A Deeper Look into RowHammer's Sensitivities

Experimental Analysis of Real DRAM Chips and Implications on Future Attacks and Defenses

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Executive Summary

- **Motivation**: RowHammer is a worsening DRAM reliability and security problem
- **Problem**: Unfortunately, it is unclear, but critical to understand, how the RowHammer vulnerability varies under different conditions
- **Goal**: Provide insights into **three fundamental properties** of RowHammer that are 1) not yet rigorously studied 2) but can be leveraged to design **more effective and efficient attacks and defenses**
- **Experimental study**:
  - 1) DRAM chip **temperature**, 2) aggressor row **active time**, and 3) victim DRAM cell's **physical location**
  - **272 DRAM chips** of DDR3 and DDR4 modules from **four major manufacturers**
- **Analysis:** We make **16 novel observations**, among which we highlight that

  A RowHammer bit flip is **more likely to occur**
  1) in **a bounded range of temperature**
  2) if the **aggressor row is active** for **longer time**
  3) in **certain physical regions** of the DRAM module under attack
- **Implications:** We describe and analyze three **future RowHammer attack** and **five defense improvements**
- **Conclusion**: Our novel observations can be leveraged to **make an attack more effective**, and design **more effective and efficient defenses**

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