

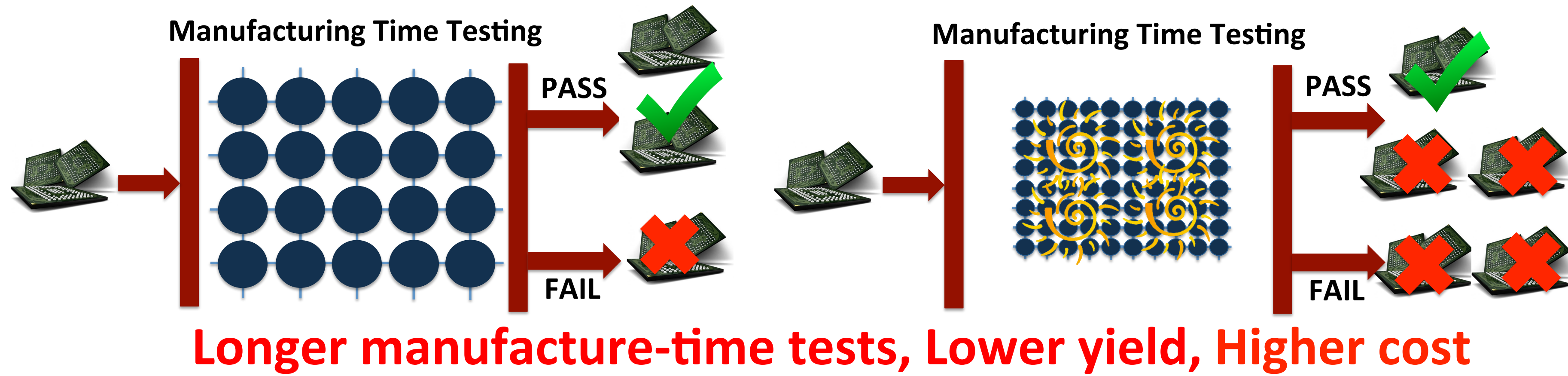
# The Efficacy of Error Mitigation Techniques for DRAM Retention Failures

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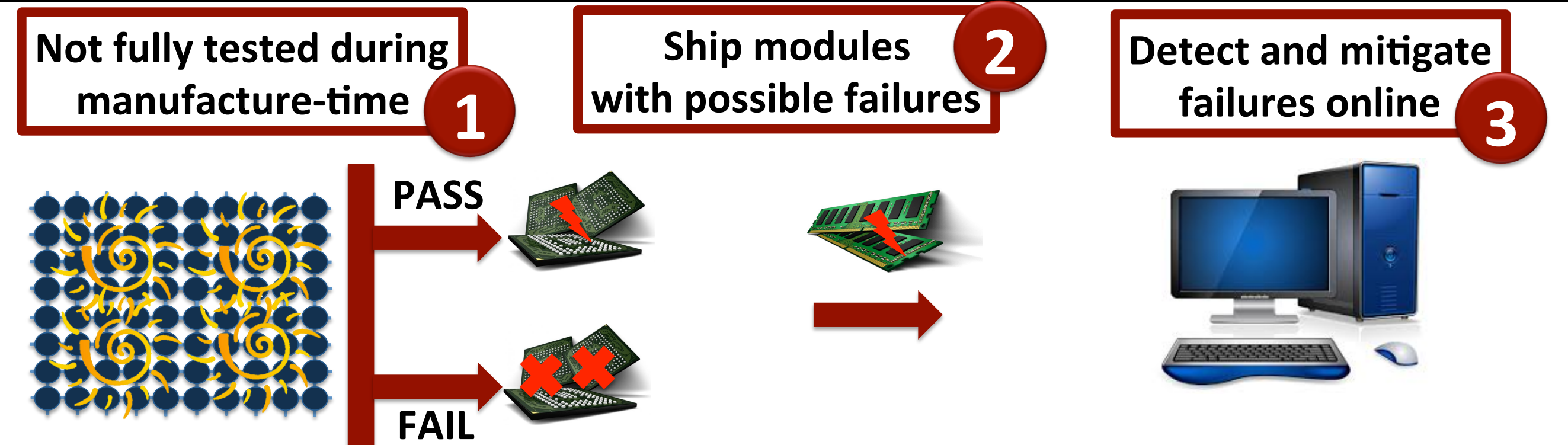
## DRAM Scaling Problem

- **DRAM** is critical for performance
- Demand for high capacity
- **Scaling** enabled higher capacity
- **Scaling** of DRAM results in **failures**
- Intermittent failures are **hard to detect**

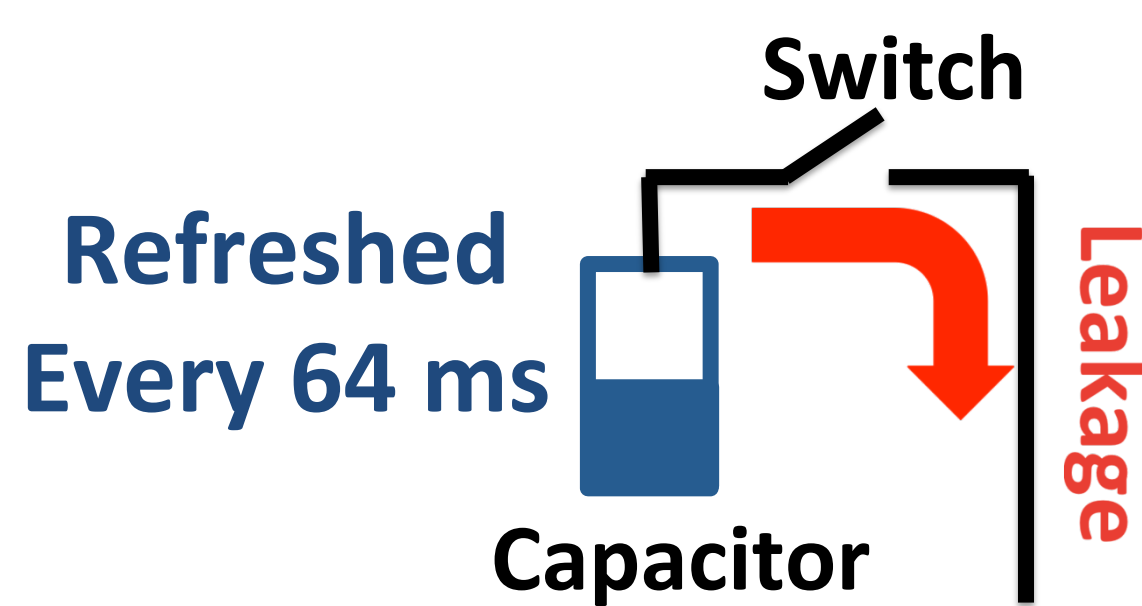


## Vision: Online Profiling

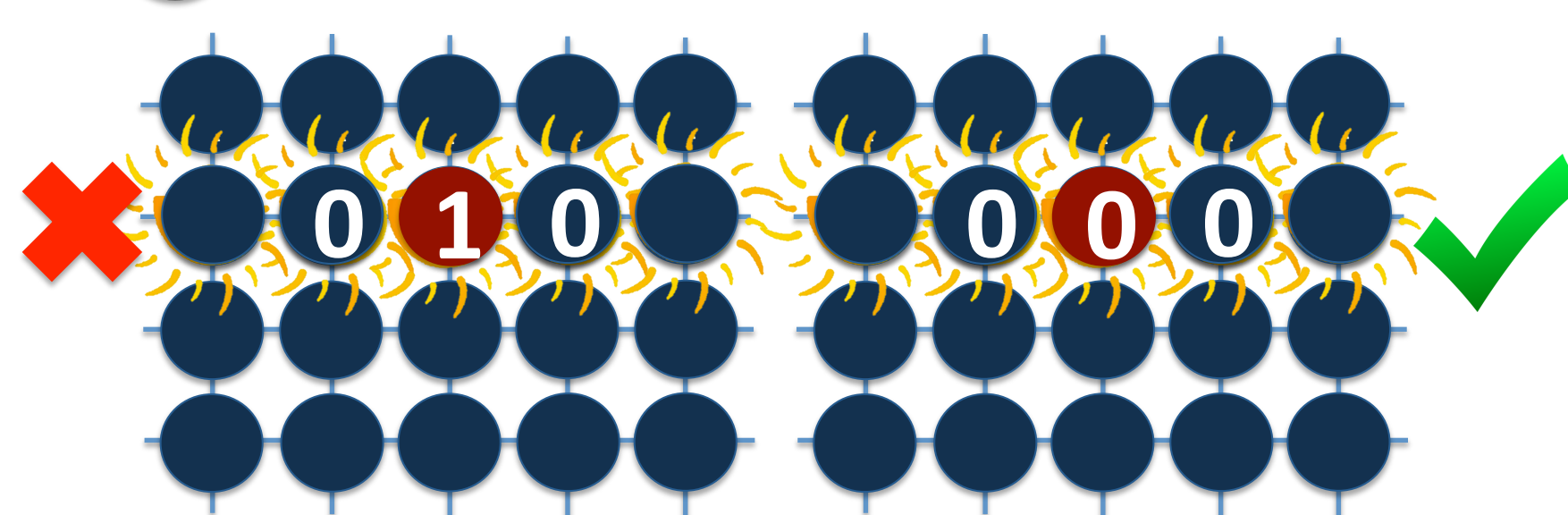
- **Detect and mitigate errors runtime**
  - After the system has **become operational**
- Reduces cost of testing, increases yield, enables scaling
- We **analyze** the **efficacy** of system-level techniques
  - Using experimental data from real DIMMs



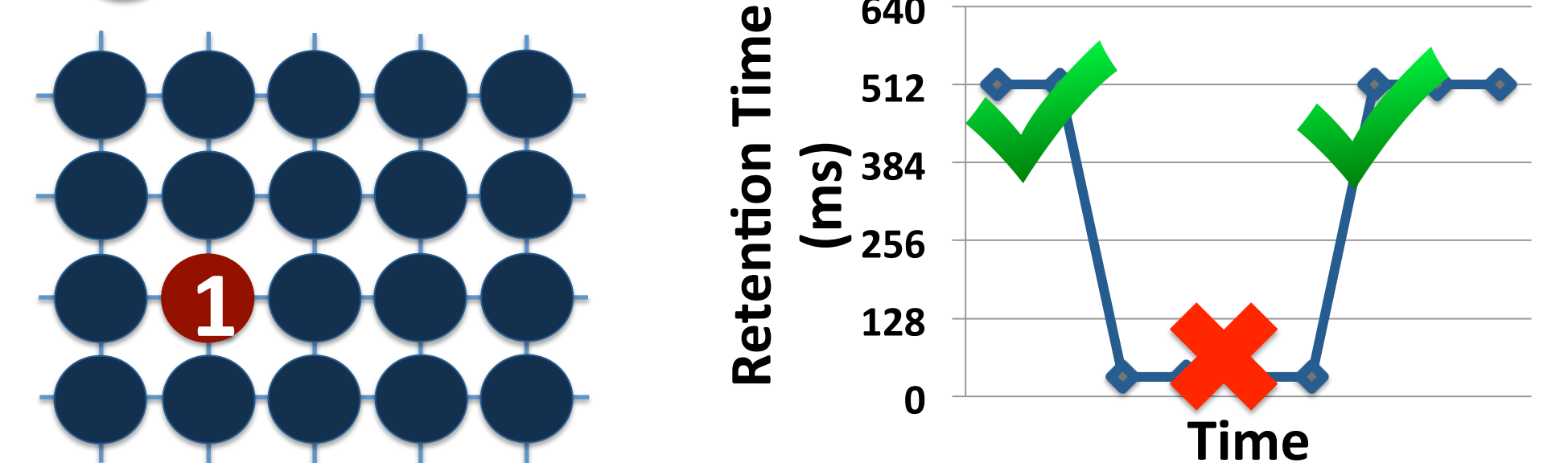
## DRAM Intermittent Failures



### 1 Data Pattern Sensitivity

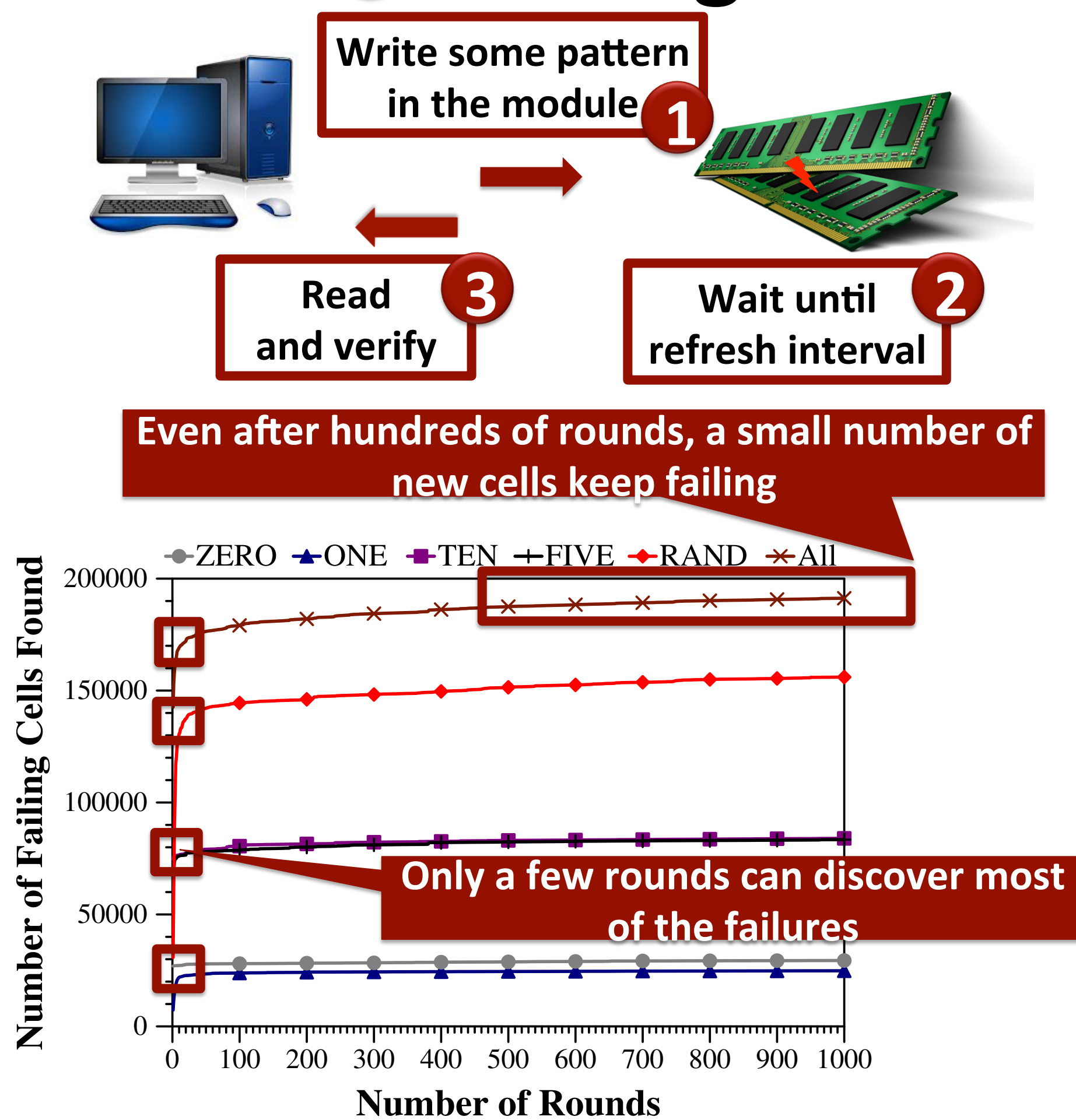


### 2 Variable Retention Time

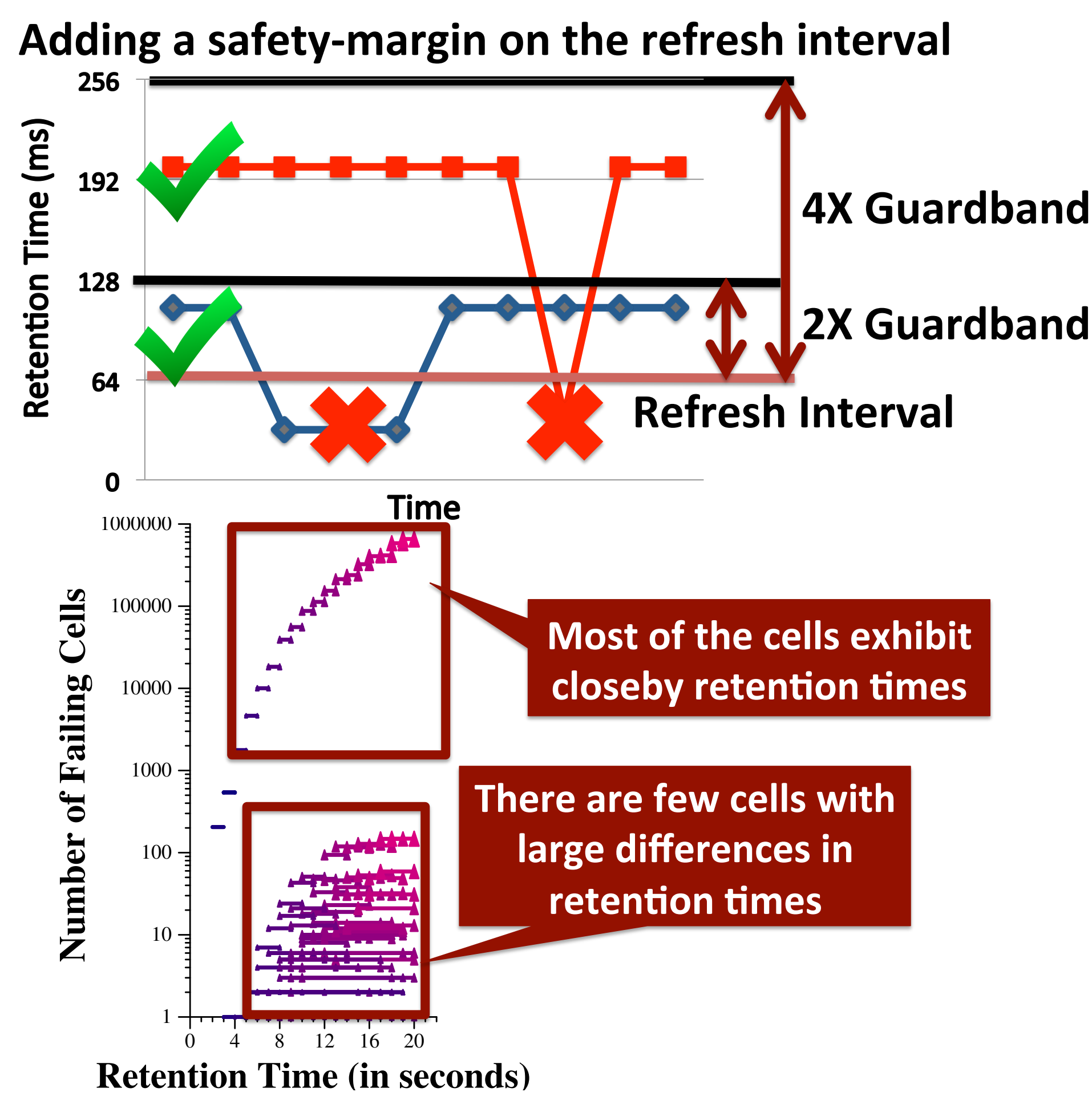


## Efficacy of System-level Detection and Mitigation

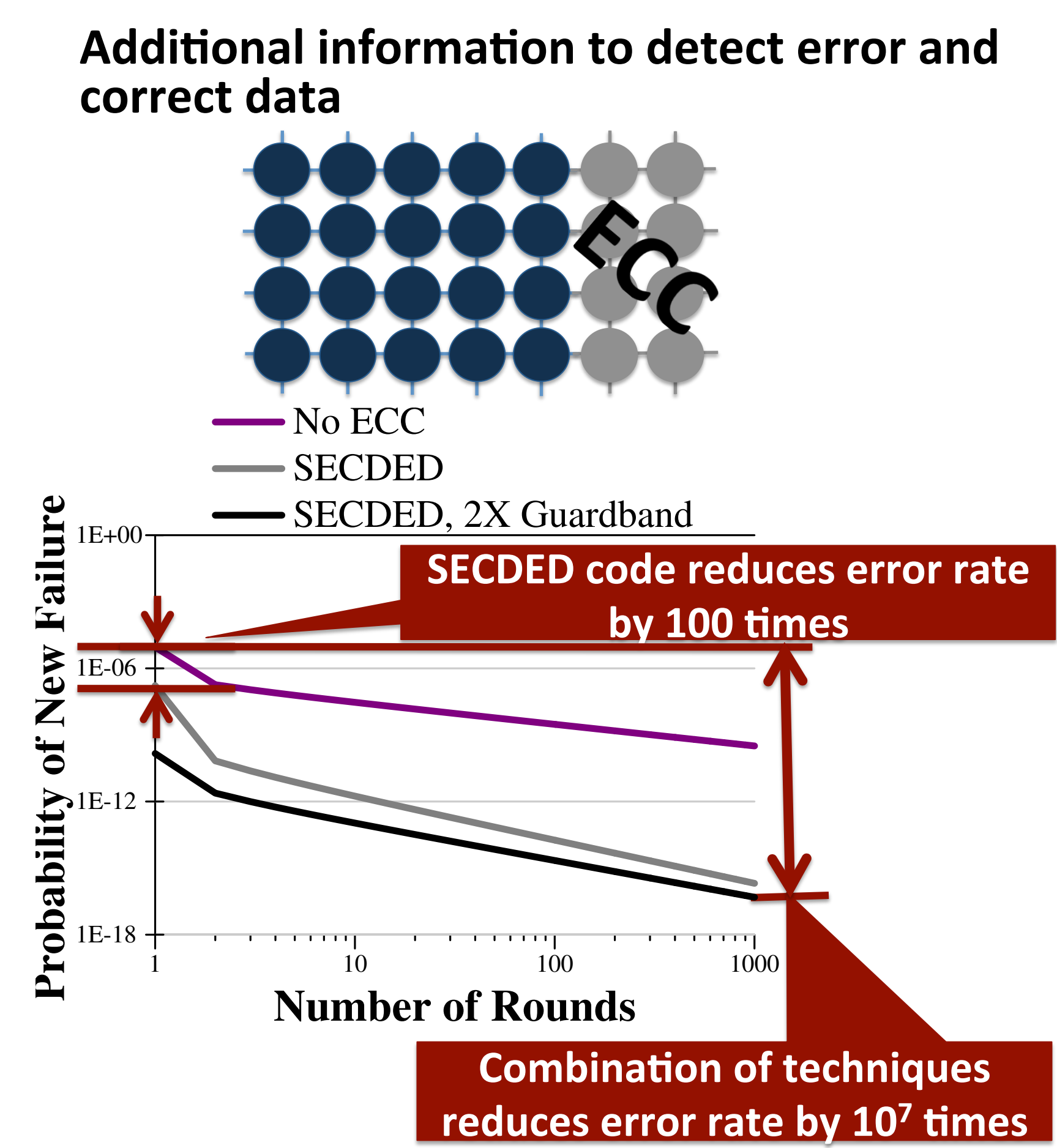
### 1 Testing



### 2 Guardbanding



### 3 Error Correcting Code



Testing alone cannot detect all possible failures

Even a large guardband (5X) cannot detect 5-15% of the intermittently failing cells

A combination of mitigation techniques is much more effective

## Towards an Online Profiling System

### Key Observations so far:

1. Testing alone cannot detect all possible failures

2. Combination of ECC and other mitigation techniques is much more effective

- But degrades performance

3. Testing can help to reduce the ECC strength

- Even if we start with a higher strength ECC

