Multi-Domain System Support Environment for Multi-Core System

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Agenda

- Multi-Core Chip as a Sub-system Integration
- Domain-base Multi-core Solution
  - Interoperation of Domains
    - EXREAL-ExARIA
  - Separation of Domains
    - EXREAL-ExVisor
- Demonstration
- Conclusions
Multi-core Processor System OS Classes

Heterogeneous Type

- Easy integration of legacy real-time system
- Deterministic Behavior

AMP

Homogeneous Type

SMP

- Easy migration from PC applications

SH Mobile G

SH-4A Multicore, SH7786

SMP = Symmetric Multi-Processing
AMP = Asymmetric Multi-Processing
P = Peripheral

AMP Configuration

- Design optimal system extension of embedded applications
  - To combine legacy systems
  - To guarantee real-time constrains (Deterministic behavior)
Software Challenges of AMP

- Communication among OS:
  - Data transfer / Synchronization / Exclusion among tasks on multiple OS

- Future Portability
  - Software restructure is needed whenever HW configuration is changed

- Reliability
  - Shared HW resources (memory, IP, etc...) among multiple OS on a chip
  - Illegal access risk from different OS

Interoperation / Separation Technology

- **Interoperation** *EXREAL-ExARIA*
  - Communicate/ Synchronize among multiple heterogeneous OS
  - Common APIs like posix thread library
  - Conceal HW configuration from SW designer

- **Separation** *EXREAL-ExVisor*
  - Isolate shared HW resources to a specific OS
  - protect / notify illegal access by HW support
  - Permission table of CPU ID and bus address
  - Illegal access interrupt to specified CPU
Example of Target Application: Cooperation of Infotainment & Drive Control in Car

Domain Separation: Physical Memory Partitioning
HW/SW Structure of the Demonstration

- Heterogeneous OS AMP (WinCE x 2, uITRON x 2)
- OS Domain Separation is using Hardware IP
- Inter OS communication (Software Layer)

Screen of the Demonstration

- Display Unit merges the frame buffer which each CPU(OS) draws
- CPU#0 Displays the CPU performance monitor which obtained by the inter-OS communication.
Summary

• Many approaches for multi-core solution exist.

• One of the realistic approaches for embedded system is sub-system integration.

• Domain (Software & Hardware) base design is proposed.

• Interoperation / Separation technologies help software development for AMP
  – Communication / Synchronization API among multiple OS
  – Resource protection from illegal accesses

• Demonstration:
  – WindowsCE® x 2 + uTRON® x 2
    with EXREAL-ExARIA and EXREAL-ExVisor