行政院國家科學委員會專題研究計畫成果報告

即時核心程式和發展環境的研究與製作(I)

Design and Implementation of a Real Time Kernel and Its Developing Environment (I)

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1. Chinese Abstract

　　傳統作業系統一般有較高的門檻，必需要較有經驗的工程師，才能很快上手進行程式的維護及修改。此外，傳統作業系統只有固定的系統服務，往往無法滿足需求多變的應用程式。於是新的系統軟體架構在過去十年中陸續提出，以解決這樣的問題。他們之中包括了微核心架構(Micro Kernel Architecture)，擴充式作業系統核心架構(Extended Operating System Architecture)，物件導向式作業系統核心(Object-Oriented Operating System Kernel)，程式庫式作業系統核心(Library-based Operating System Kernel)及動態核心程式合成架構(Synthetic Architecture in Kernel-Service Generation)。每一新架構或多或少解決了一些問題，但都無法達到原來的理想。

　　在本計畫中，我們專注於即時核心架構和整體作業系統環境兩項議題。我們將設計與實作以軟體元件為基礎的核心系統，同時我們將提供即時 Java 作業環境、檔案系統以及網際網路通信協定系統。

　　這一年我們從頭開發一套新的核心程式，將與硬體有關的軟體模組化成為 12 個模組。並利用 Linux'96 的現成驅動程式原始碼，包裹一段中間軟體，而成為我們的驅動程式庫。此外，我們也將 TCP/IP 移植到即時核心上。元件式檔案系統架構的初步分析也已完成。

關鍵詞：作業系統、即時系統、軟體元件

Abstract

Operating systems traditionally have higher threshold in system design and implementations, which usually asks for well-experienced and qualified system engineers in system enhancement, modification and maintenance. In addition, traditional system implementations have fixed system services that cannot meet all the needs from various applications. The researchers in operating system communities have tried to explore new kernel architectures to solve above problems in the passed decade, which have given birth to many new kernel construction techniques. The micro kernel architectures, extended system architectures, object-oriented operating systems, library-based kernels and synthetic architecture in kernel service generation are all kind of such new techniques. They each have solved some issues but all are proved in the literature

to fail to archive the expected goals.

In this project, we focus on two important research issues: real-time kernel structure and application environment of real-time system. We will design and implement a real-time kernel based on the concept of software components and we will provide real-time Java programming environment, file systems and Internet protocol suite for the new kernel.

In this year, a real time kernel has been implemented from the scratch. For the device drivers, the Slackware Linux'96 driver source codes are integrated into this kernel. Due to the different semantics in kernel services, wrapper codes are needed in the kernel to incorporate with the existing driver source codes. In addition, the TCP/IP component has been ported to our real time kernel, and the initial analysis on the architecture of the component-based file system was done.

Keywords: Operating System, Real-time System, Java Technology, Software Component

2. 計畫緣由與目的

我們整合計畫的目的在於探討新的即時核心程式架構,以達到一個完全模組化的即時系統軟體元件庫。在這個新的元件式組合架構下,作業系統相關的程式均高度模組化,每個模組都是獨立的軟體元件,藉由新的組合機制,我們可以很迅速的增加、修改或置換不同的軟體元件,如此系統便有了不同的personality,有助於我們在系統軟體技術方面的研究。此系統可以成為我們研究的平台,例如,藉由置換不同的軟體元件,核心程式可以很容易的研究不同

的管理策略,諸如排程方法或記憶體管理策略等等。而發展環境也可以針對不同的需要應用(例如即時應用、嵌入式應用、行動式計算應用等等),經由發展及置換不同的軟體元件,即可展現不同的personality,而不必對核心程式大肆修改,因此也可以很快地應用於不同的產品上,如Set-top box、Media Server、Cellar Phone 等等,節省軟體開發的成本與時間。

我們的總體目標即是利用元件化技術來研發一個新的即時系統,其中的一個子計畫即是研究與製作此元件化的核心程式,但是一個完整的即時系統平台則不應只有核心程式而已,尚應包括通訊模組及儲存裝置,因此另有一子計劃是研究與製作元件化的檔案系統。而本計畫除了負責元件化通訊模組的研究與製作之外,尚負責發展環境的研究與製作。我們將提供支援 Java 功能的平台(Java Platform),因為開放式系統是所有軟體及硬體廠商所追求的目標,希望藉由開放式的標準能達到軟體的互通性,節省軟體的發展成本。

3. 結果與討論

本計劃在提出時共分二年。第一年的成果描述如下:

在核心程式方面:

我們已經成功地開發出此核心程式的測試平台,我們實作一個在 Intel x86 相容 PC 上的 priority-based、嵌入式即時核心程式,並已經整合了 Linux'96 的驅動程式庫,將 Linux'96 的驅動程式原始碼移植到此核心程式上,並探討 Linux'96 傳統驅動程式架構,用之於 priority-based 即時核心程式的通用性。其中與其他子計畫 TCP/IP stacks 的整合亦已完成。

在檔案系統方面：

我們完成元作式檔案系統架構的初步分析和設計並從事 Flash memory 檔案系統擬和管理策略的研究。

在 Java 與通信子系統方面：

我們將 TCP/IP stack 移植至即時核心。並在即時核心上來完成之前在 Linux 作業系統上試行檢測 Java JDK 所需的核心程式支援以提供即時核心支援 Java Virtual Machine 所需的系統支援，同時我們也研究改進 Java VM 以支援即時作業的可行方法。

4. 計畫成果自評

計畫進行到目前為止，我們已經獲得一些初步的成果。包含：我們實作一個在 Intel x86 相容 PC 上的 priority-based、嵌入式即時核心程式，並已經整合了 Linux'96 的驅動程式庫，完成元作式檔案系統架構的初步分析和設計，將 TCP/IP stack 移植至即時核心，並在即時核心上來完成之前在 Linux 作業系統上試行檢測 Java JDK 所需的核心程式支援。

我們相信，這個整合型計畫成果，不僅可以預期是一個針對各即時系統的實驗及研究平台，更可以直接應用到實際的產品上，諸如 Set-top boxes！而且，藉由第一年的成果與經驗，就可以直接技轉其他單位，做為諸如 set-top box 的雛形系統平台使用。

在第二年，我們將延續第一年的成果，將相互關連的核心程式，模組細分獨立開。訂定每一軟體元件的輸出入介面，以重新建立以軟體元件為基礎的即時作業系統。同時我們也將在第一年計畫製作的 Java Virtual Machine, TCP/IP stack, Device Drivers 併入核心程式，並進行 real-time embedded Java 方面的研究。在檔案系統方面，我們將從事元件式檔案系統各組成元件的設計與製作並與核心程式整合。

相關本計畫已發表著作如下：

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