

Dynamic Behavior of Processor Temperature: Modelling and Estimation

UNIVERSITY OF TWENTE.

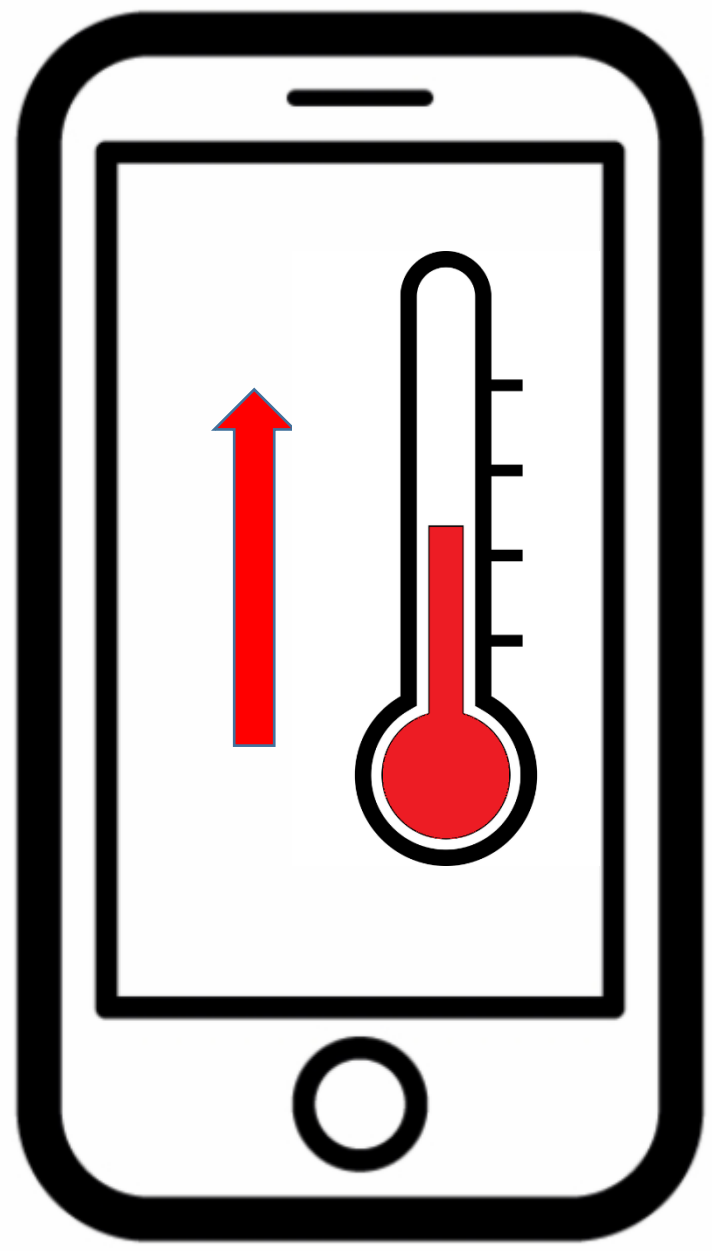
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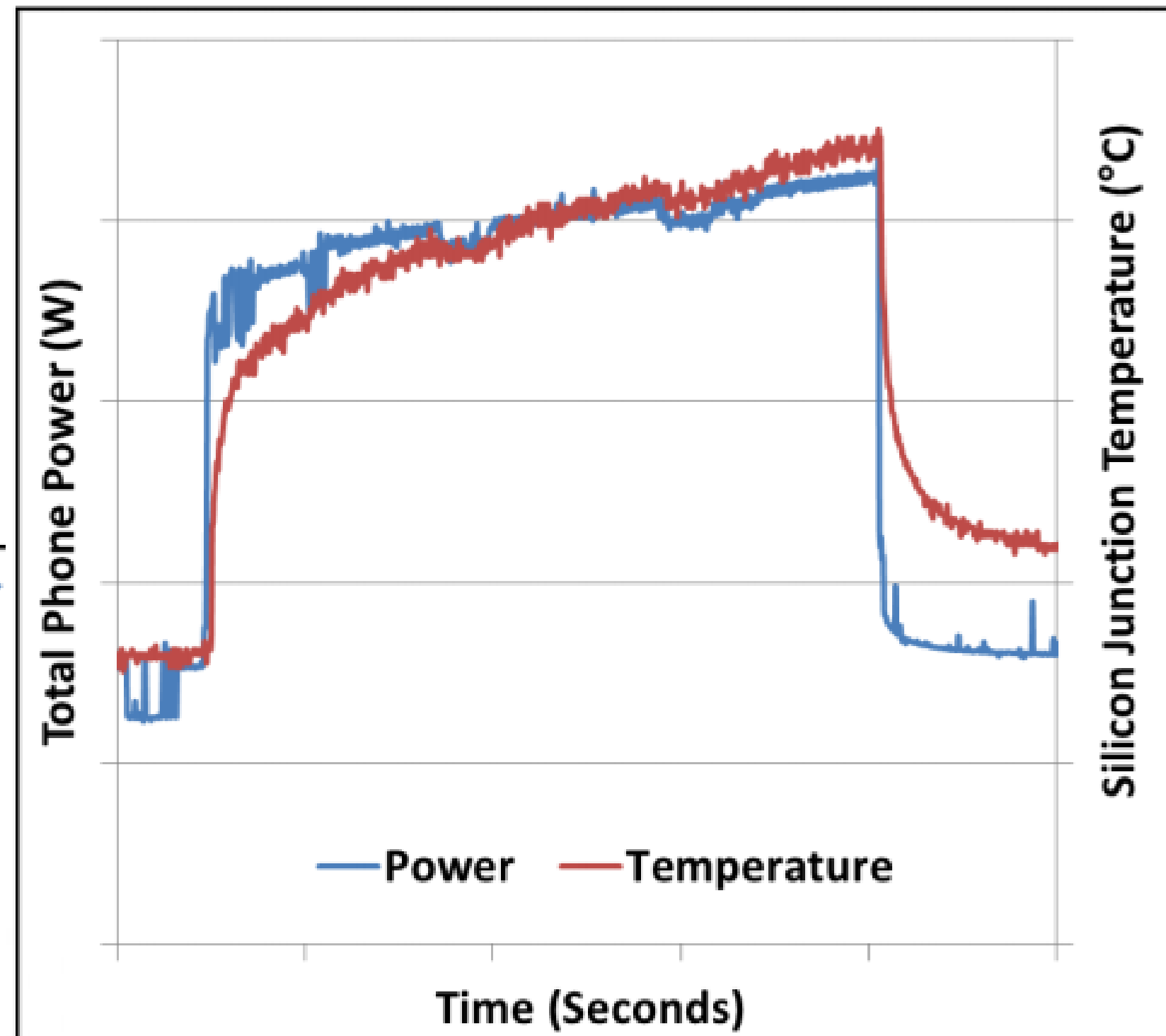
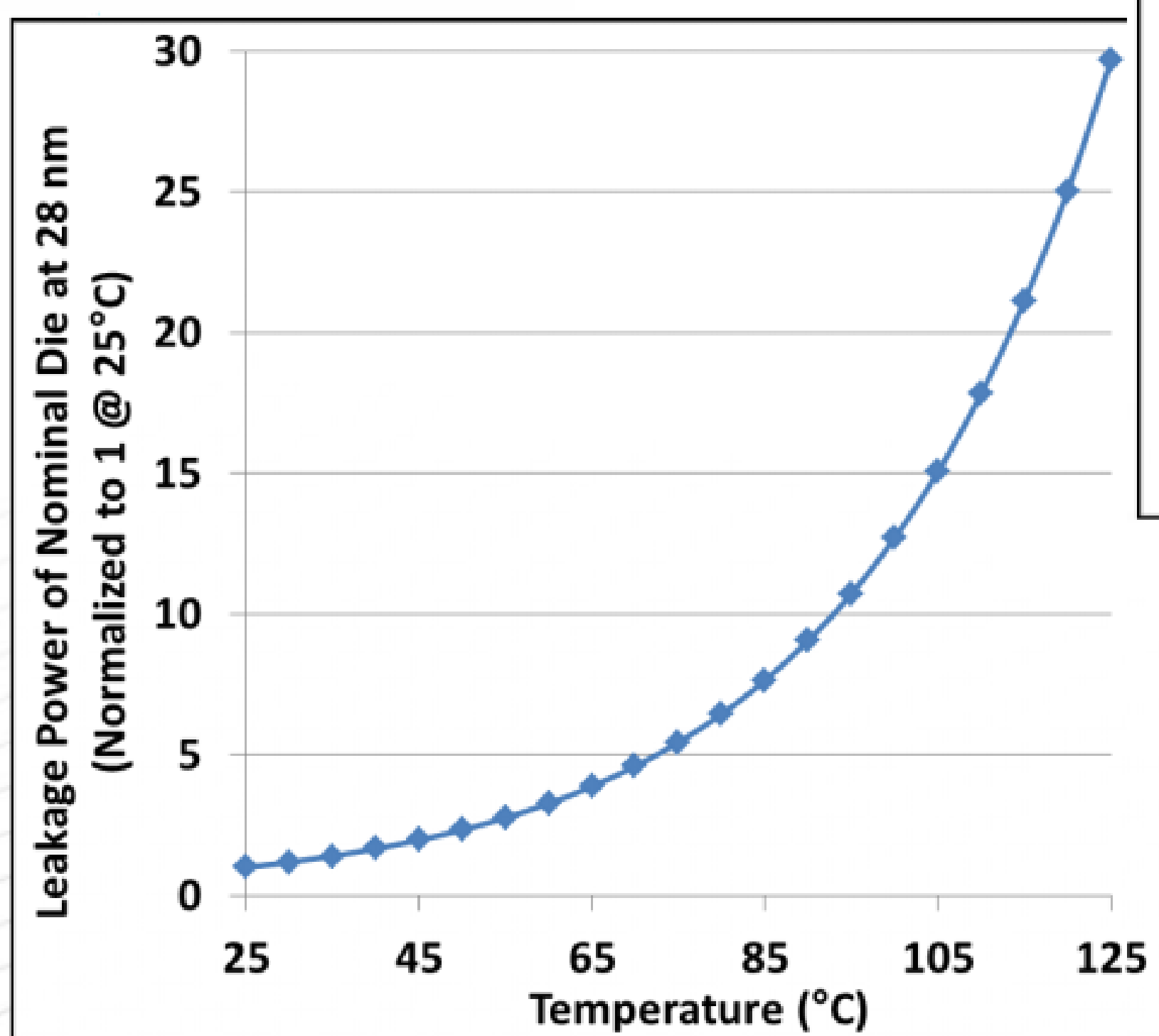
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Why do we need to estimate the processor temperature?



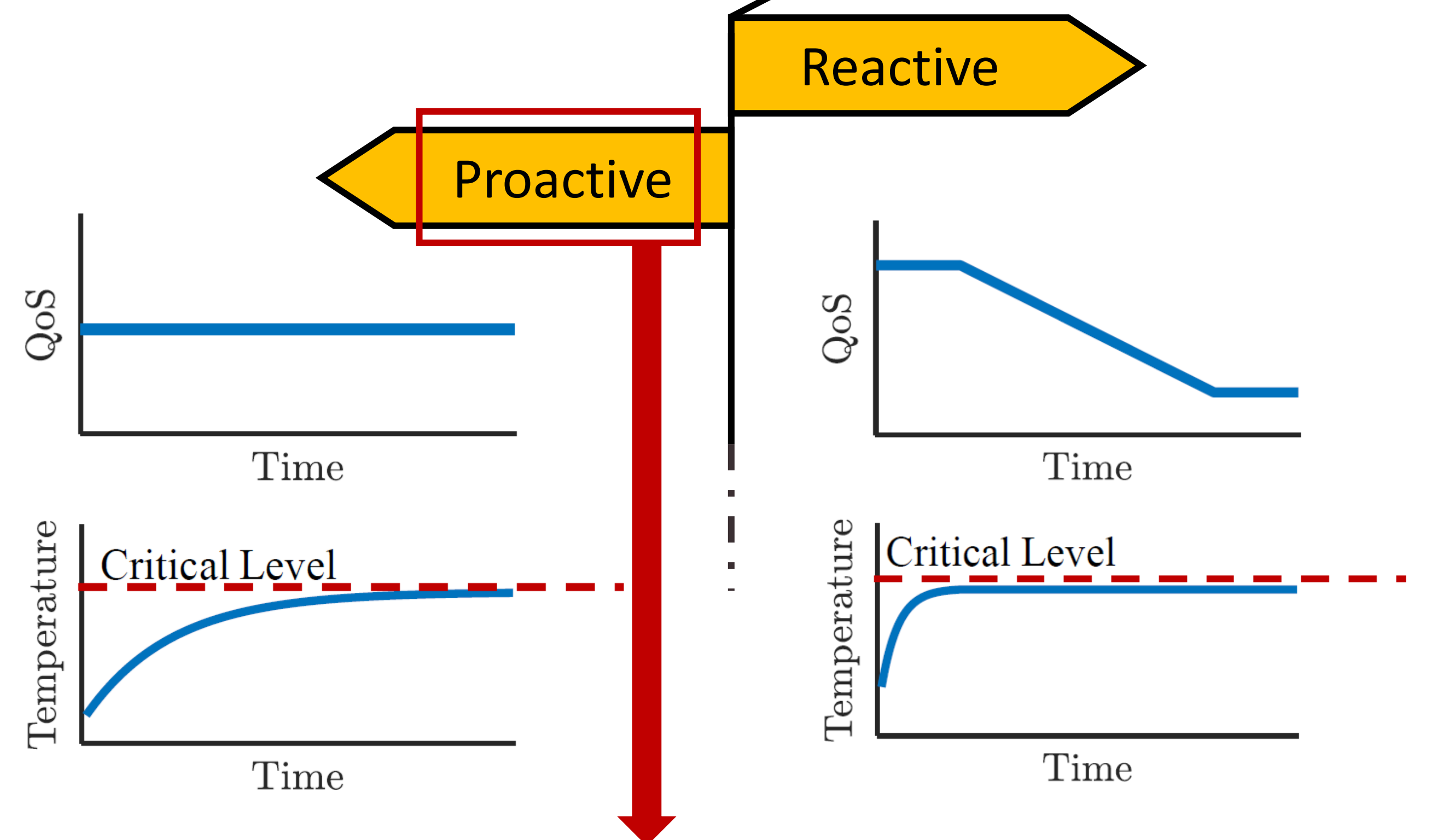
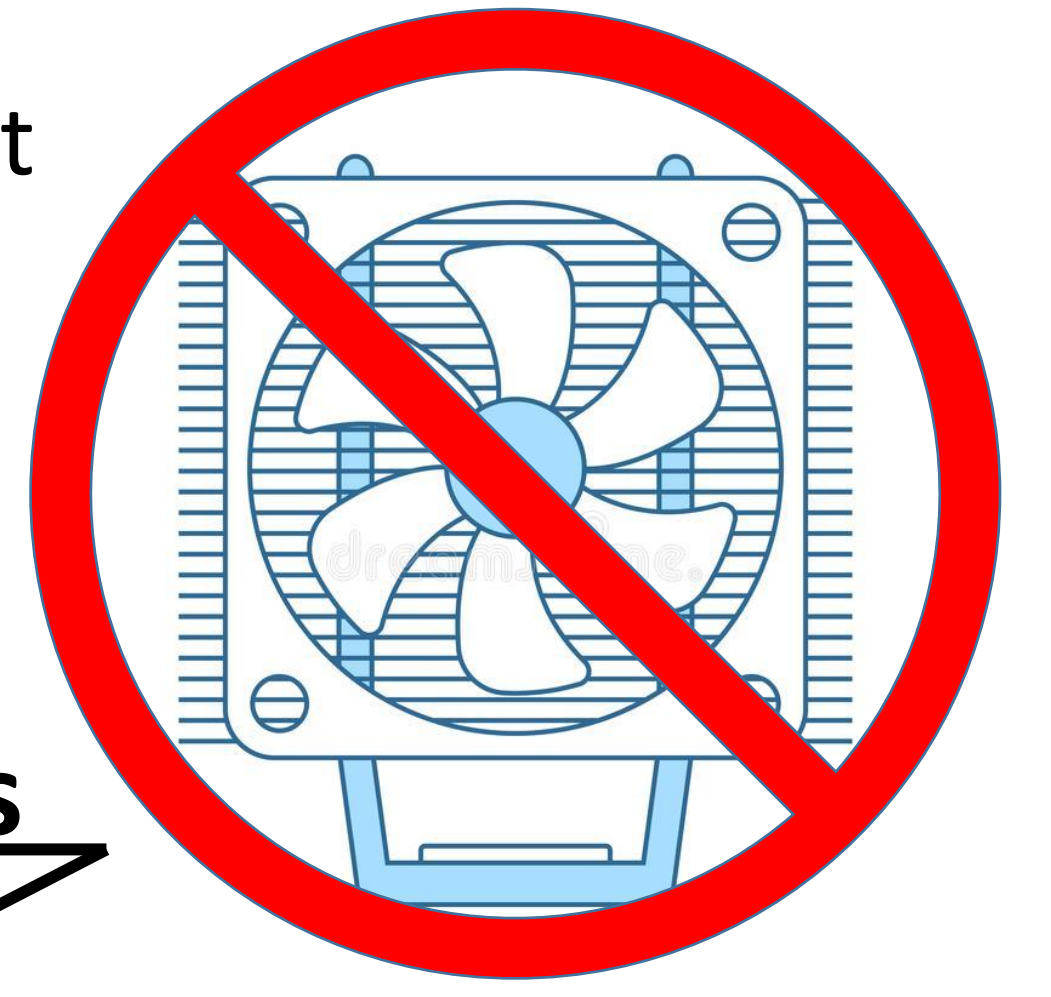
Having high computational power in modern mobile devices causes high heat dissipation so that the chip temperature can elevate above the design limit. Overheating may damage electronic components and decreases device lifetime.



"Leakage power is becoming much more dominant factor in the total power dissipation and depends exponentially on temperature" [1]

[1] Sekar, Krishna. "Power and thermal challenges in mobile devices." Proceedings of the 19th annual international conference on Mobile computing & networking. 2013.

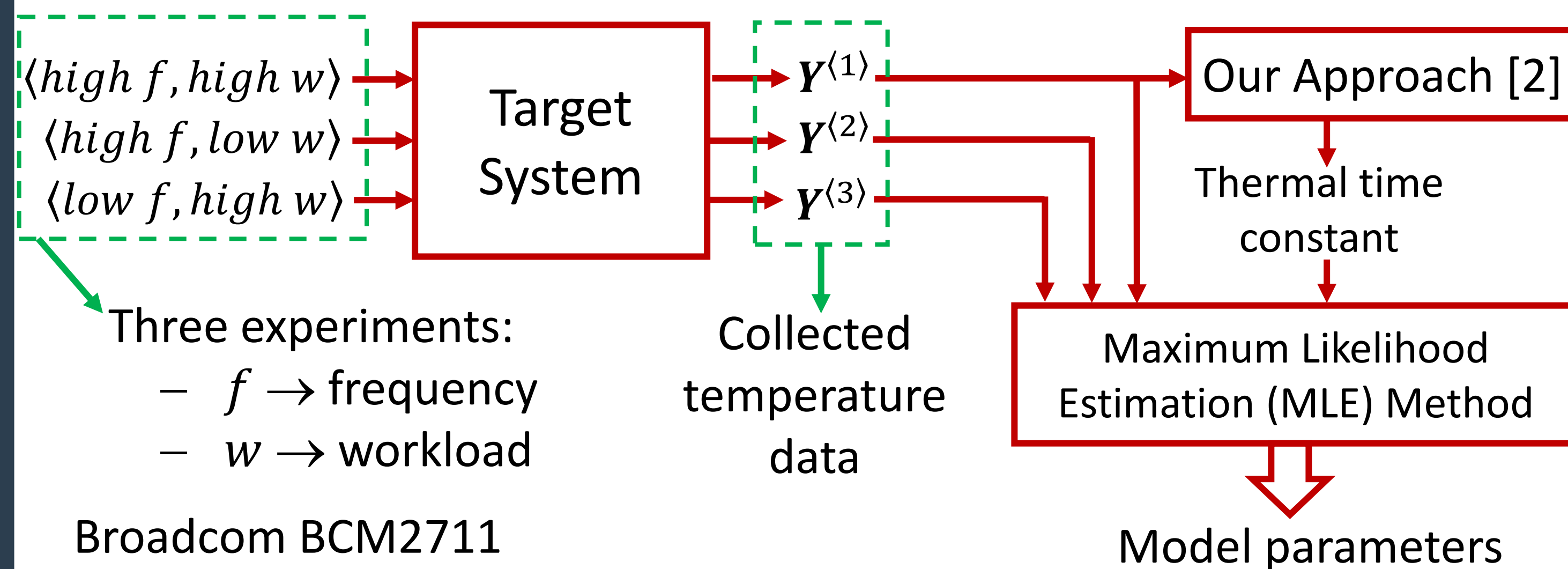
Active cooling mechanisms are not suitable for mobile devices due to additional energy consumption, spatial or electromechanical limitations. Thus, we focused on **passive cooling mechanisms** (slowing down the CPU)



The challenge is to develop a simple model to accurately predict future thermal behavior

Modelling Approach

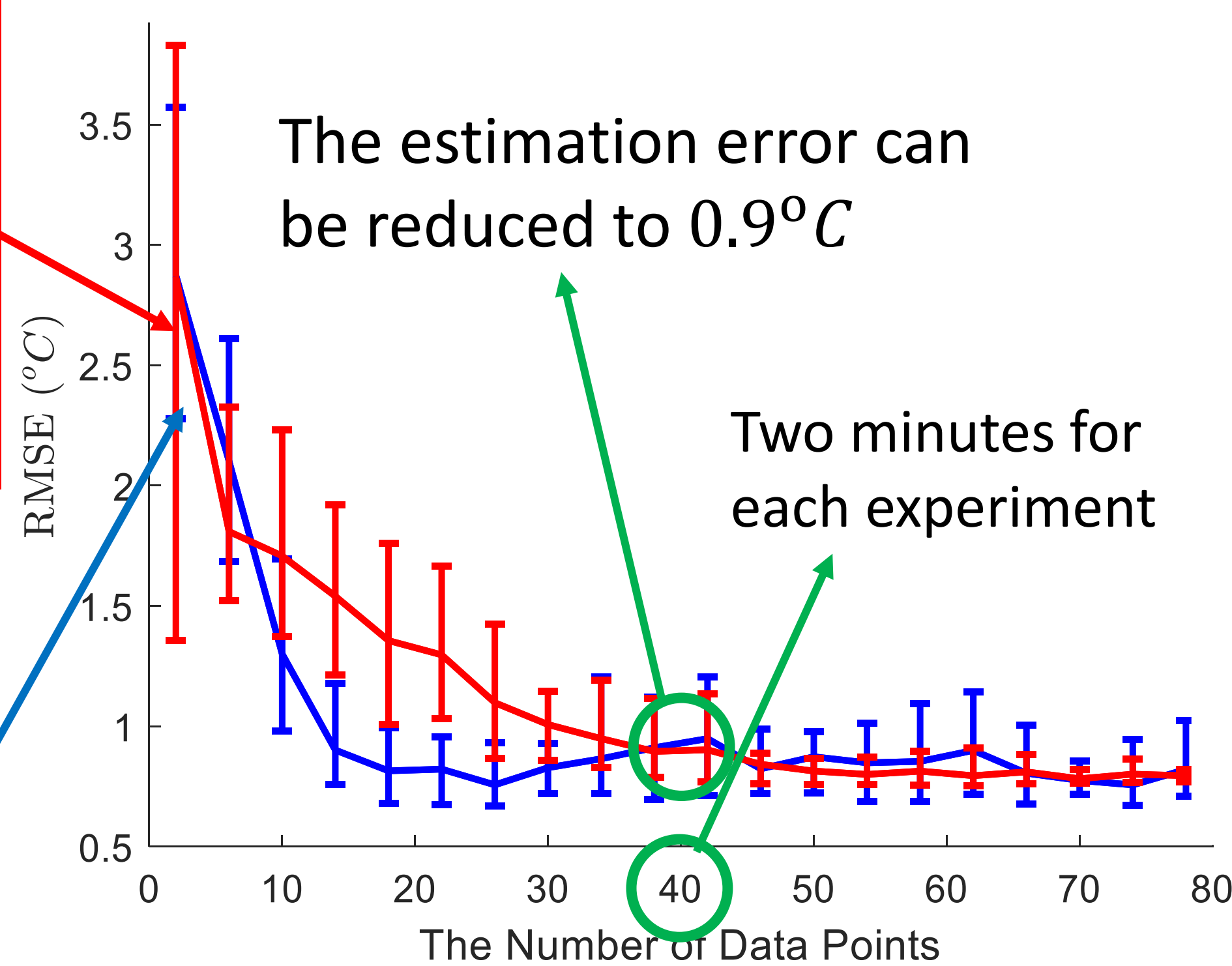
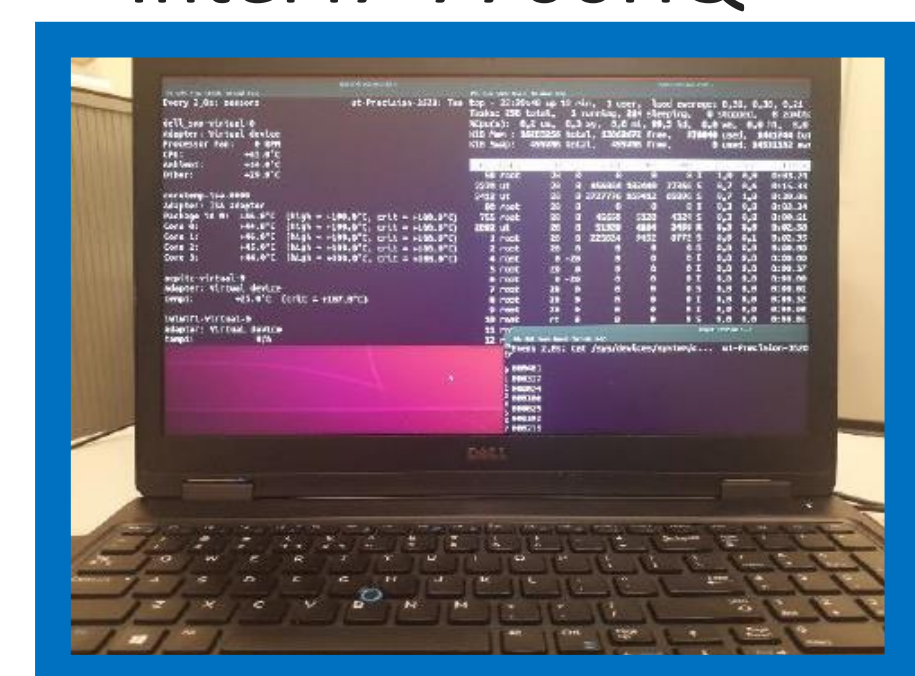
The 2019 Harvey Rosten Award for Excellence



Broadcom BCM2711
ARM Cortex-A72



Intel i7-7700HQ



[2] Ozceylan, Baver, et al. "A Generic Processor Temperature Estimation Method." 2019 25th International Workshop on Thermal Investigations of ICs and Systems (THERMINIC). IEEE, 2019.

Estimation Approach

Approach (1): Our original model

- Sensor noise has a significant effect
- Changes in the environment reduces the accuracy

Approach (2): Our model with a Kalman filter

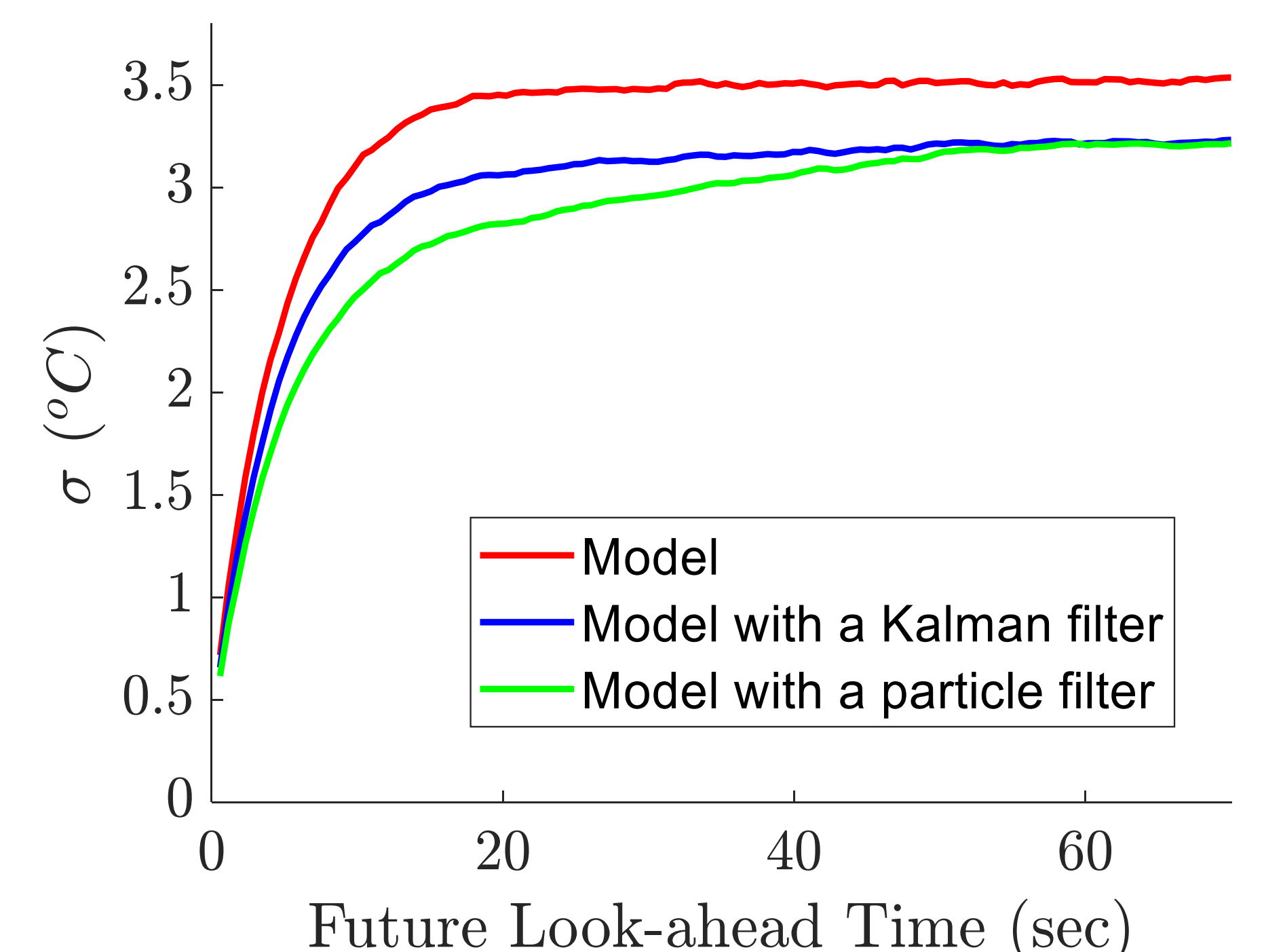
- The effect of sensor noise is decreased
- The Kalman filter adapts to changes in the environment
- Every variable has to be normally distributed
- Non-linear operations are not allowed

Approach (3): Our model with a particle filter

- Sets of particles are used to represent the probability distributions of the noise components
- These sets are evolving over time to approximate the actual distributions and to adapt to changes in the distributions
- These particles can be used in non-linear operations



SAMSUNG
Exynos 5422
ARM Cortex-A15
and Cortex-A7



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