Mobile Convergence Communicator (MCC)

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Tae Joon Park
Embedded S/W Research
Division / ETRI

ETRI 한국전자통신연구원
Electronics and Telecommunications Research Institute

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Concept of Mobile Convergence

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Concept of Mobile Convergence

Convergence into a mobile device

Office Desktop

- Email
- Groupware
- Remote Desktop

Home Server

- Streaming
- File View
- Seamless Connect

Car Server

- Hands Free
- I/O Redirection
- Car Security

Mobile Convergence Computing

Requirements of Mobile Convergence

	Technologies
Operating System	❑ Integrated A/V management ❑ Dual-core IPC (Inter-Processor Communication) ❑ Embedded file system ❑ APIs for mobile resource use (ex. system configuration, communication, multimedia, broadcasting)
UI & Middleware	❑ Mobile remote desktop ❑ I/O redirection for multimedia ❑ Multi-point touch screen ❑ Remote management of operating system and applications ❑ Routing for inter/intra network of mobile devices ❑ Seamless handover between CDMA and WLAN
Development tools	❑ Per thread resource usage analysis & monitor ❑ Prelinking / preloading ❑ Multi-core supported debugging ❑ Analysis & optimization for DVS (Dynamic Voltage Scaling)
Communication	❑ CDMA, HSDPA, WiBro ❑ WLAN, Bluetooth
Applications	❑ Mobile office ❑ Mobile broadcasting ❑ Mobile co-browsing ❑ Mobile entertainment

Applications of Mobile Convergence

Office Desktop | Home Server | Car Server

Mobile Convergence

- Kernel auto configuration & installation
- Optimization of characteristics of mobile devices
- Target supported light-weight graphic system
- Appliance platform supported middleware
- Mobile routing between Inner and Outer
- Independent environment of target CPUs

Robots | Telematics | m-IPTV | PMP | SmartPhone | MCC

MCC : Mobile Convergence Communicator

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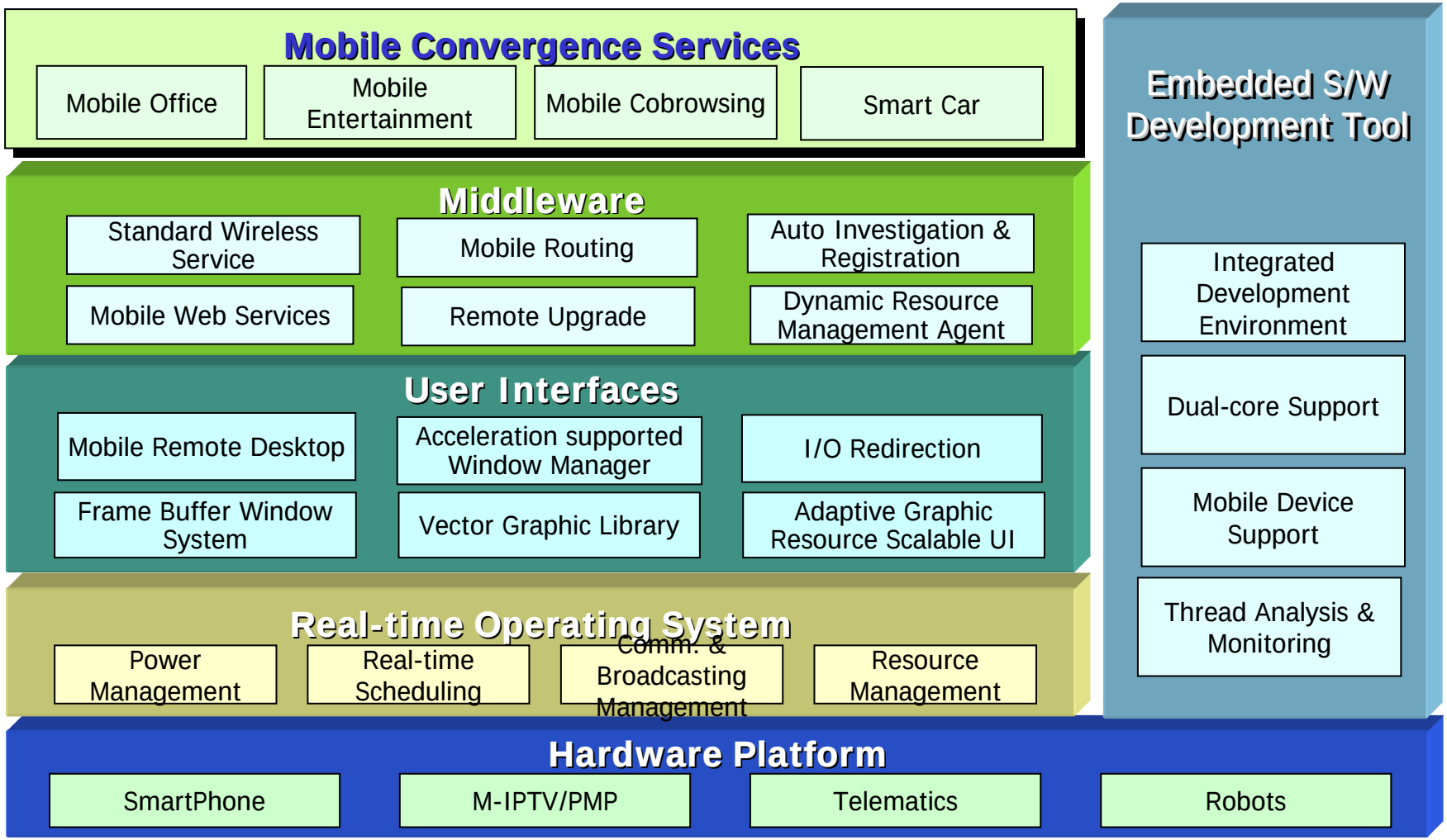
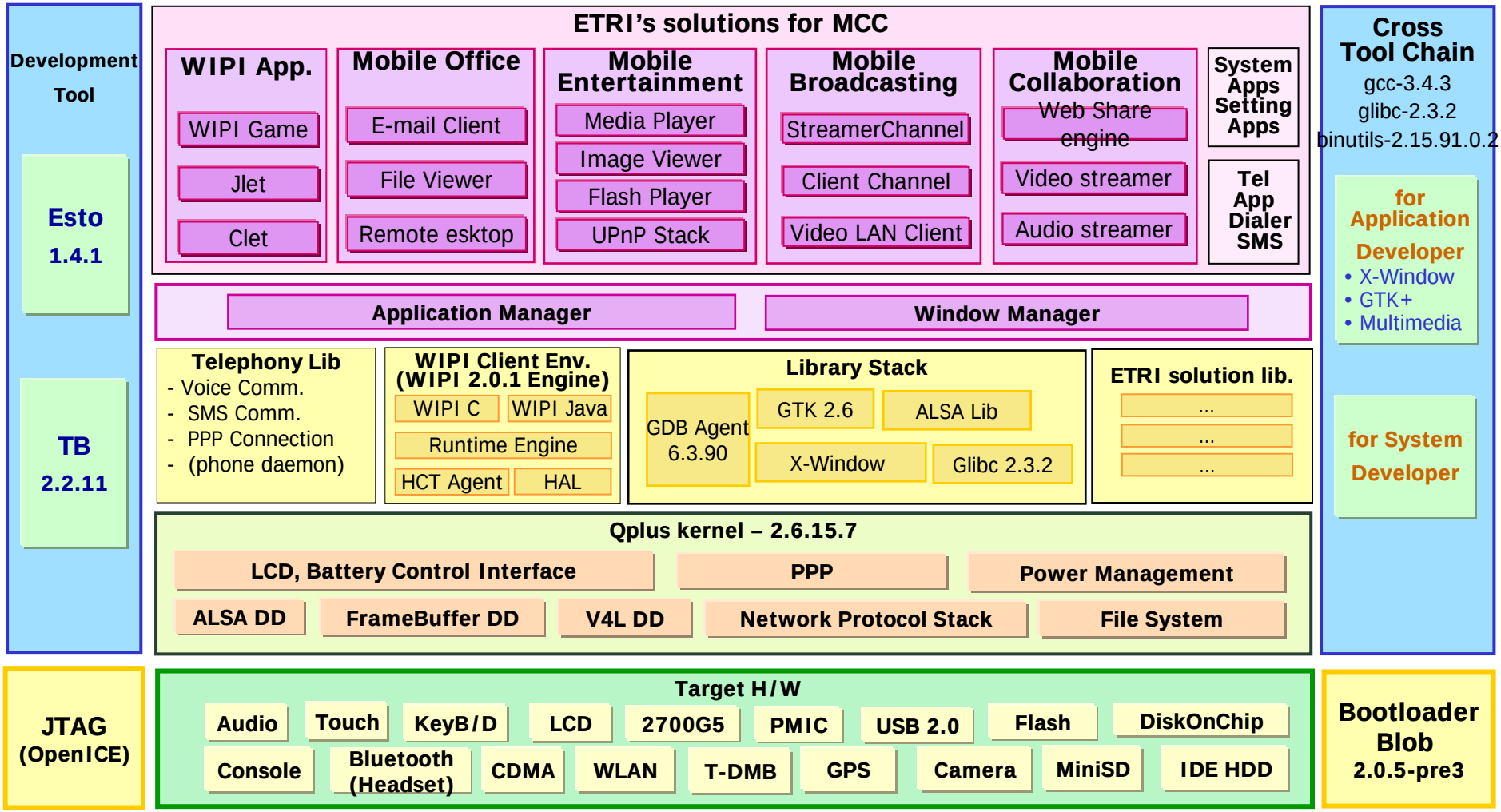
Technologies within MCC

	Technologies within MCC
Operating System	❑ Customizable kernel ❑ Automatic kernel installation & configuration ❑ Device drivers for MCC
UI & Middleware	❑ Frame buffer-based light-weight window system ❑ Light-weight 2D/3D/Vector graphic library ❑ Scalable UI for various resolution types ❑ Ad-hoc based plug-and-play (UPnP) for mobile devices
Development tools	❑ Integrated development environment ❑ Frame buffer based GUI builder
Applications	❑ Robots, Telematics ❑ m-IPTV, PMP, SmartPhone

Overall Architecture



MCC Software Architecture



Major Features of MCC (1st Generation)

- Hardware
  - Dual processor architecture (PXA270 & MSM5500)
  - 3.5 inch TFT-LCD touchscreen
  - Sliding QWERTY keyboard
- Operating system for MCC
  - Kernel & device drivers
- XFreeDesktop for MCC
- TAPI (Telephony API) for KTF CDMA

Operating System for MCC (Qplus)

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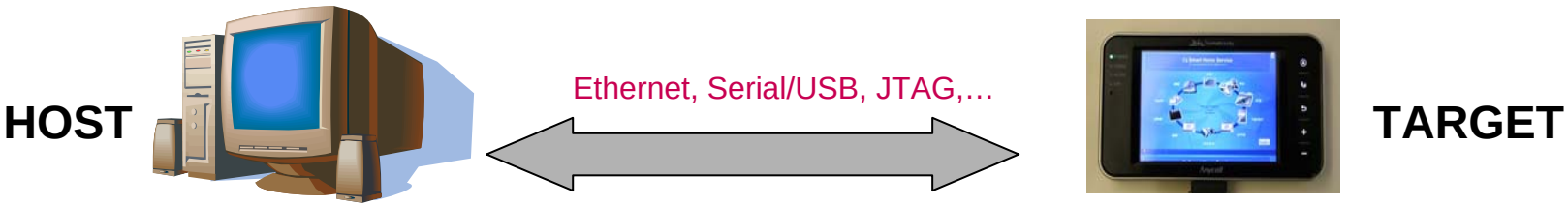
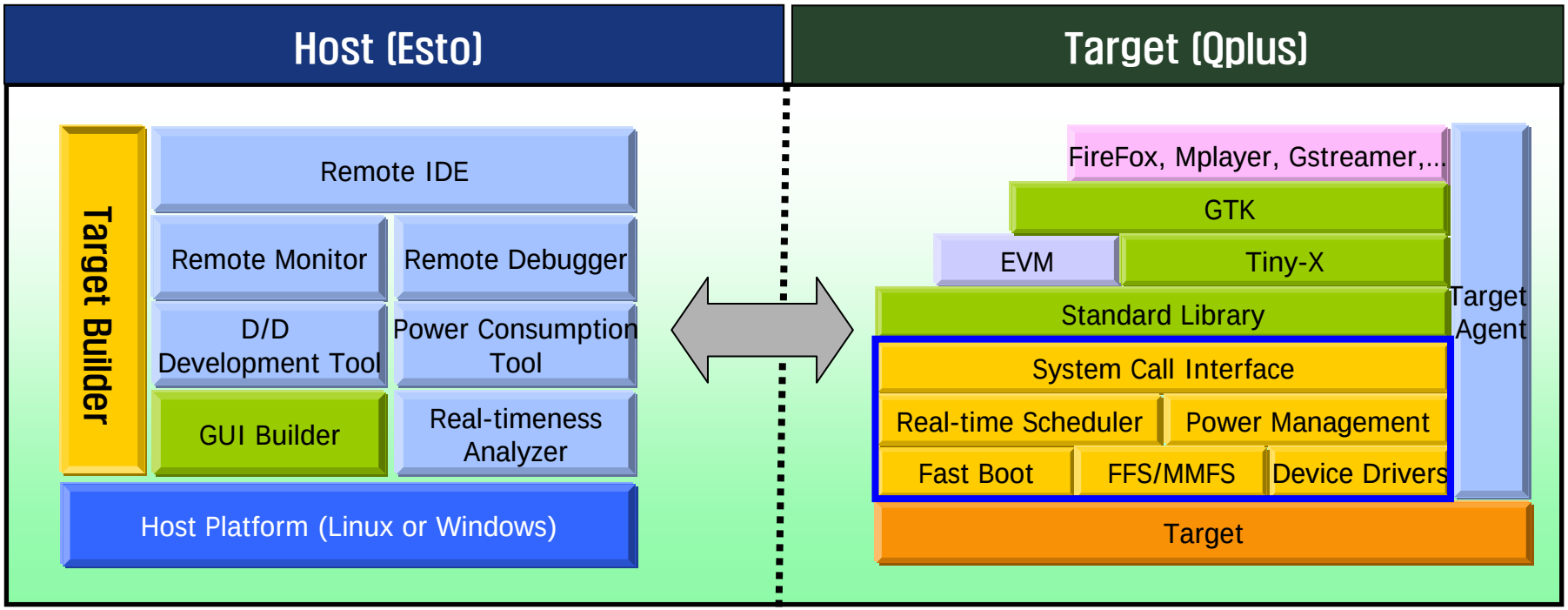
Overall Development Environment





Overview of Qplus

- Linux-based embedded S/W platform
  - Qplus system and solutions
- Qplus System
  - Bootloader
  - Linux kernel 2.6.x and standard C libraries
  - BSP (For various graphic chips and boards)
  - MMFS (Multi-Media File System) / FFS (Flash File System)
  - Light-weight window system and graphic libraries
- Qplus Solutions
  - Target Builder: Qplus kernel configuration tool
  - Applications: Web Browser, Media Player, and more

Qplus in Detail (1/7)

- Linux-based kernel
  - Linux kernel version: 2.6.15.7
  - Optimized footprint on MCC specifications
    - Kernel, device drivers, standard C libraries, graphic libraries, and basic applications
  - Real-time features
    - Preemptive kernel and lock-breaking
    - Guarantees of 50 usec latency
  - Power management
    - Power management based on power consumption pattern
  - Fastboot
    - Direct boot from NOR or NAND flash memory
  - Various device drivers
    - Rapid device driver support via ETRI's collaborators

Qplus in Detail (2/7)

- Lightweight GUI
  - Lightweight window system based on DirectFB
  - GUI builder based on lightweight window system
- Various applications
  - Media player optimized on MCC
  - Lightweight web browser
- Target system configuration
  - TargetBuilder: Qplus reconfiguration
  - Esto: Target loading

Qplus in Detail (3/7)

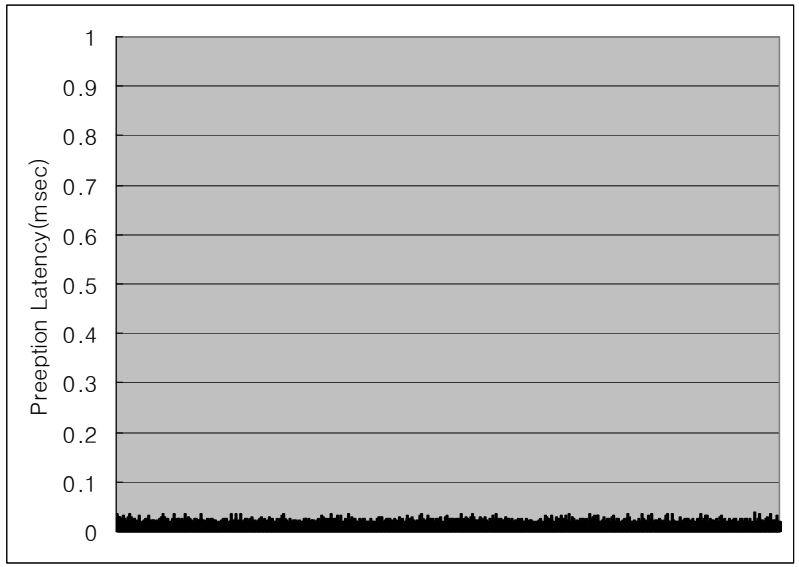
❑ Supported Hardware

Arch	CPU	Target OS
X86	VIA-Cyrix Family(Samuel, Ezra, Nehemia, Eden ESP, Eden-N)	Qplus CE 2.3
	Intel Pentium Family, Celeron Family	Boyo
ARM	Intel PXA27x Family	Qplus ME
	Samsung S3C2400, S3C2440	Qplus ME
MIPS	AMD Alchemy Family(Au1000, Au1100, Au1200, Au1500, Au1550)	Via Collaborator
PPC	PowerQUICC	Via Collaborator

Qplus in Detail (4/7)

- Real-time Scheduling
  - Kernel mechanism and scheduler support for max. latency of 50 usec
    - Ingo Molnar's real-time preempt patch has been applied
    - Thread-based ISR (Interrupt Service Routine)
    - Most of kernel codes are based on mutex-lock

	Max. latency (usec)	Min. latency (usec)	Avg. latency (usec)
Vanilla kernel	7021.25	2.81	7.89
Qplus kernel	36.83	5.58	7.16

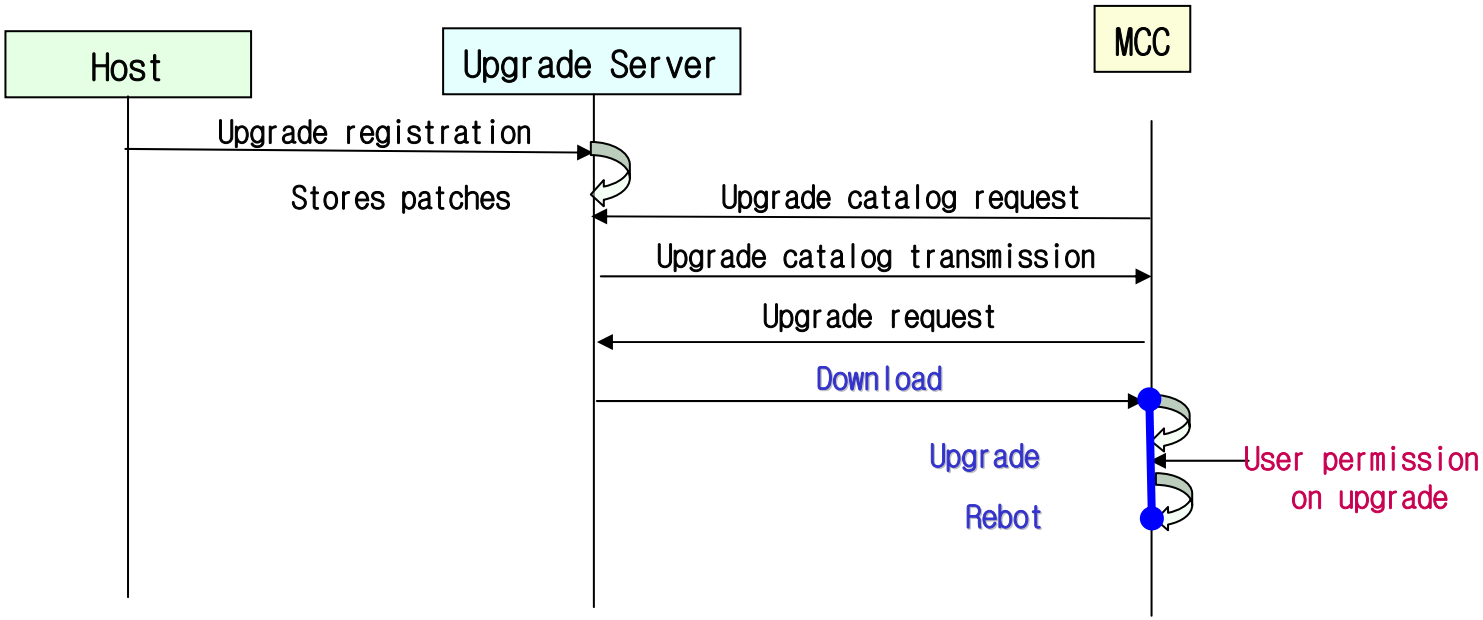


Qplus in Detail (5/7)

- Power Management
  - Power management on system level
    - Auto suspend
    - Resume on Power On
  - Power management utilities
    - Battery status monitor
    - Backlight

Qplus in Detail (6/7)

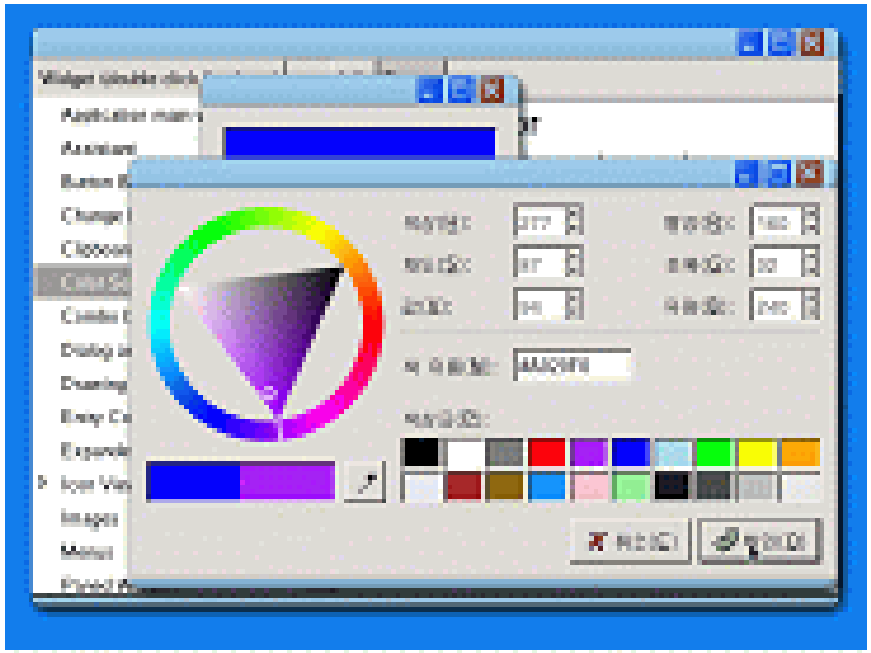
- Remote System Management
  - Overall system upgrade within 30 seconds
    - Partial upgrade within an object
  - Fastboot within 15 seconds



[Upgrade Process]

Qplus in Detail (7/7)

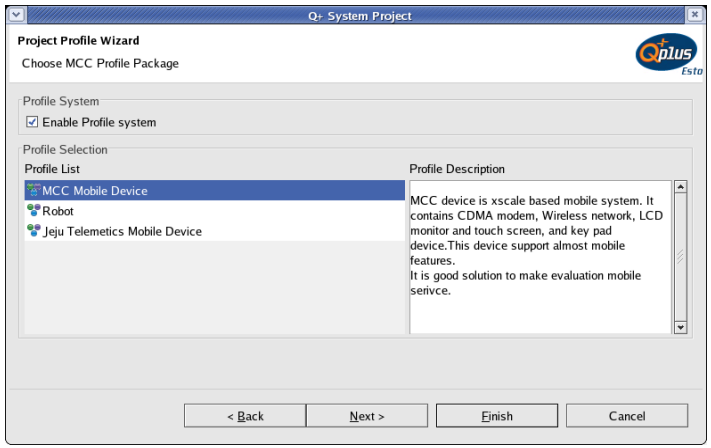
- Lightweight window system
  - Frame buffer based window system
  - Window system is as small as 5MB
  - Multiple windows management
  - Lightweight Hangul IME (Input Method Editor)



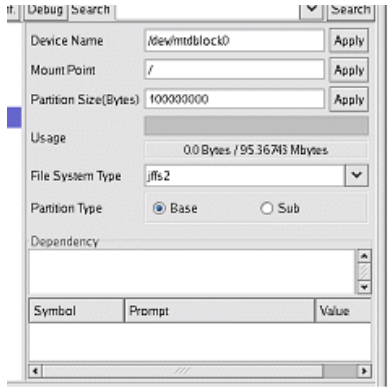
Window style setting snapshot

Development Tools in Detail (1/10)

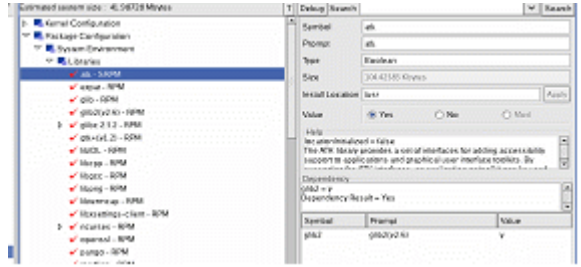
- Target Builder
  - Profile-based system configuration tool
    - Both kernel, libraries, and applications
  - Multiple partition support
    - Warning on partition size overflow
    - Inter-partition package dependency check
    - Relocation of package installation path (RPM)



[Profile Wizard]



[Multiple partition setting]

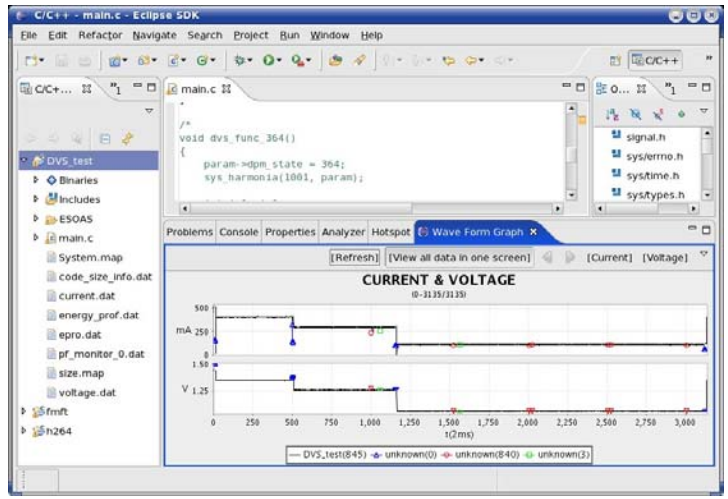


[Relocation of package installation path]

Development Tools in Detail (2/10)

- ESTO (Embedded S/W Toolkit)
  - Target cross compiling environment
    - ARM, x86, MIPS, and more
  - Remote debugging on dual core processor
  - Power consumption analysis in terms of both voltage and current

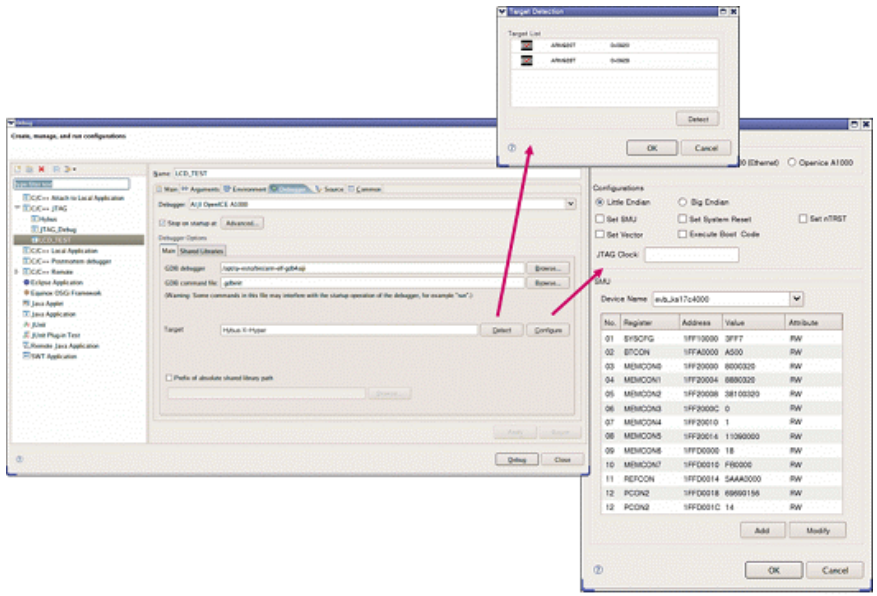
[Debugger for dual core processor]



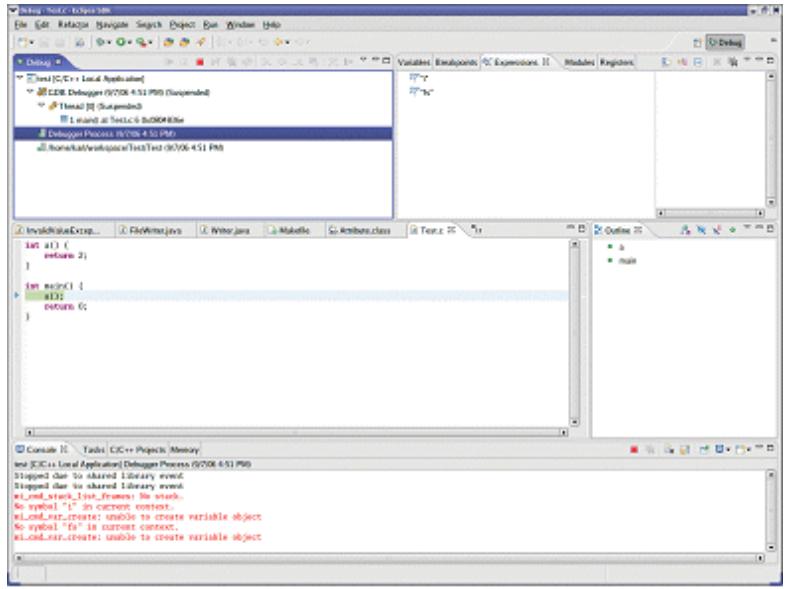
[power consumption analysis]

Development Tools in Detail (3/10)

- Debugger for dual core processor
  - New perspective for dual core processor debugging
  - New debugging engine for multi-core processor
  - Development of ICE facility for multi-core processor debugging
  - Target agent for various processors



[Selection and setting screen snapshot]



[Debugging snapshot]

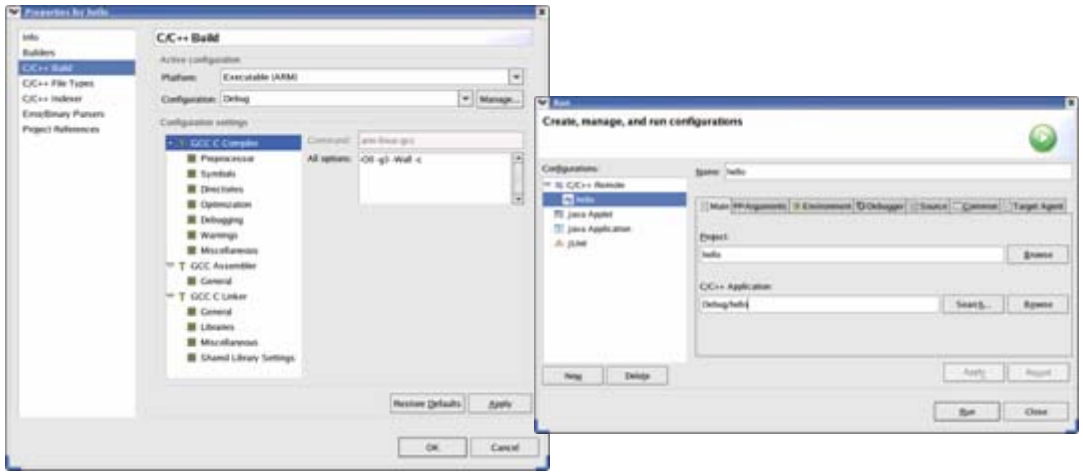
Development Tools in Detail (4/10)

- Support Platforms
  - Target : X86, ARM, XScale, MIPS, PowerPC
  - Host : Linux, Windows

- Features
  - Integrated development environment based on Eclipse
  - Remote and non-stop debugging
  - Economic firmware debugging with JTAG technology
  - Remote monitoring
  - Power analysis and optimization
  - Easy device driver development
  - Easy GUI design

Development Tools in Detail (5/10)

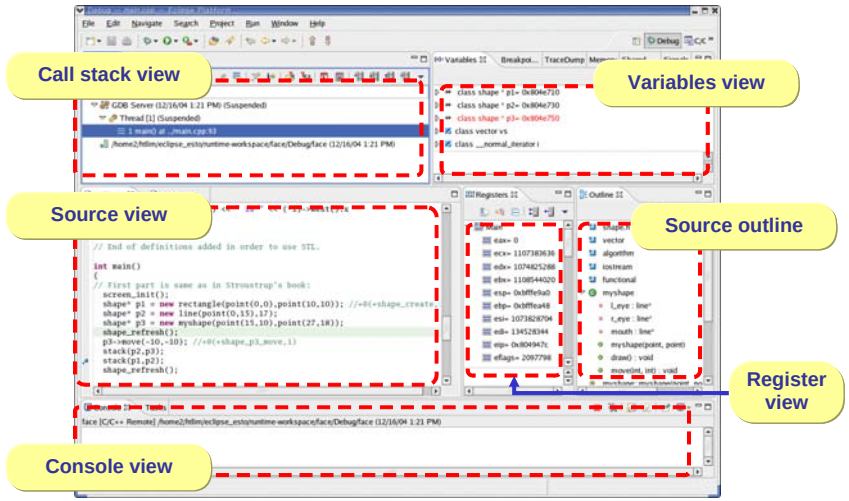
- IDE
  - Project Management
    - Creation, configuration, and building
    - Makefile management
    - Qplus package import/export
  - Development
    - Source code editing facilities
      - Syntax highlighting, automatic formatting, class browsing, etc.



Project Build & Remote Execution Configuration

Development Tools in Detail (6/10)

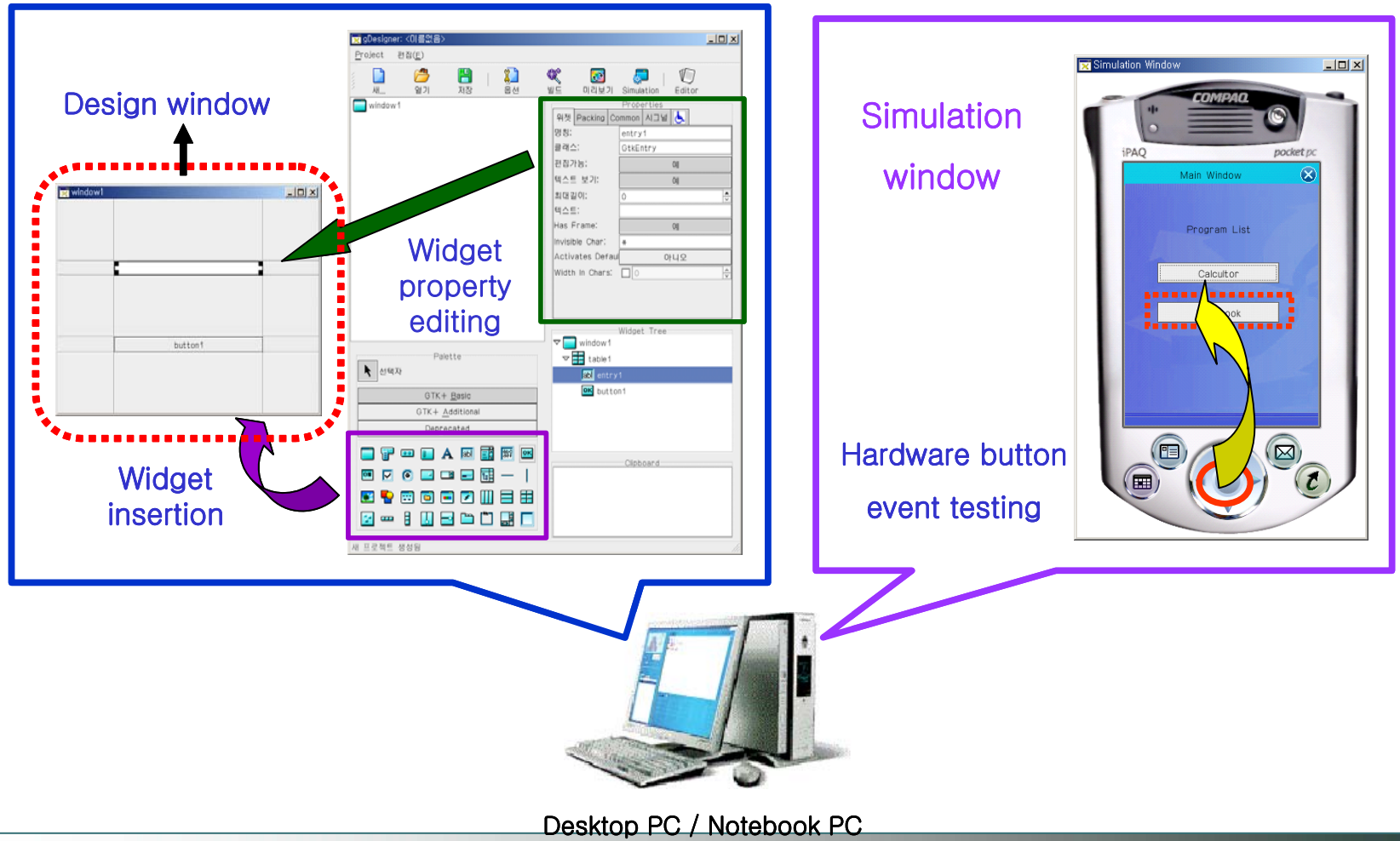
- Debugger
  - Remote Debugger
    - Remote debugging starts with just one button click
    - Nonstop-debugging with tracepoint and replay
      - For time-sensitive applications
  - JTAG-based Debugger
    - A cost-effective way to debug applications on a target system
      - Needs only a cheap JTAG adaptor
    - Supports full C source level debugging
    - Supports both breakpoint & tracepoint



Snapshot of Debugger

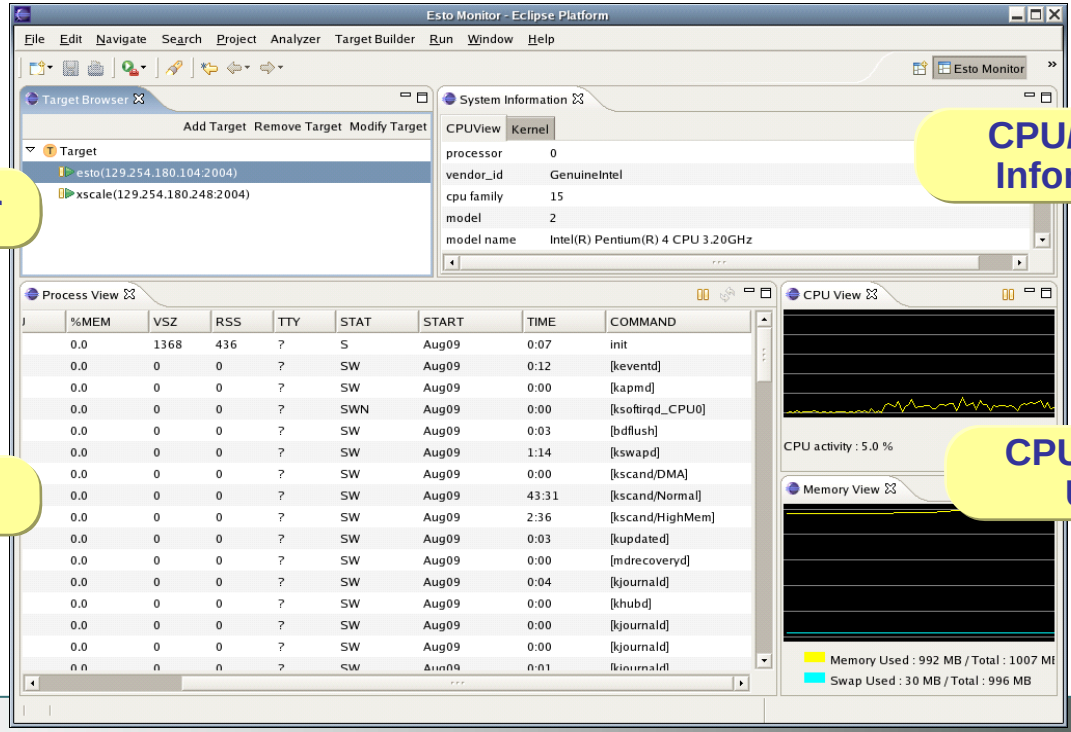
Development Tools in Detail (7/10)

❑ GUI Builder (gDesigner)



Development Tools in Detail (8/10)

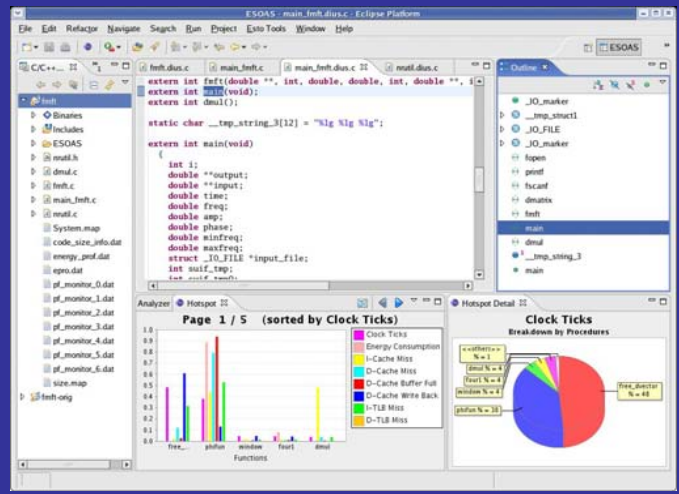
- Target Monitoring Tool
  - Concurrent multiple-target monitoring
  - Various target resource monitoring
    - CPU, memory, process list, process memory map, kernel module, etc.
  - GUI based kernel event trace
  - Remote tracing of system call and library function



Development Tools in Detail (9/10)

- Optimization and Analysis Tool
  - Optimizing Application
    - By using loop transformation such as loop distribution, loop interchange, loop unrolling, and scalarization
  - Analyzing Power of Embedded Application
    - Together with performance and code size
  - GUI-Based Integration of Optimizing and Analyzing

Multi-meter & Target System



Optimization & Analysis Tool

Development Tools in Detail (10/10)

- Device Driver Development Tool
  - Specialized Toolset for Device Driver development
  - Driver Development IDE
    - Driver module building & installation
  - Driver Project Wizard
    - Skeleton code generation
      from the driver requirement specification including device name & id, driver type, bus type, entry-point names, etc.
  - Device Test Wizard
    - Hardware resource access program routine generation & test
  - Target Devices
    - PCI, USB, I^2C, etc.

MCC Applications

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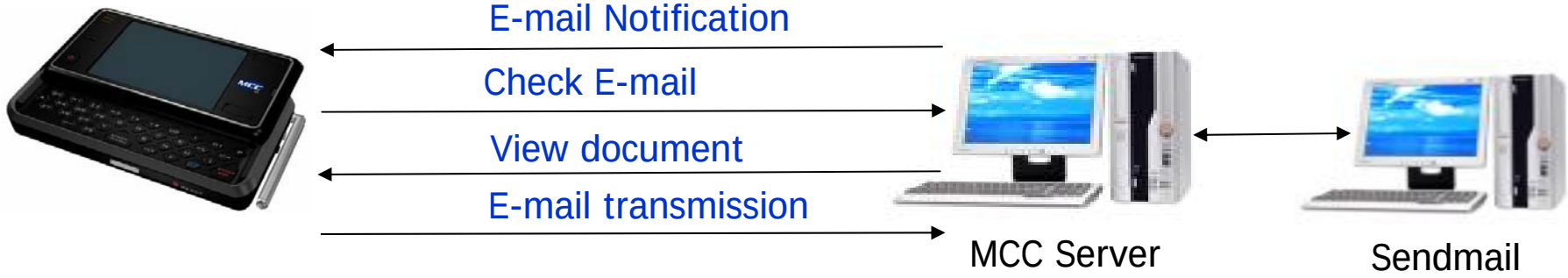
Mobile Office

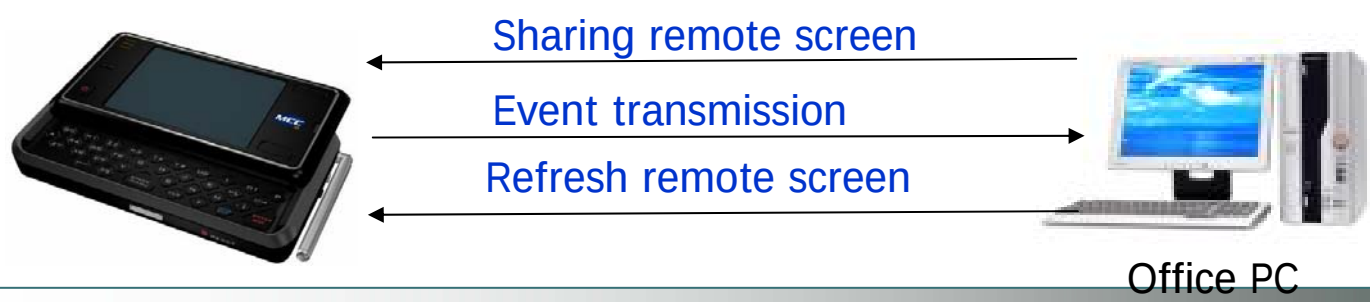
Mobile Office

- Converging office computing environment into MCC
  - E-Mail browsing
  - Office file viewer

Email and View Documents

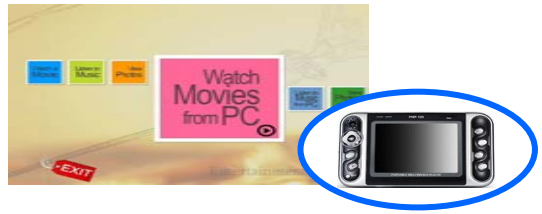


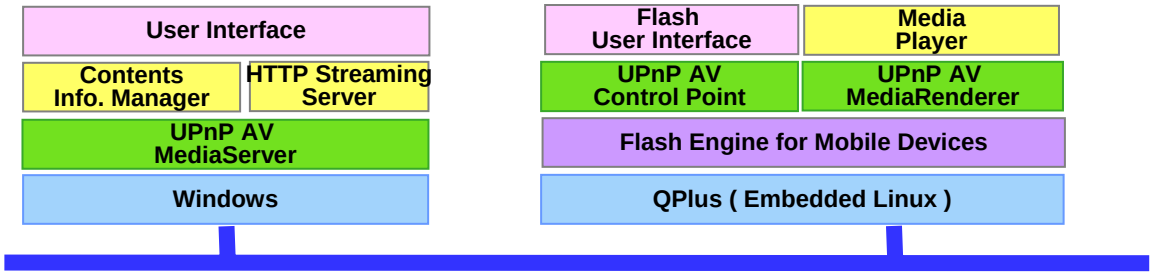
Mobile Remote Desktop Service



Mobile Entertainment Center (1/2)

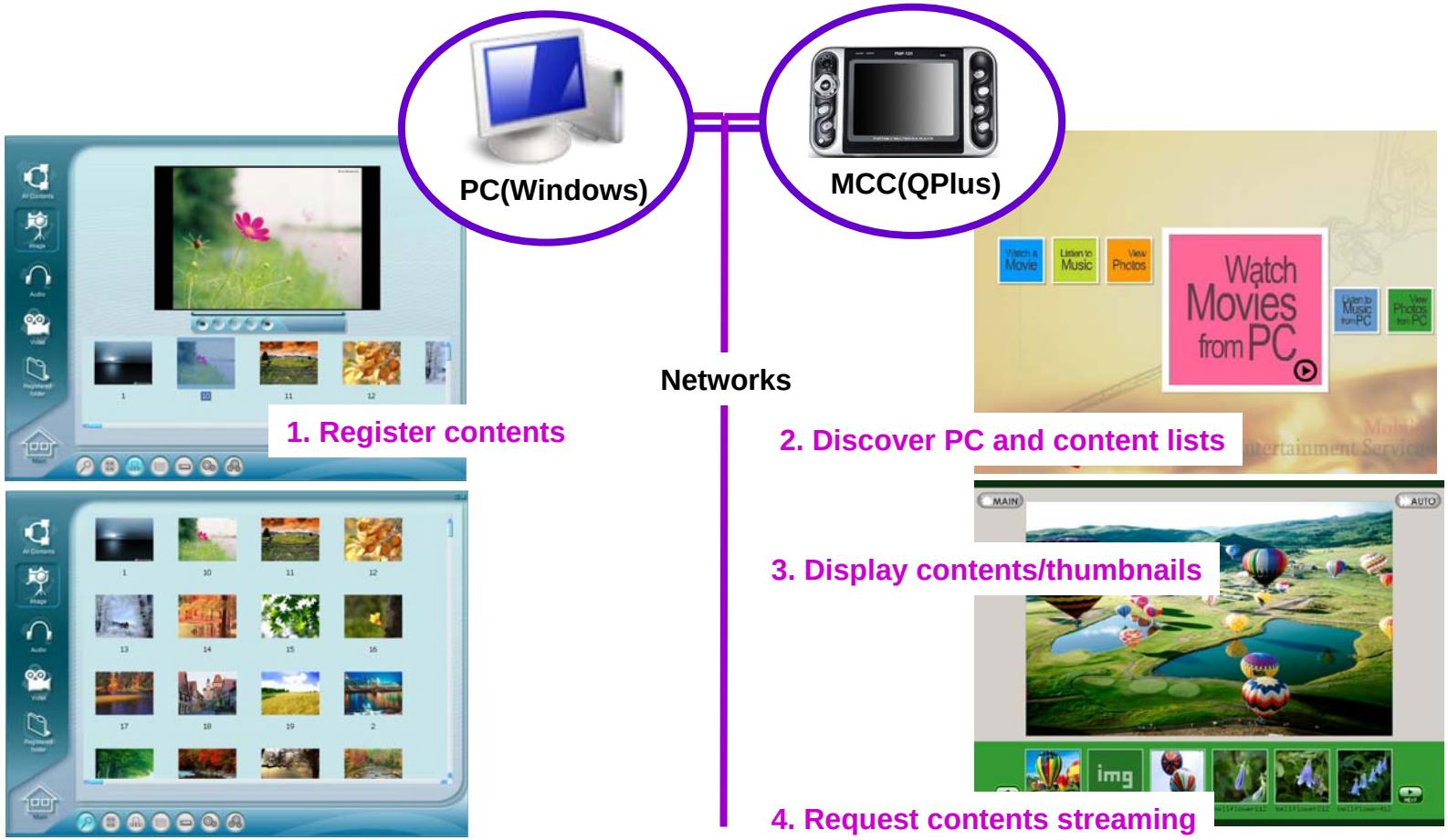
- Sharing multimedia contents on remote
- Running local/remote multimedia contents
- Image/Audio/Video
- Auto-discovery of remote multimedia contents via UPnP AV spec.
- Lightweight Flash engine for MCC
- New Flash UI for MCC



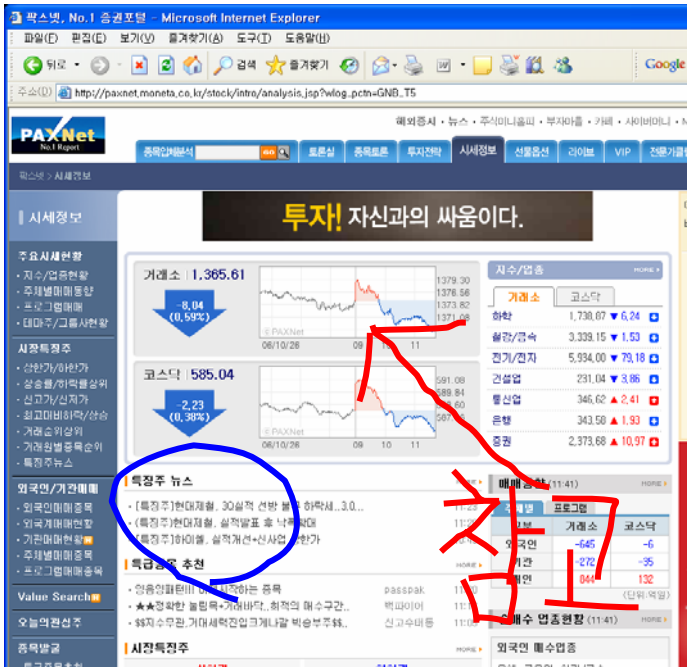


Mobile Entertainment Center (2/2)

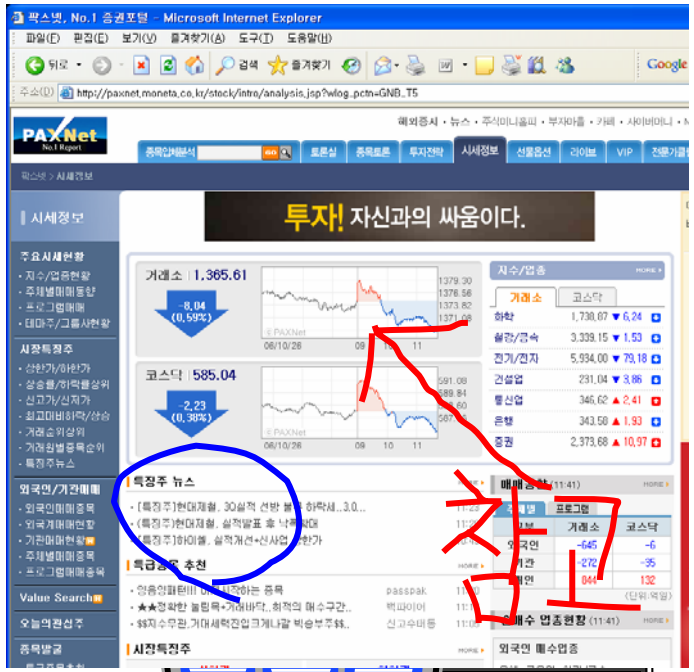
- Remote A/V Media Sharing Service



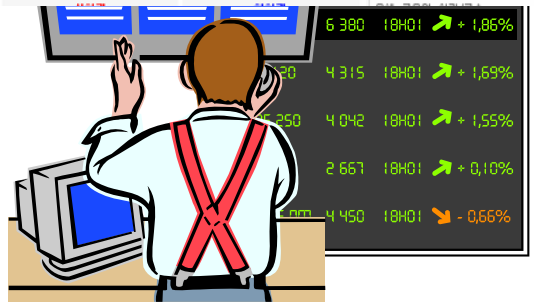
Mobile Cobrowsing



- URL Change
- Scrolling
- Scripting
- Voice Chat



Sharing web screen



Thank you

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Q&A