Good afternoon, everyone! Today, we're diving into how to enhance energy efficiency in modern computing systems. We'll explore two key optimization strategies: NUMA optimizations and advancements in energy-efficient technologies. Let's unpack why energy efficiency matters before diving into these cutting-edge methods.

**Why Energy Efficiency Matters?**

Environmental Impact: Our primary concern. Reducing energy consumption is crucial for combating climate change.

Economic Cost: Energy isn't free. Lowering the power consumption of servers, data centers, and personal devices can significantly reduce operational costs for both businesses and individuals.

**NUMA (Non-Uniform Memory Access) Optimization**

We've previously discussed SMP (Symmetric Multiprocessing) and its efforts to minimize memory access contention. However, with the advent of systems sporting more CPUs, memory access contention has only grown. NUMA addresses this by dividing the system into multiple nodes, each with its own memory space. While this reduces contention, accessing memory from remote nodes is slower, impacting efficiency.

**SSD on NUMA Configuration**

We explored different SSD configurations on NUMA systems, focusing on how they impact performance and energy efficiency. These configurations vary from having a single SSD attached to one CPU, to having multiple SSDs attached to different CPUs, affecting both the contention penalties and the balance between local and remote access.

**Energy Efficiency and Scheduling**

A key strategy for reducing latency and improving efficiency is through intelligent scheduling. The default CFS scheduler, while efficient in general purposes, does not consider the latency and bandwidth implications of NUMA environments. Our proposed scheduling algorithm aims to better map IO threads to CPUs, considering the balance between contention penalties and NUMA locality, leading to significant reductions in energy consumption without sacrificing performance.

Now, I'll switch to my partner, Yu Yang, who will cover the second half of our presentation.