Wearables and the Internet of Things

As the current wave of innovation expands smart technology into a new class of products, there is a growing importance for the real-time operating system (RTOS) and middleware to meet these design challenges. The introduction of new system-on-chip (SoC) architectures designed for wearables and the Internet of Things (IoT) requires an operating system optimized for size and performance – along with power-efficient connectivity options needed for machine-to-machine (M2M) communication and cloud connectivity.

Mentor® Embedded Nucleus® RTOS is a real-time operating system designed for smart wearable devices that connect to each other or directly to the cloud. Supported with an array of wireless connectivity options, Nucleus includes a rich networking stack, M2M and IoT communication protocols, and security services.

Extending Battery Life

In this rapidly growing and extremely competitive environment, product differentiation among wearables is critical for success. Battery life has long been an important feature for connected devices as consumers have little patience for energy consuming gadgets requiring frequent charging cycles. The new generation of wearable products will place new demands on reducing power consumption at a time in which system resources are decreasing and software complexity is increasing. Nucleus is the first RTOS with a built-in power management framework designed to take advantage of the low-power features in the SoC. Nucleus Power Management Framework allows developers to manage the power state for each peripheral, set of peripherals, or system using simple high-level application programming interface (API) calls. This reduces both the complexity and size of code needed to place a device in low-power modes. Nucleus Power Management Framework supports sleep and deep sleep modes, operating point transitions (to lower the system clock frequency), and dynamic voltage shifts.

The full-featured capabilities of the Nucleus RTOS supports both device-to-device and device-to-cloud communications.

SOLUTION FEATURES:

- Real-time deterministic kernel
- Scalable to a very small footprint
- Power management APIs
- Wearable and IoT applications
  - HTTP, CoAP, RESTful
- Data and network security
  - DTLS, SSL/TLS, CyaSSL
- M2M: mDNS, DNS-SD
- Networking
  - IPv4/IPv6, and UDP/IPv4 (optimized for minimal footprint)
- Wireless connectivity
  - 802.11 a/b/g/n, BT/BLE, 6LoWPAN over 802.15.4
- File system software
  - FAT 12/16/32 and SAFE (fault tolerant)
- Connectivity
  - SDIO, I2C, SPI, USB 2.0/3.0/OTG
- Rich graphical user interface
  - With optimized Qt® graphics support and Embedded Wizard
- Integrated development tools
  - Mentor Embedded Sourcery™ CodeBench (Eclipse-based IDE)
- Extensive architecture support
  - ARM®, MIPS®, and PowerPC®

BENEFITS:

- Minimize risk
  - Nucleus is market proven and highly reliable; shipped in billions of products powered by hundreds of different types of MPUs/MCUs
- Faster time to market
  - Broad range of integrated and tested OS modules from a single vendor speeds integration and application development
- Lower production costs
  - Achieve desired results with less processor and memory overhead
Out-of-box Connectivity

For wearables and IoT devices, eliminating the design challenges associated with wireless connectivity to support M2M communication and cloud integration can be a critical factor in introducing a new product to market on schedule. This is especially true for wearable and IoT systems with complex applications that use multiple wireless devices, or multiple profiles on a single device. Nucleus networking incorporates a wide range of standards-compliant networking and communication protocols designed for wearable and IoT devices with support for Wi-Fi, Bluetooth, Bluetooth Low Energy (BLE), and 6LoWPAN over 802.15.4 on an array of supported chipsets. Nucleus RTOS networking and wireless connectivity reduces risk and eliminates complexity to reduce development time and cost, allowing software developers to focus on their application and product differentiation.

Memory Partitioning for Device Provisioning

The introduction of new SoCs designed for wearables and IoT provides enhanced system performance capable of running robust applications. However, the need to reduce size, power consumption, and cost will challenge software developers to run complex applications with limited memory resources. Consumers demand robust applications, and many manufacturers will focus on new business models to add value. Nucleus Process Model is a light-weight approach for space partitioning to create protected memory regions that can isolate application, middleware, and kernel subsystems. Utilizing the MMU or MPU, Nucleus Process Model partitions memory to create protected memory regions without virtualizing memory. Space partitioning provides the framework to load new applications using cloud services, or the ability to partition large algorithms into smaller components that are loaded slightly ahead of execution time. With Nucleus Process Model, device manufacturers have the ability to provide compelling applications on devices with limited system resources. Nucleus can also take advantage of advanced hardware-based security separation mechanisms to enable a Trusted Execution Environment that ensures data and code loaded within that secure partition can be completely isolated from the rest of the system.

Multicore Framework for Inter-process Communication (IPC) and Processor Life Cycle

Today’s wearable and IoT SoCs combine application-class and microcontroller-class cores, driving the consolidation of heterogeneous operating environments on a single device. A framework is needed for interprocess communication and processor life cycle support to overcome challenges created by heterogeneous systems. Nucleus RTOS includes the embedded industry’s first complete AMP heterogeneous multicore enablement with the Mentor Embedded Multicore Framework, a clean-room implementation of functionality in virtIO, remoteproc, and rmmpsci which enables developers to seamlessly integrate Nucleus RTOS, Linux®, and bare metal-based applications. Developers can control the boot-up and shut-down of individual cores on a SoC, allowing wearable and IoT applications to maximize compute performance or minimize power consumption based on the use case.

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