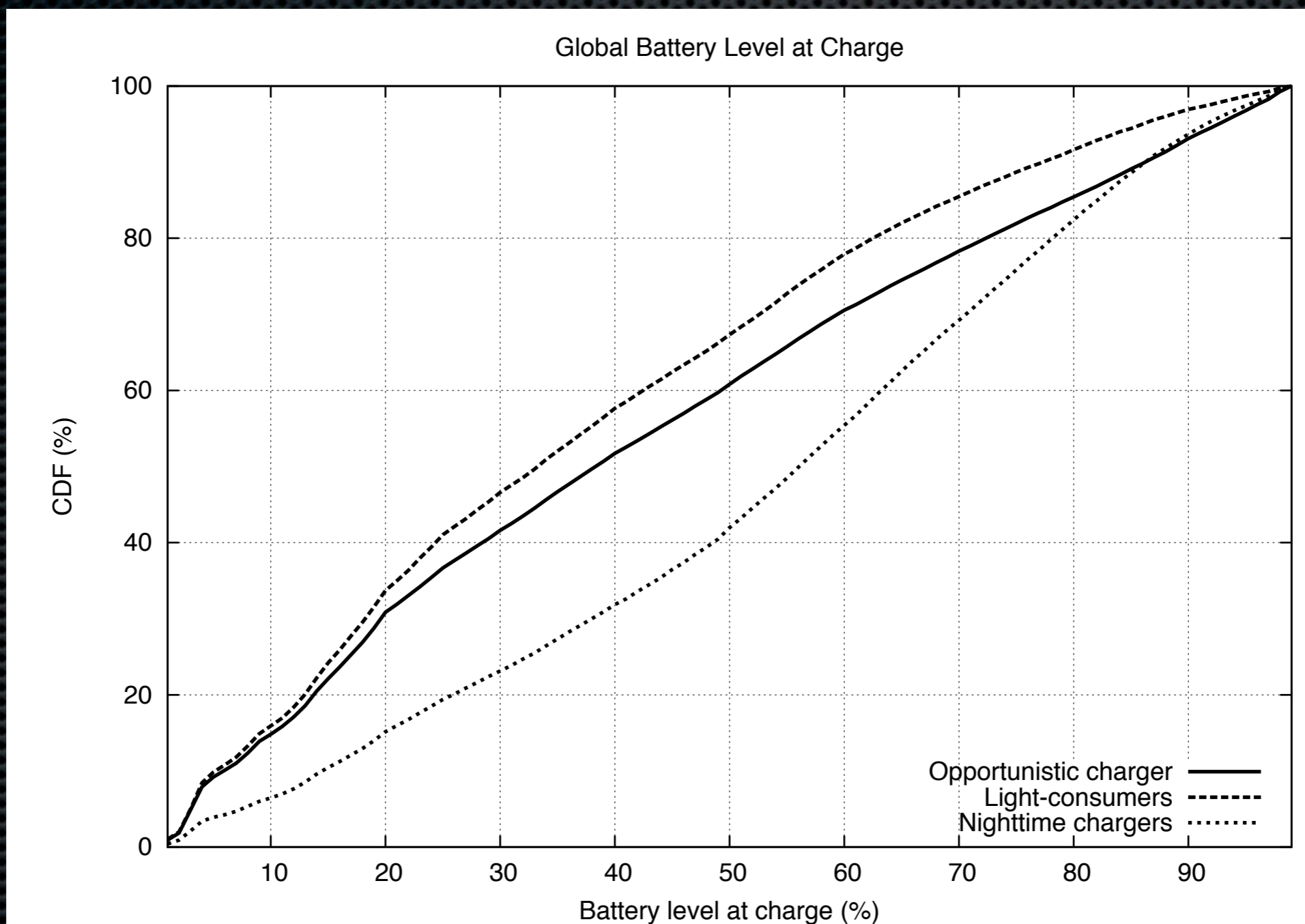
Discharge duration



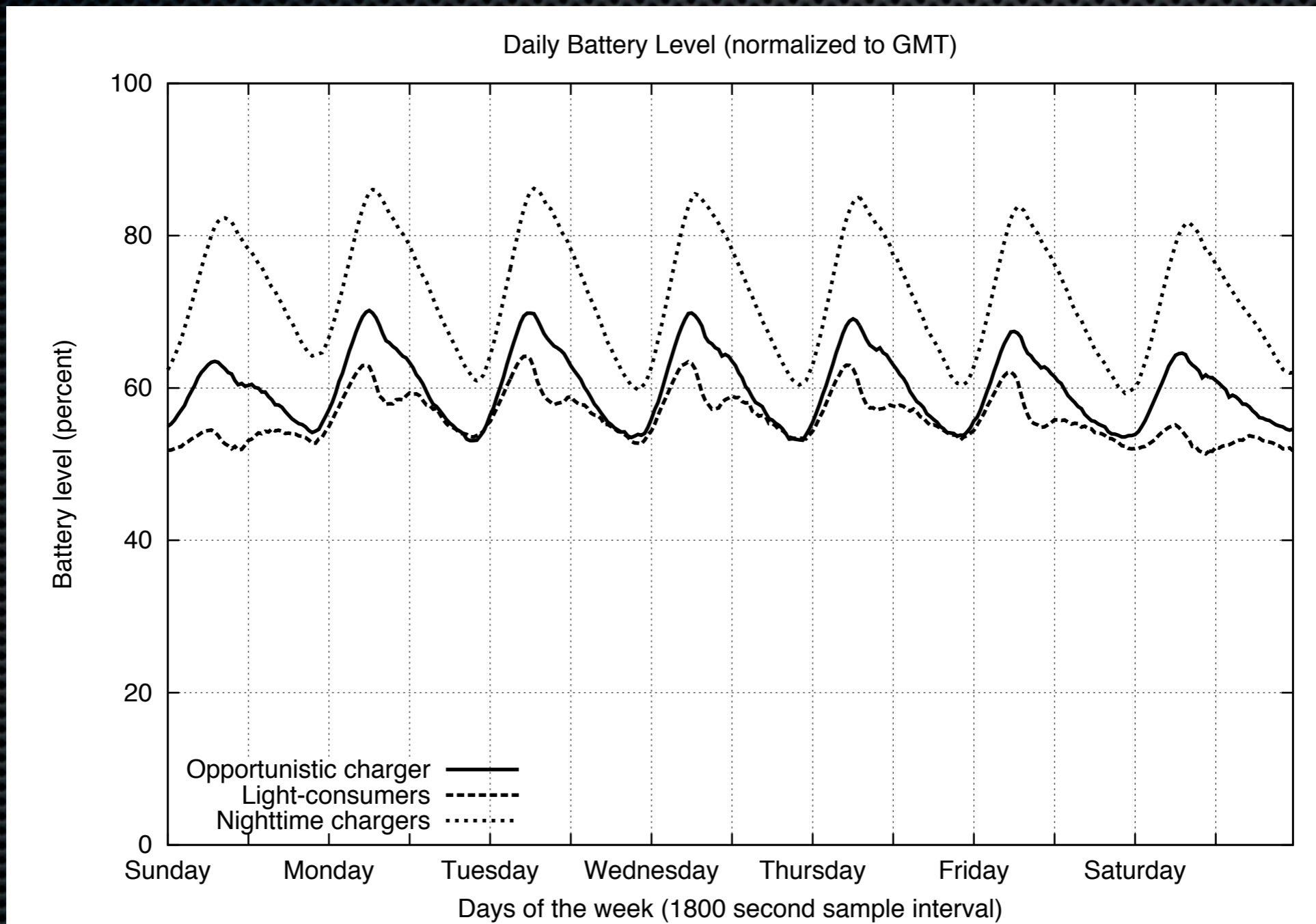
Charge initiation time



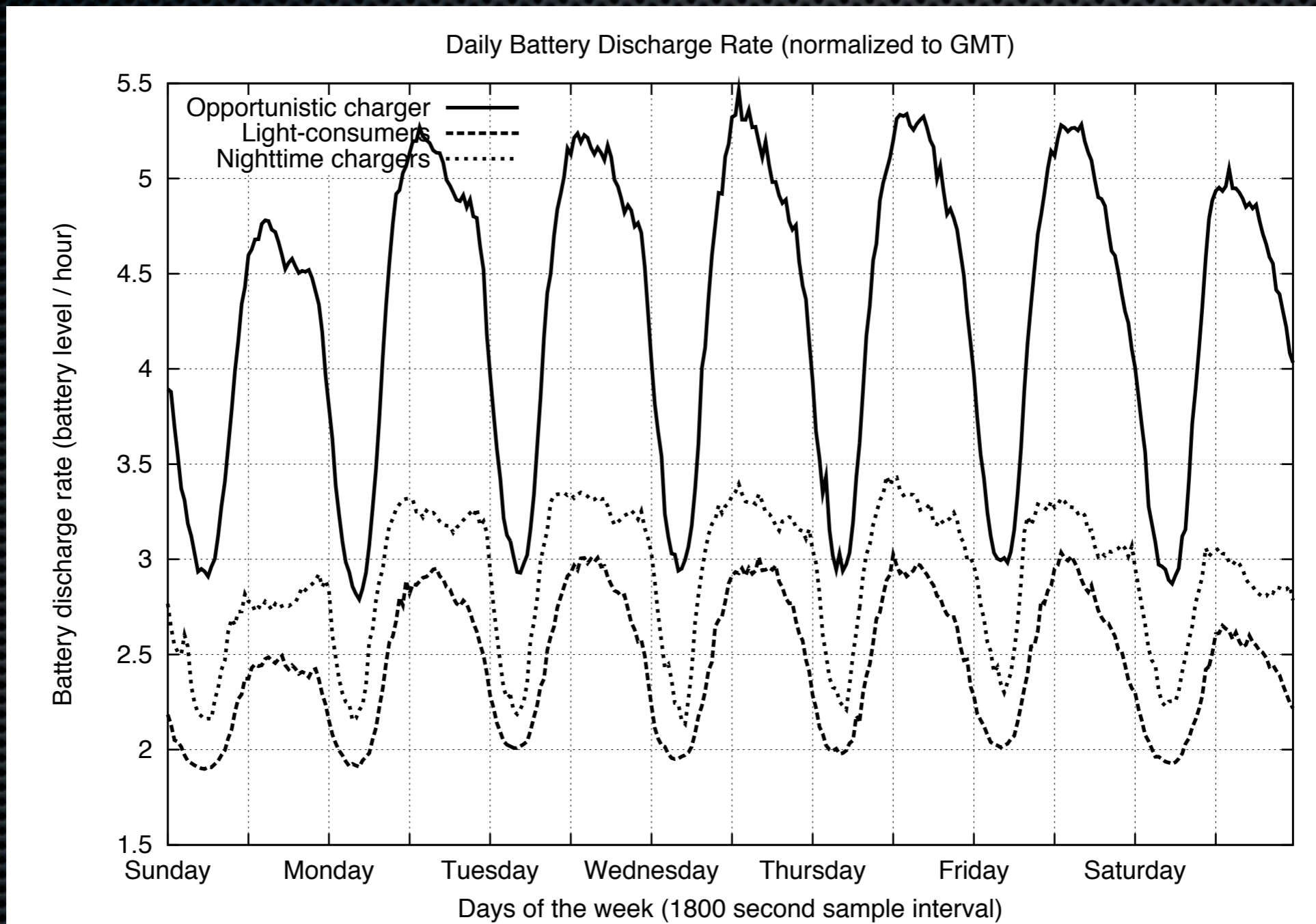
Charge initiation level



Daily battery level



Discharge rate



Summary

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- Comprehensive user study
 - opportunistic chargers
 - light-consumers
 - nighttime chargers)

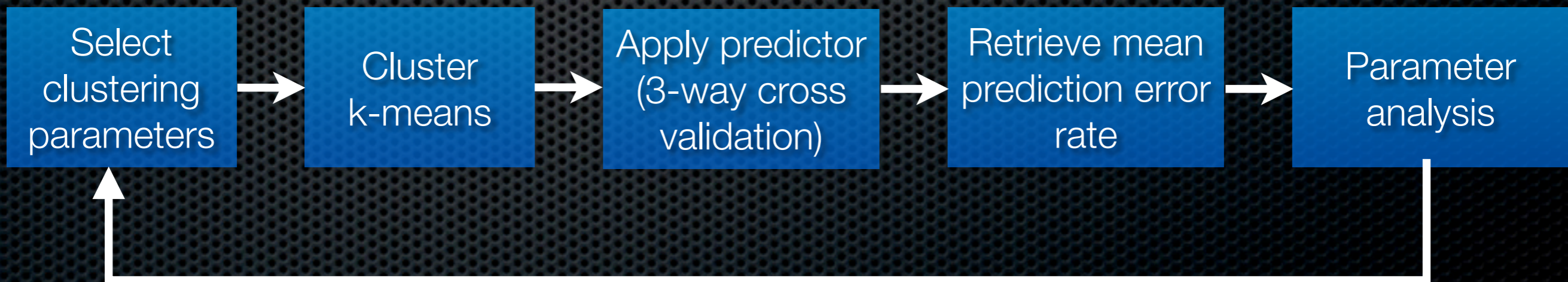
Summary

- ✦ Comprehensive user study
 - ✦ opportunistic chargers
 - ✦ light-consumers
 - ✦ nighttime chargers)
- ✦ Foundation for:
 - ✦ Regulating mobile application execution based on a **predicted future battery level**.
 - ✦ **Predicting the successful execution rate** of energy intensive applications given known energy consumption behaviour.

Questions?

User classification

- ✦ Cluster by device
- ✦ Cluster by energy consumption/replenishment characteristics
 - ✦ Which set of characteristics are best?
 - ✦ The set that yield the best prediction results.



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Prediction algorithm

t_{last} = last time that the device began charging or discharging

δ_{charge_t} = mean charge duration of a charge initiated during $bucket(t)$

$\delta_{discharge_t}$ = mean discharge duration of a discharge initiated during $bucket(t)$

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Prediction algorithm

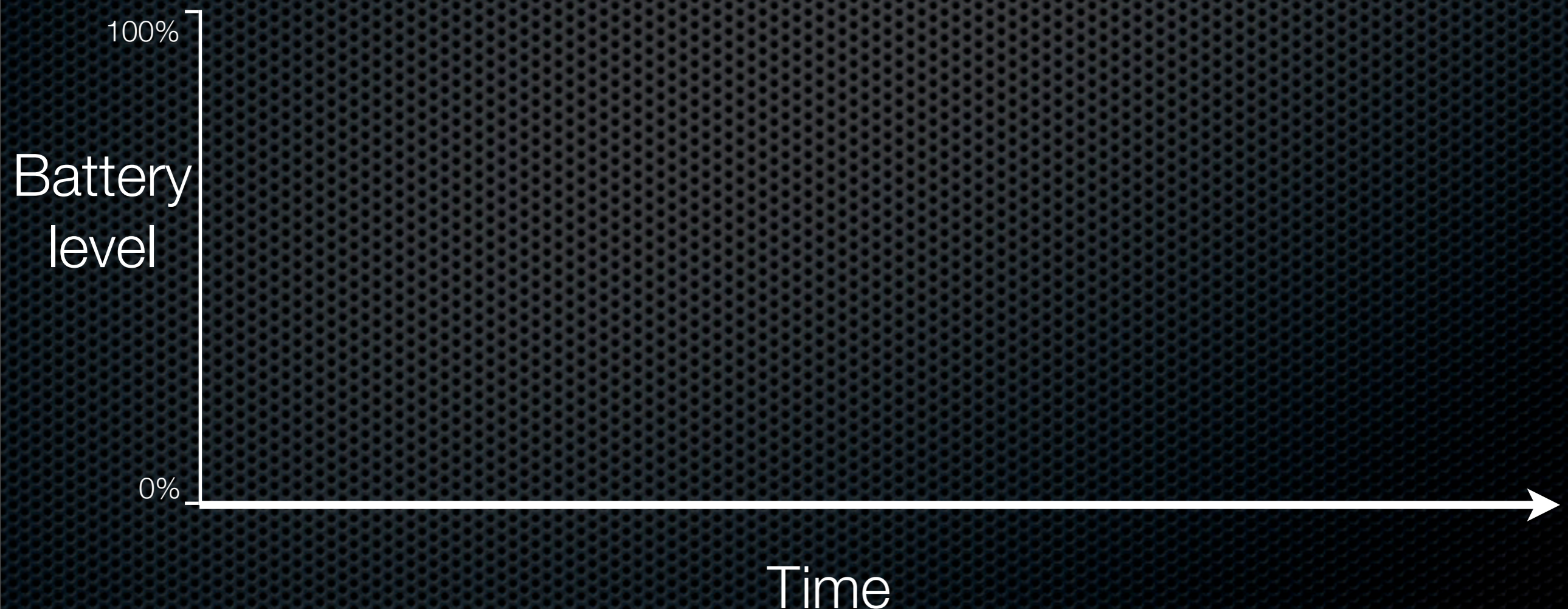
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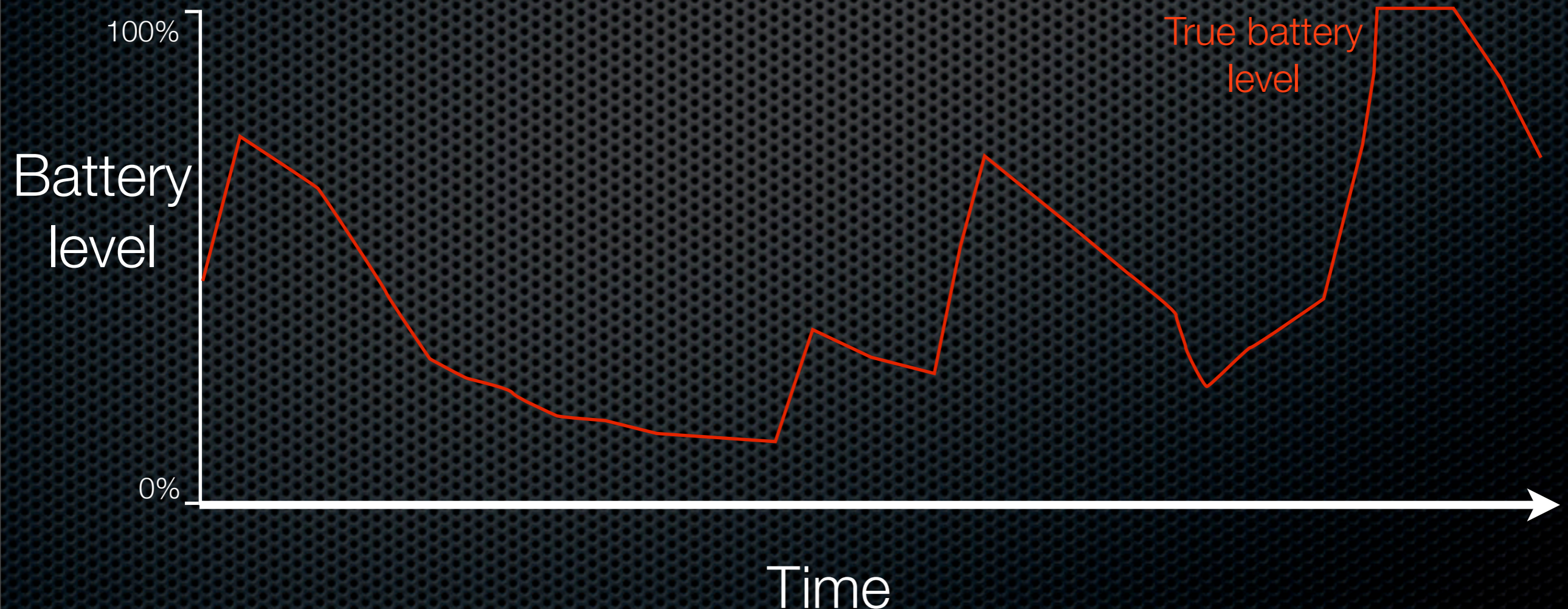
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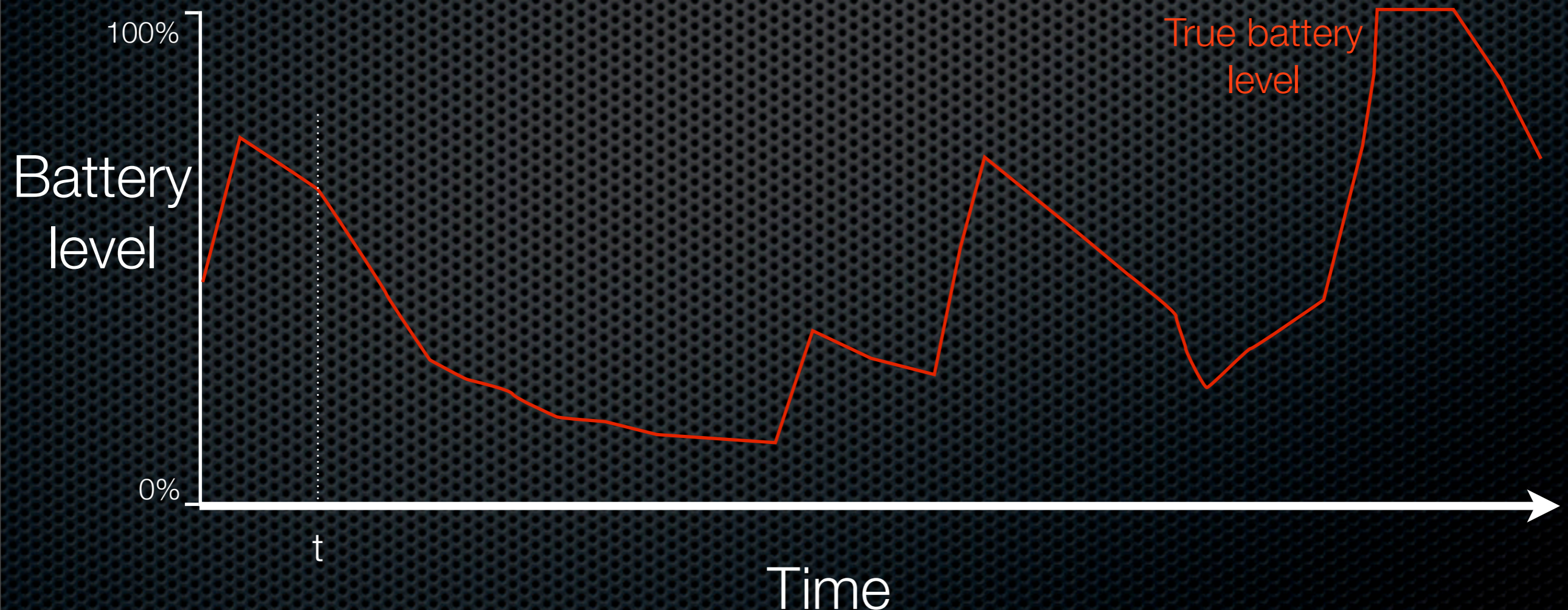
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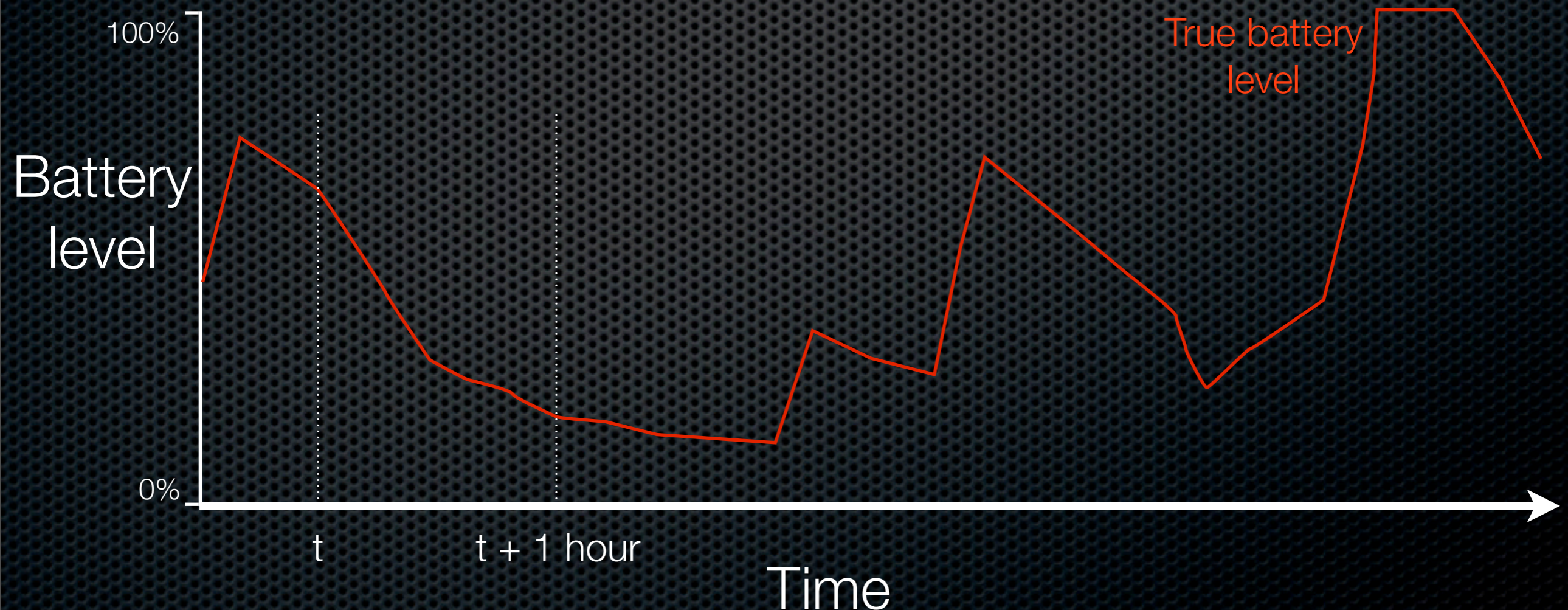
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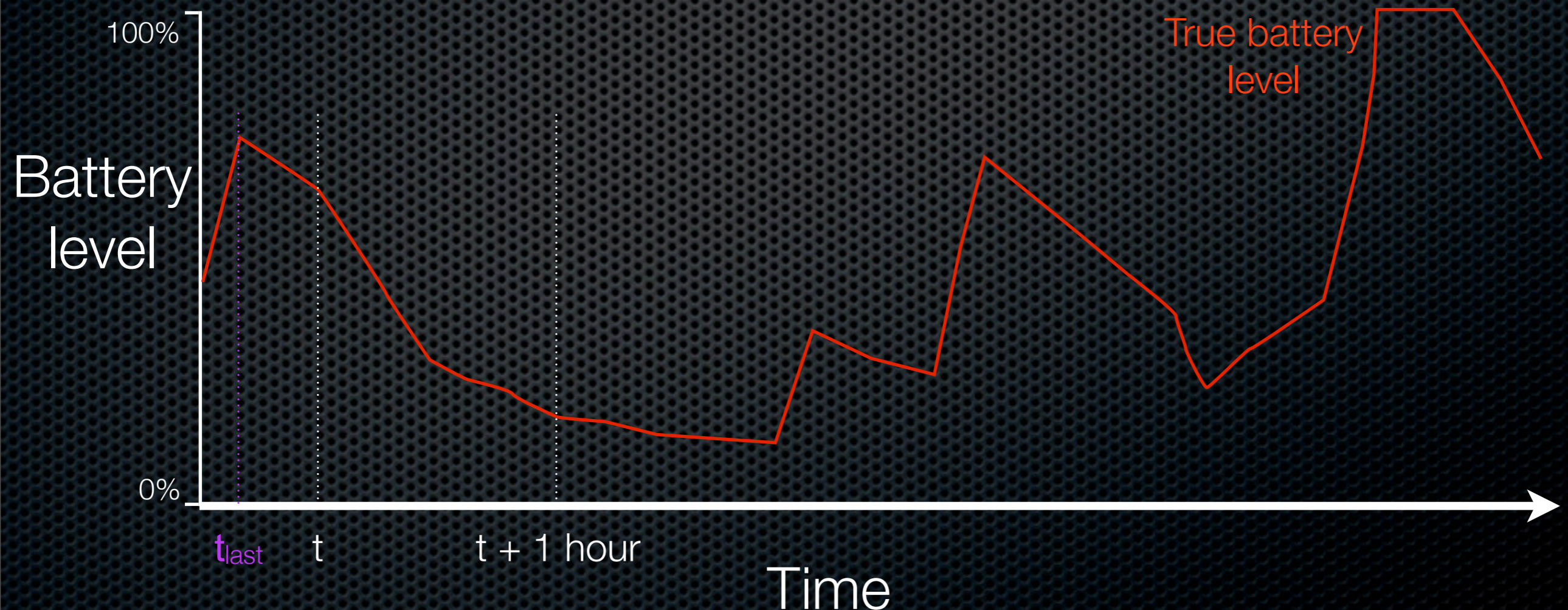
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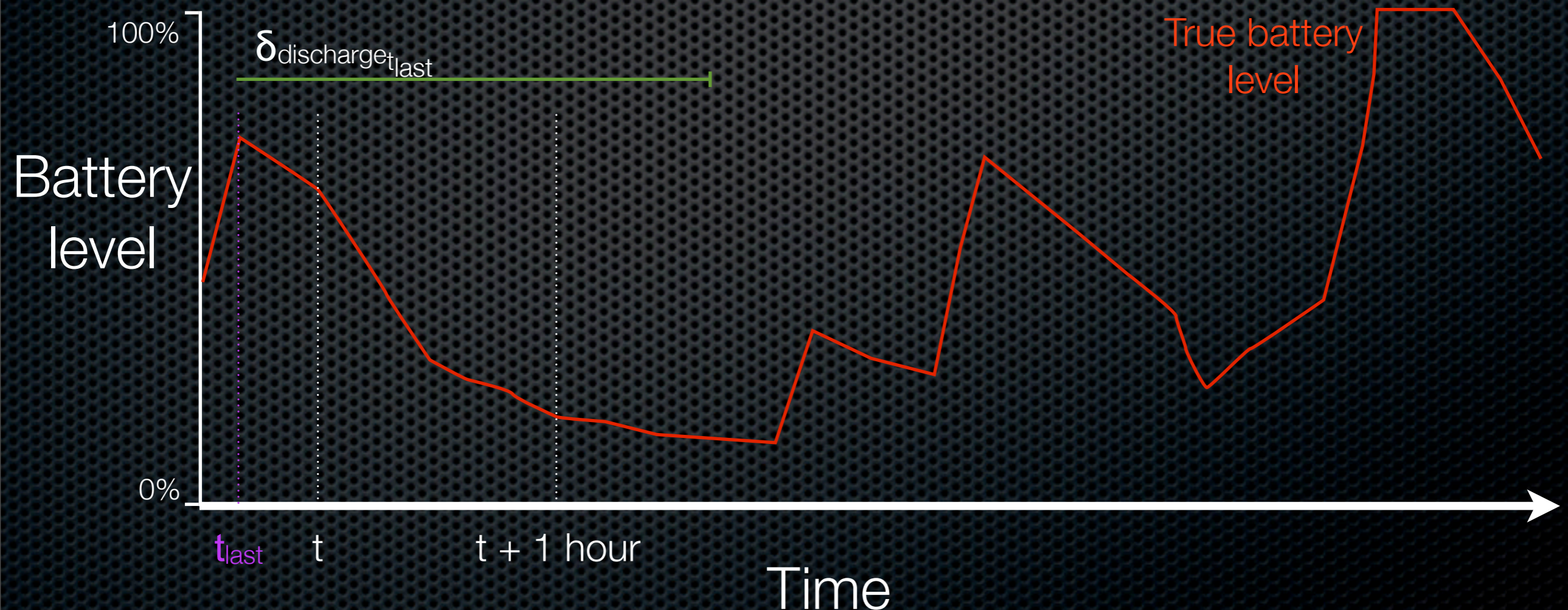
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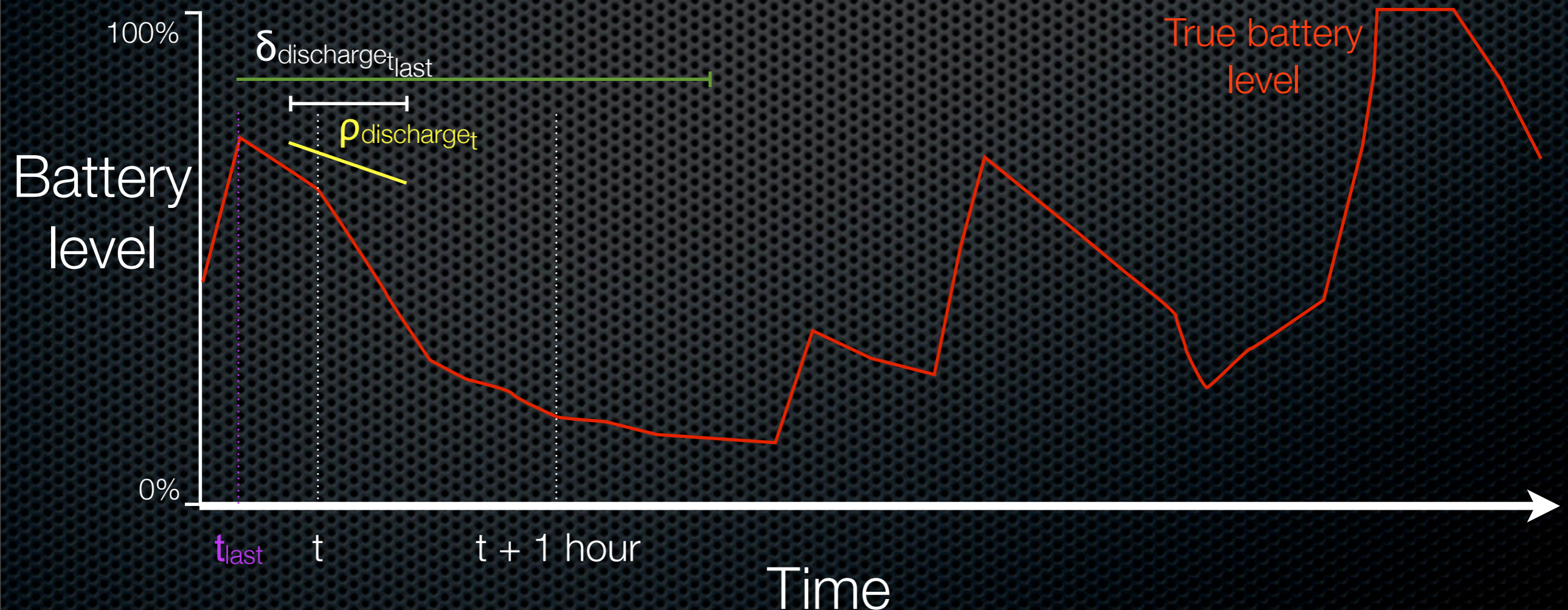
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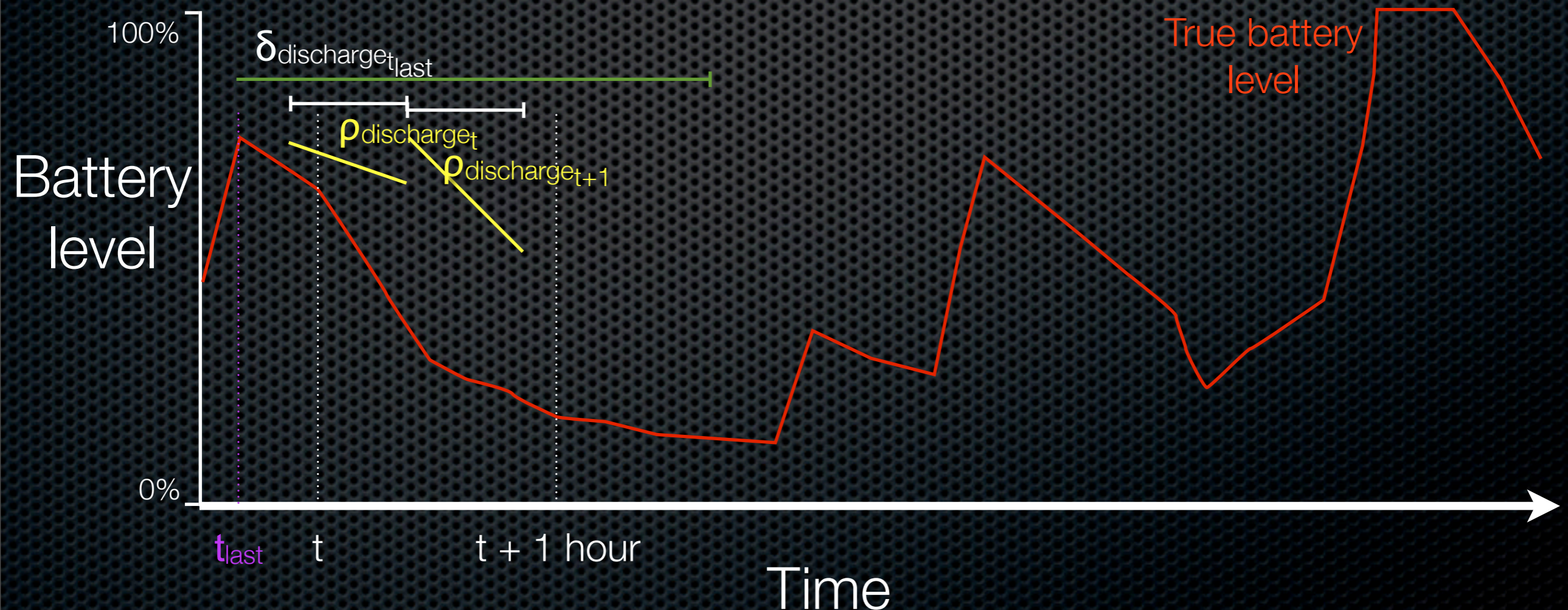
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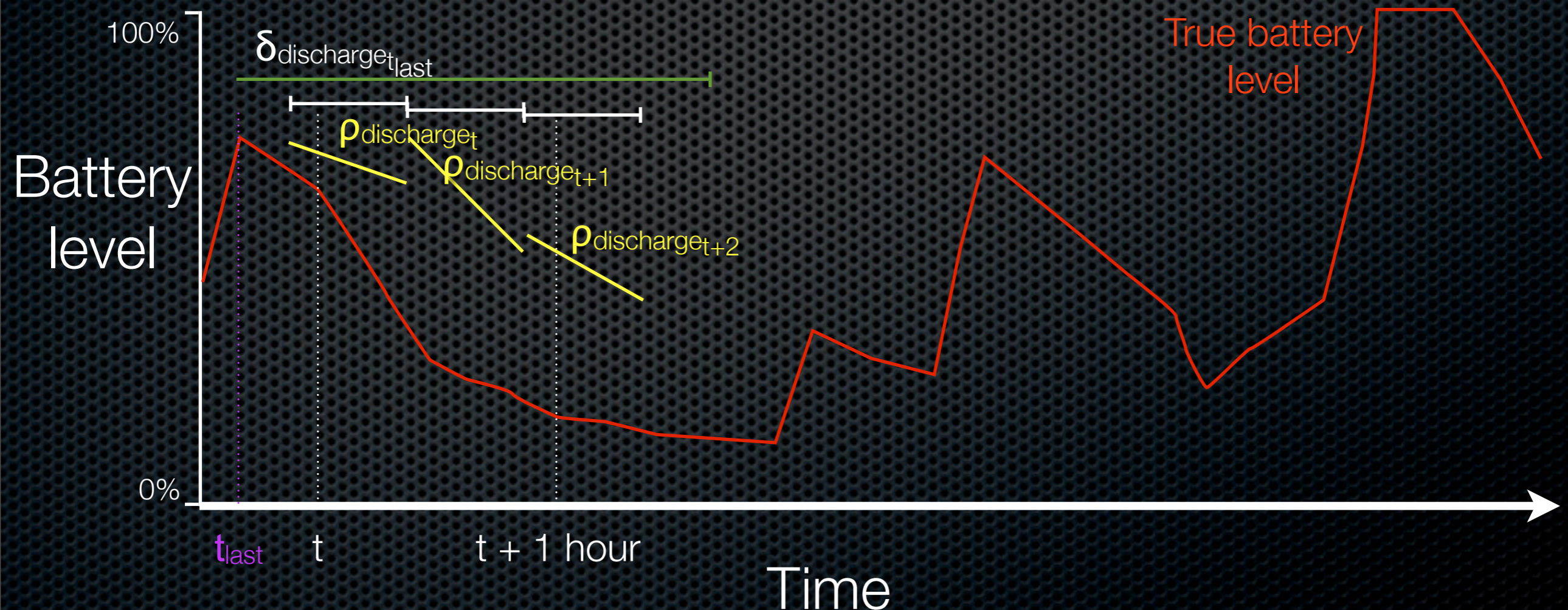
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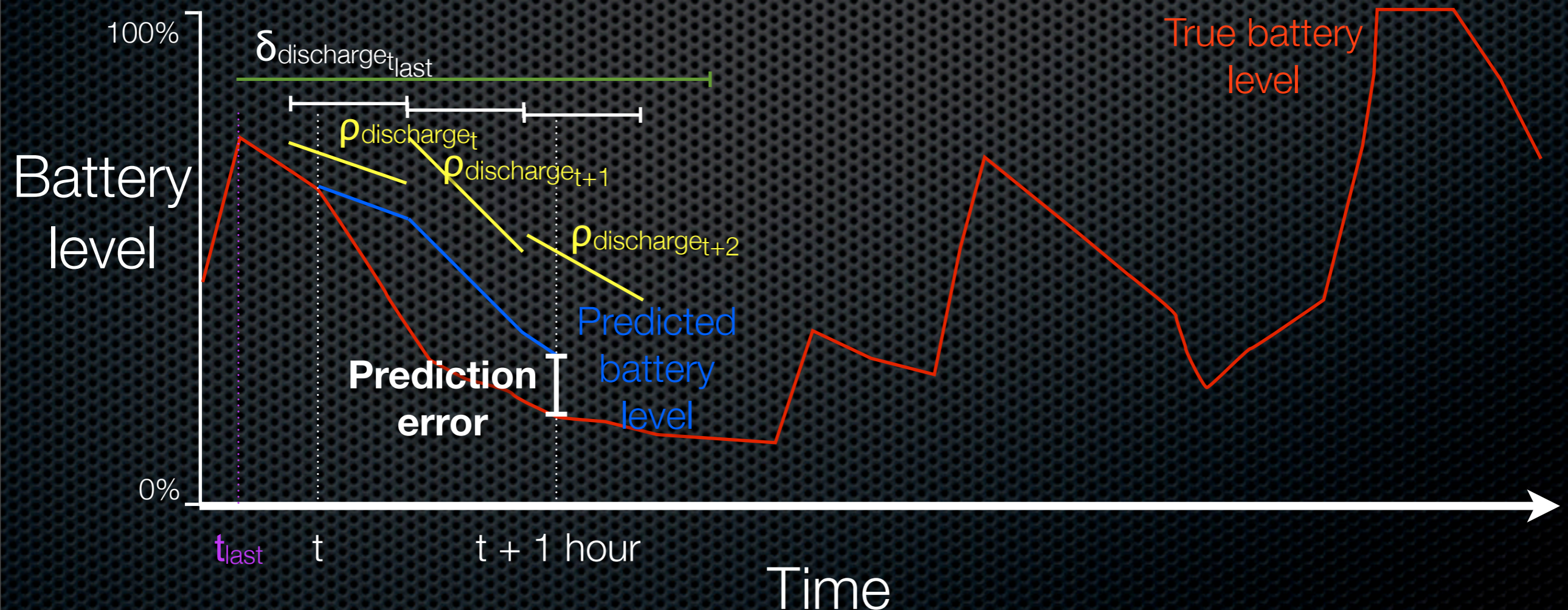
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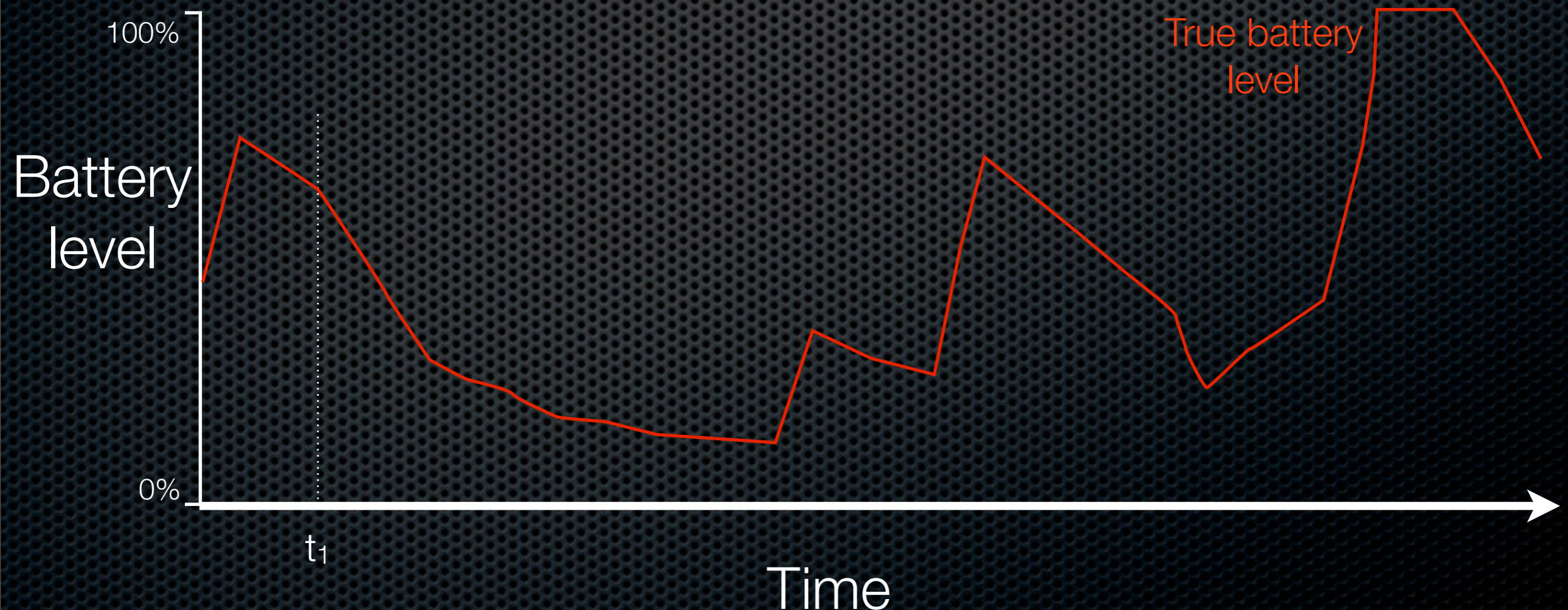
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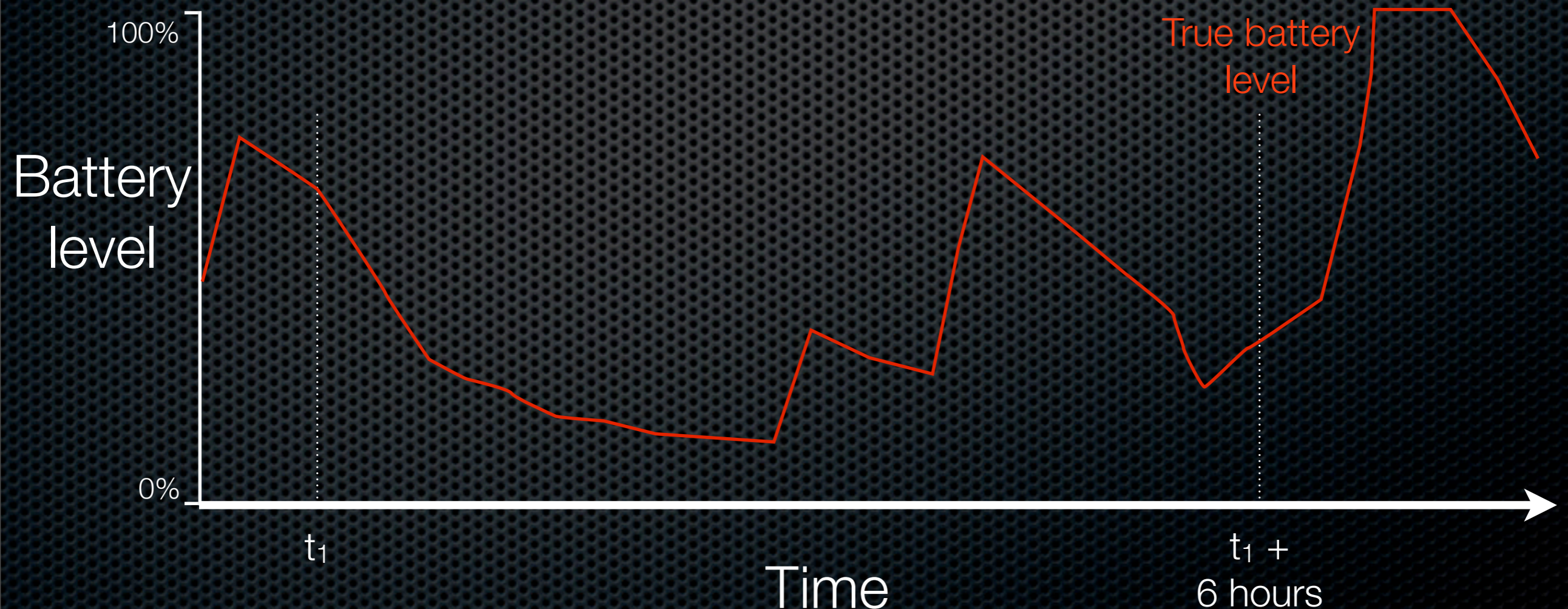
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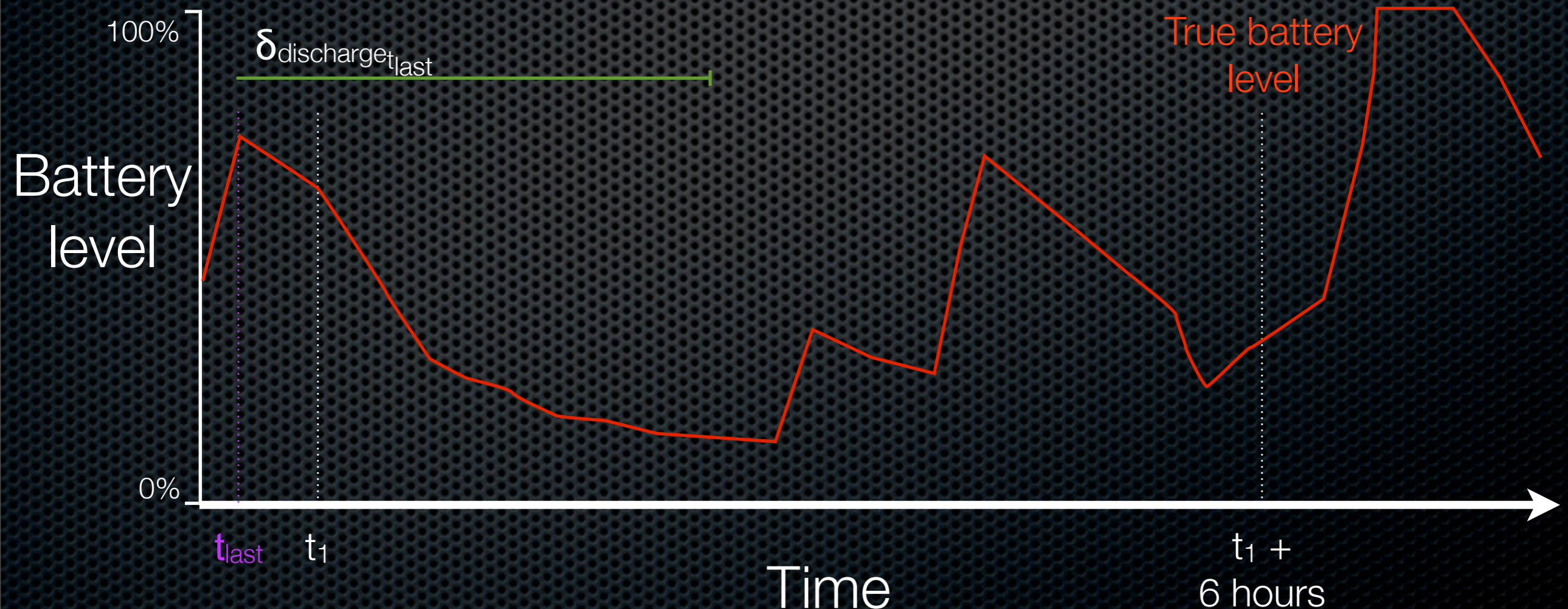
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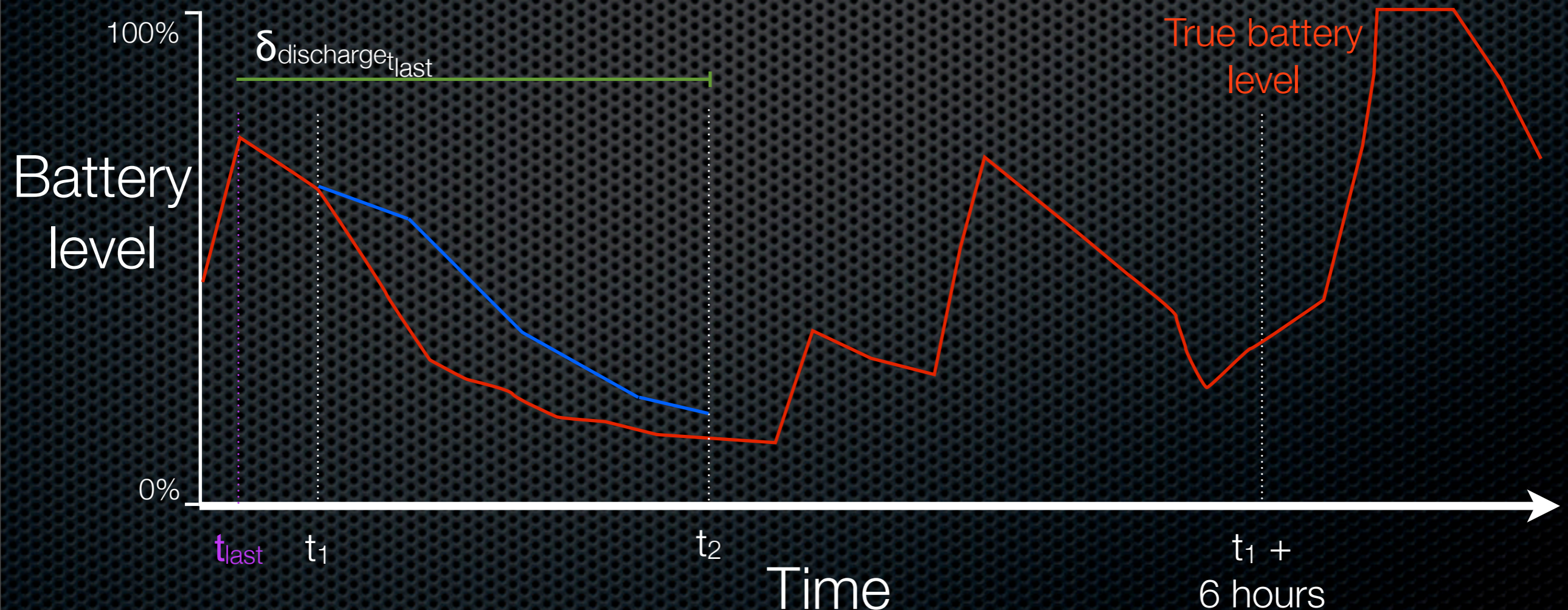
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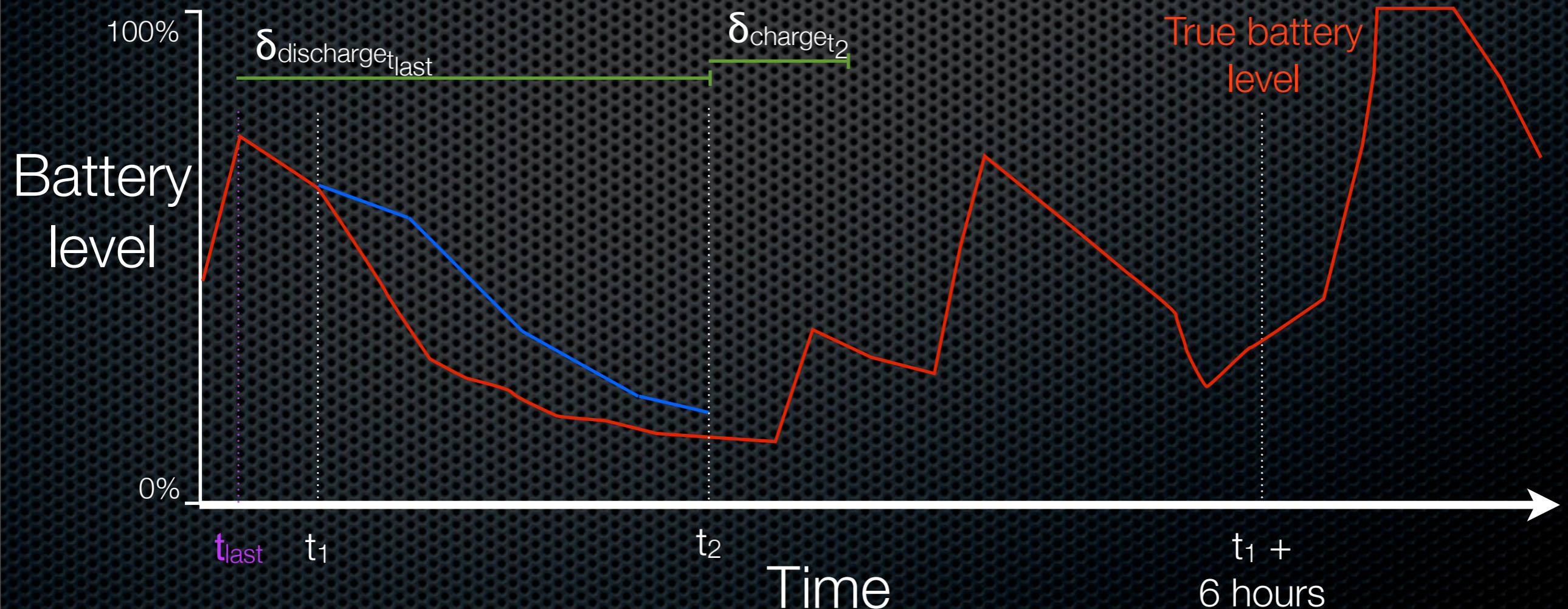
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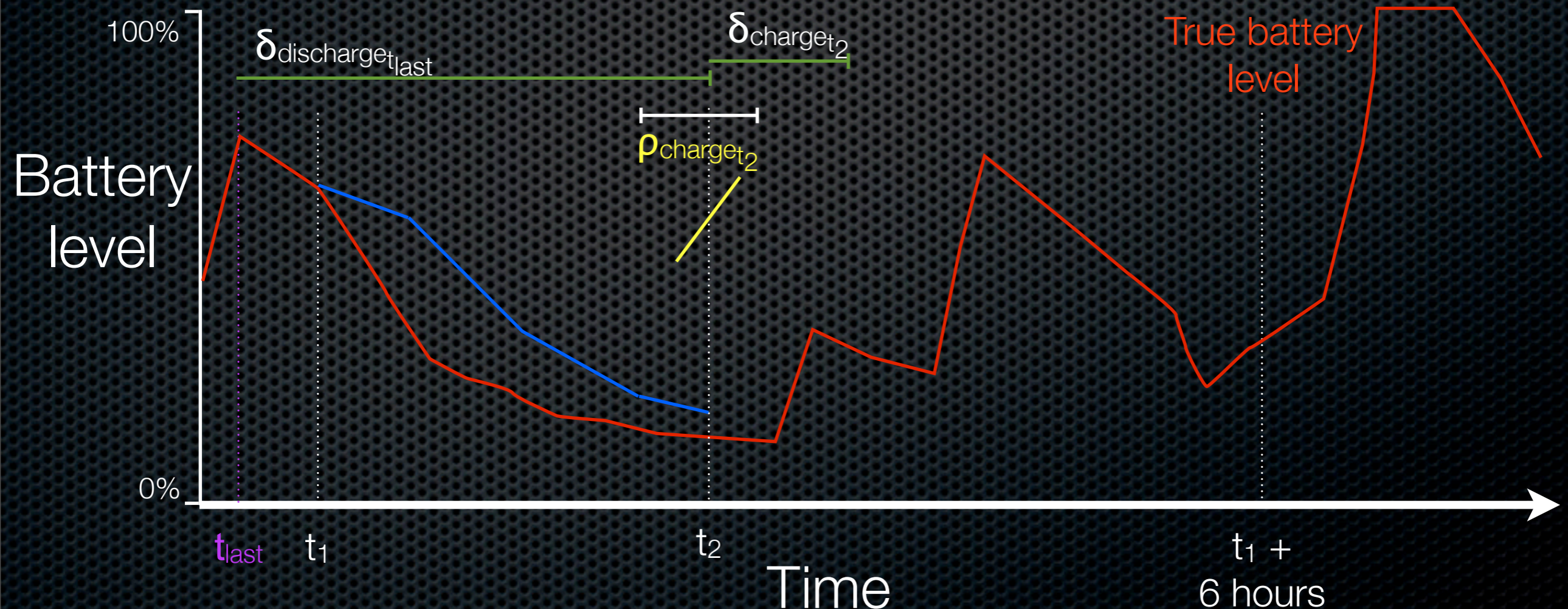
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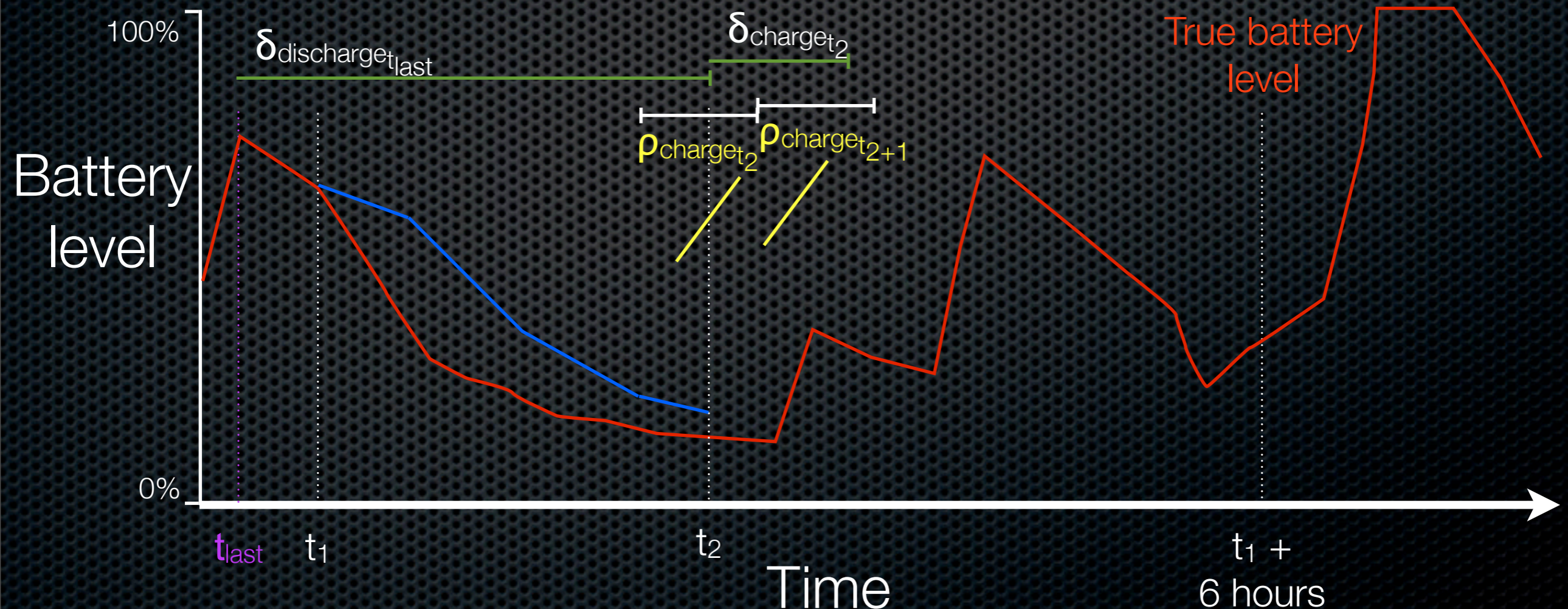
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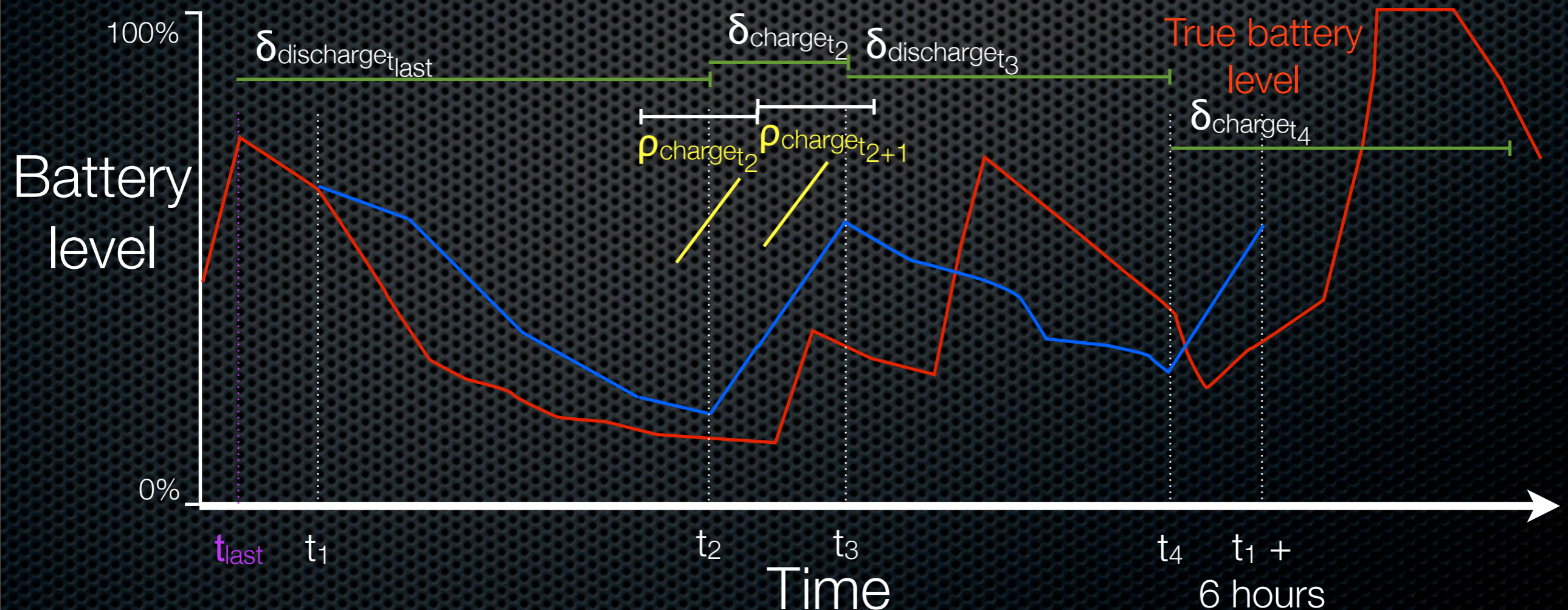
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