Today, I’d like to present a practical robotic system built on a microkernel architecture, designed for diverse mobile tasks.

Traditional operating systems often struggle to balance real-time and general tasks in robotics. Our mixed-criticality approach allows for the simultaneous management of safety-critical and less critical functions, enhancing system reliability.

Many academic proposals face issues like slow startup, complex updates, and limited reliability. Our microkernel design minimizes core components, which speeds up startup and simplifies updates. By isolating tasks into lightweight processes, we ensure that failures in one part do not compromise the entire system, thus improving efficiency in various mobile environments.

The ahardware architecture of our autonomous vehicle integrates multiple sensors—camera, LiDAR, IMU, and GNSS—feeding data to an intelligent controller. This controller has two units: the Automatic-Driving Control Unit for high-level decisions and the Chassis Control Unit for steering and braking, communicating via a CAN bus. Connectivity is supported through WiFi and 4G using Ethernet.

On the software side, a hypervisor manages distinct software stacks: a General Purpose OS (GPOS) for tasks like SLAM and AI applications, and a Real-Time Operating System (RTOS) for real-time functions. Both systems share and access resources through the hypervisor.

To mitigate risks from Linux crashes, our recovery module monitors performance. SmartKit uses SmartOSEK OS to signal Linux every 2 seconds. If errors exceed a threshold, SmartOSEK reboots the crashed Linux component.

In our testing, the vehicle undergoes two phases: "Boot the System" T1 and "Attack the System" T2. In T1, the system boots and operates until a crash, while T2 focuses on recovery. A performance comparison shows that while bootloader times are consistent at 26.36 seconds, the seL4-based Robokit has a longer overhead compared to SmartKit’s. Recovery times for SmartKit and seL4 are similar at 25.13 seconds.

In conclusion, our microkernel architecture significantly enhances the performance, reliability, and adaptability of robotic systems, providing a robust solution for mobile robotic tasks. Thank you!