



Building the Infrastructure for a Harmonious Information Society

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Outline

- **Changing Landscape in Computing**
- **Emerging Opportunities in Industry**
- **Harmonious Information Society**
 - **A Smart Classroom Project as Example**
- **Research at Tsinghua University**





Quick Look Back (I)

- **What has been done?**
 - **A. Turing: Turing Machine**
 - **J. von Neumann: von Neumann machines**
 - **C. Shannon, N. Wiener, L. von Bertalanffy**
- **Machine Computing**
 - **Binary stored data and program**
 - **Processor, memory, and I/O**
 - **Numerical and logical computation**





Quick Look Back (II)

- **What is being done?**
 - **Moore's Law:**
 - In 1965, Gordon Moore stated, "The complexity for minimum component costs has increased at a rate of roughly a factor of two per year."
 - Number of transistors on an integrated chip doubles every 18 months.
 - **Network Bandwidth**
 - **Network Efficiency**





Quick Look Back (III)

- **What has not been done or need to be done?**
 - **Binary data and Shannon's theory are all about coding, for storage, process and communication**
 - How do we handle content?
 - Can or should knowledge be represented this way?
- **Machine Intelligence**
 - **Failure of 5th Gen Computer**
 - **The old question: “Can machine think?”**





Brave Look Forward (I)

- **Make Machine Thinking**
 - **Mimic Human Intelligence**
 - Is our way of thinking the only best way?
 - Even people don't always “think” the same way!
 - In a harmonious society, we don't all think the same way, we communicate
 - **Content-aware**
 - **Context-aware**





Brave Look Forward (II)

- **Help People Thinking**
 - **Extend Human Intelligence**
 - Global village
 - Massive/Multimedia data
 - Real-time/Instant communication
 - **Yahoo, Google**
 - **Napster, Skype**





Lay Out Nerves

- **Nerves form a network of pathways for conducting information throughout the body**
- **Converging network**
 - **Date, voice, and video**
 - **Internet, phone/cellular, and broadcasting**





Seamless Mobility

- **Why Do We Work Around Computers?**
 - They are tethered
- **How Can We Have Computers Work Around Us?**
 - **Make them wireless and embedded: mobile**
 - Power
 - Bandwidth
 - Security
 - ...





Smart Environment

- **Work environments allowing people to perform tasks efficiently by offering unprecedented levels of access to information and assistance from computers**
 - **Augmented Reality**
 - **Natural User Experience**
 - **Spontaneous Interoperation**
 - **...**





Augmented Reality





Natural User Experience



Voice Communication via MA



Pen/Touch Interaction



Laser Pointer Interaction

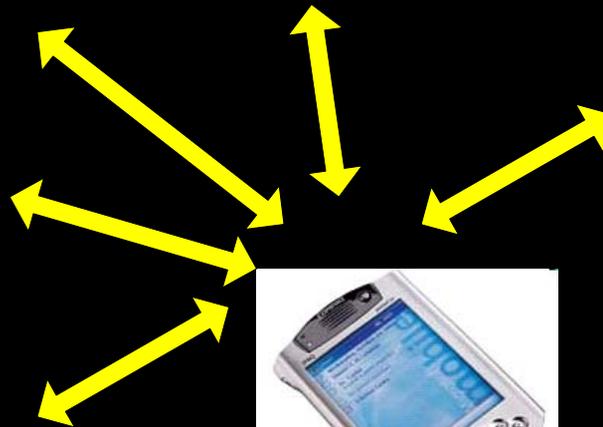
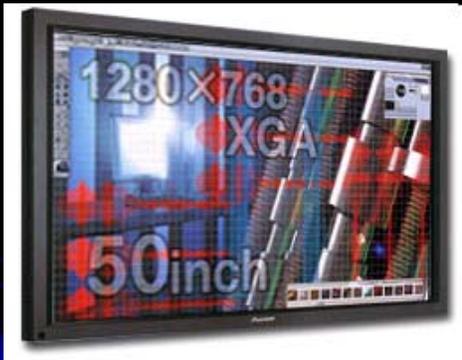
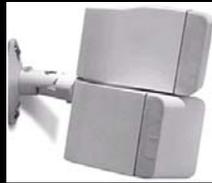


Context-aware Interaction





Spontaneous Interoperation





Smart Space Testbed

Inter-module coordination

Coordination Model, Multi-Agent, Communication Language

Natural Human Computer Interface

Tangible Interfaces, Sensors, Perceptual technology

Eternity & Invisibility

Loose coupling, Embedded technology



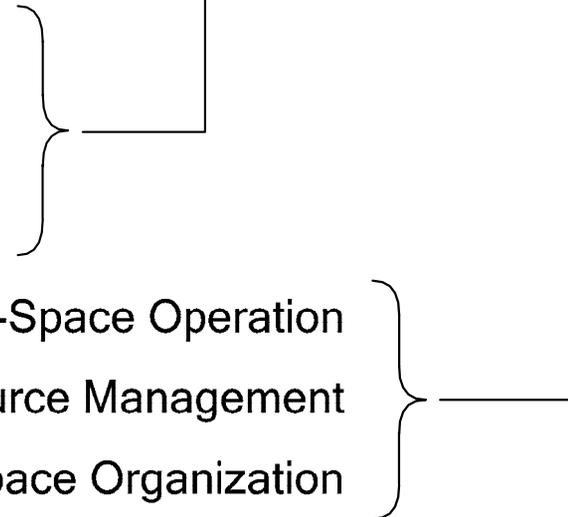
Cyber Foraging

*Environment Discovery, Resource Management
Surrogate, Virtual Service, Proxies,
Hybrid Communication Method Support*

Inter-Space Operation

Inter-Space Resource Management

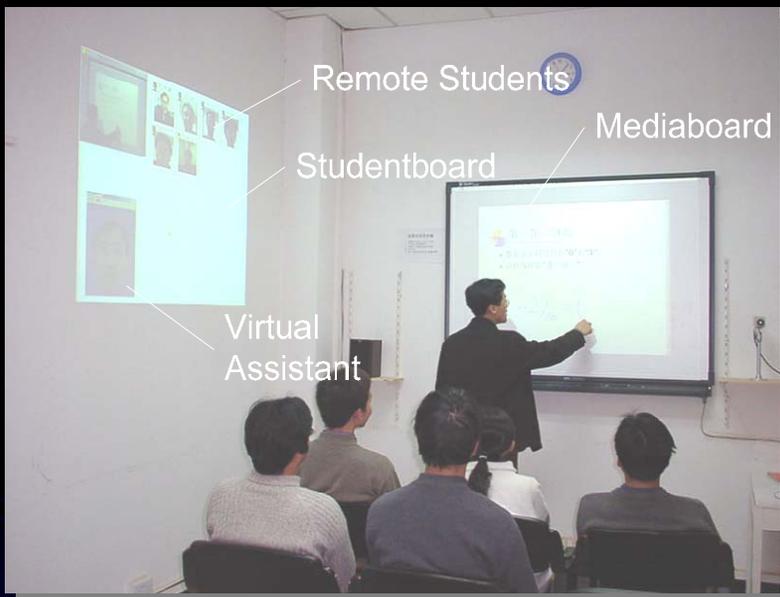
Hierarchy Space Organization



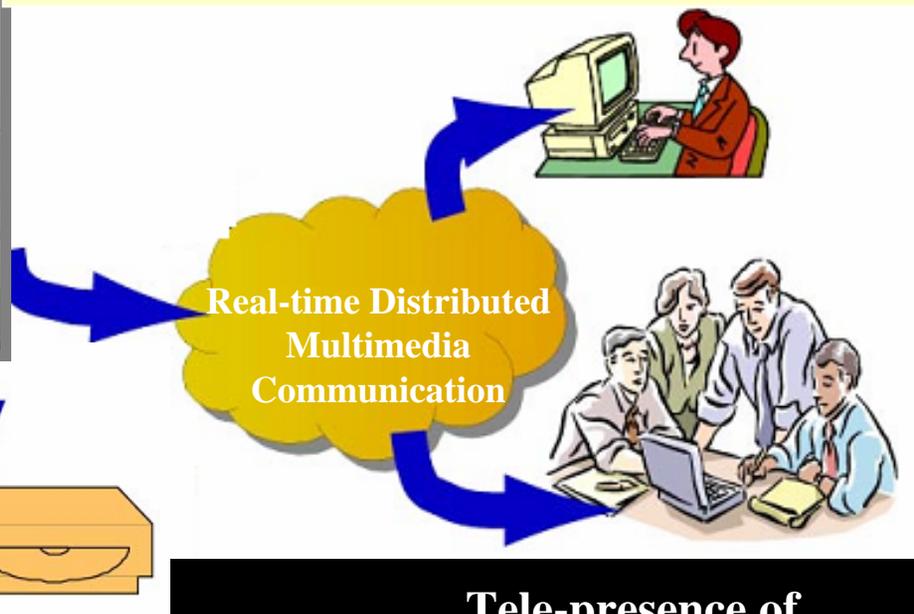


The Smart Classroom Project

An augmented classroom where a teacher can instruct remote and local students at the same time and in a similar fashion.



Smart Classroom



Experience Record of the Classroom

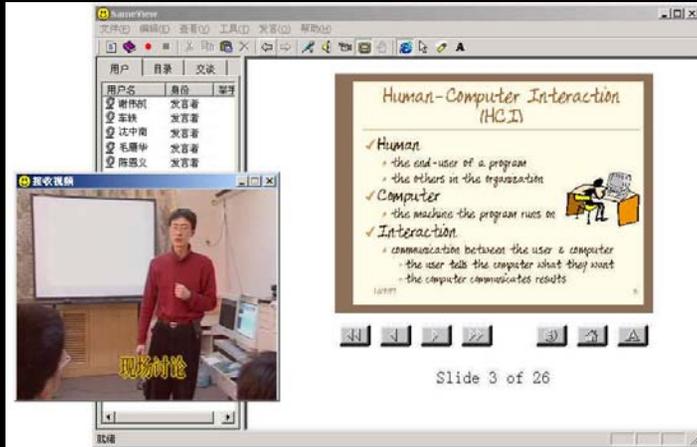
Tele-presence of Remote Students



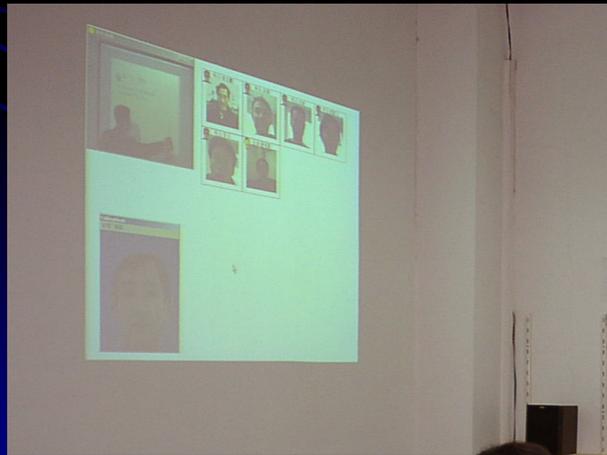
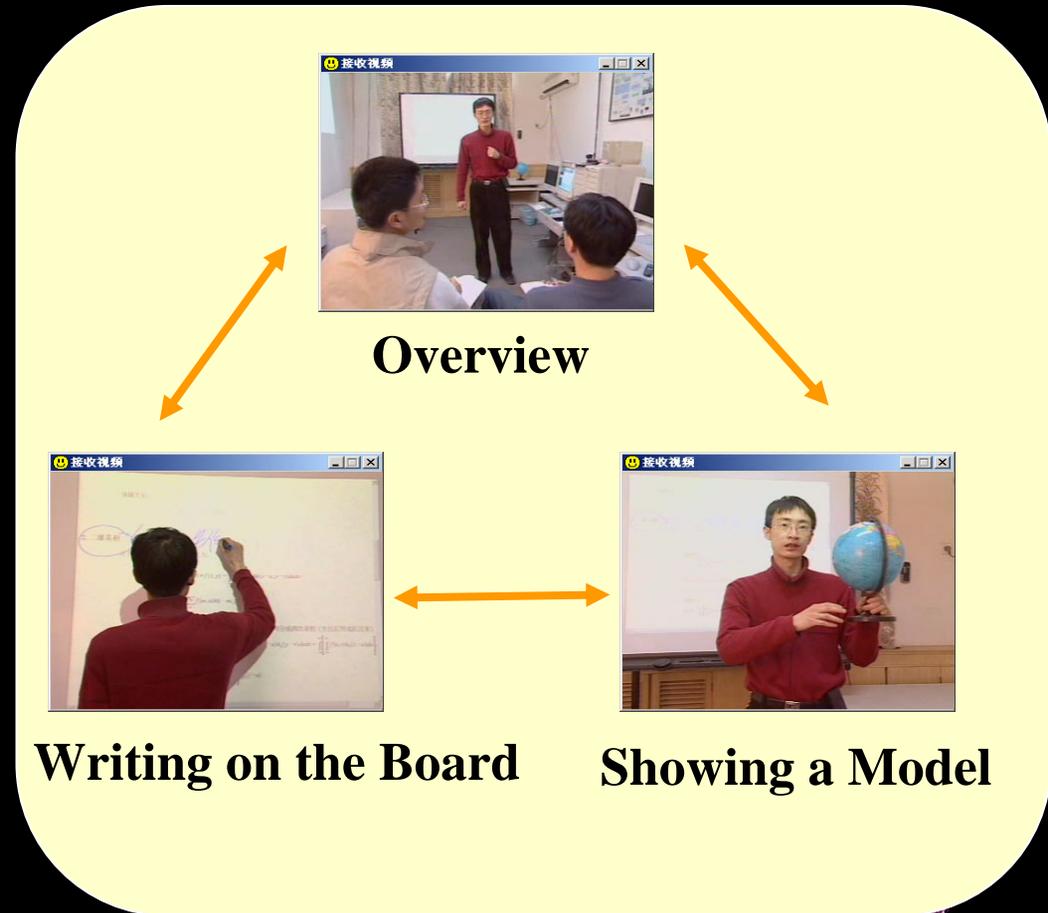


Tele-presence

Smart Cameraman



Interface of Remote Clients

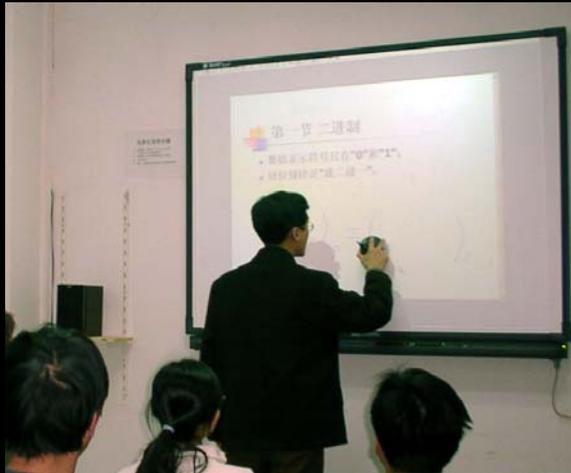


Student Board in the Classroom

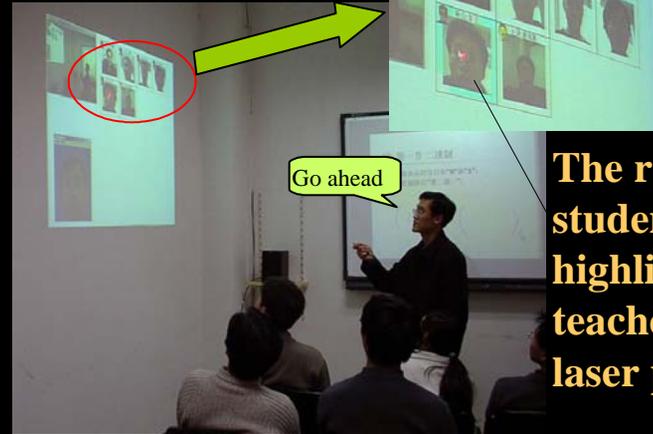




Invisibility: Natural UI



- Pen-based writing



The remote student's image is highlighted as the teacher aims the laser pointer at it

- Highlight remote student by laser pointer and voice command

- Speech-capable virtual assistant
- Biometrics-based login authentication

A camera for Face-Recognition is installed behind the mirror





Experience Capture

- Auto-record the synchronized multiple data streams

- Lecture on mediaboard and its presentation progress

- Writing and pointing on the boards

- Live audio/video

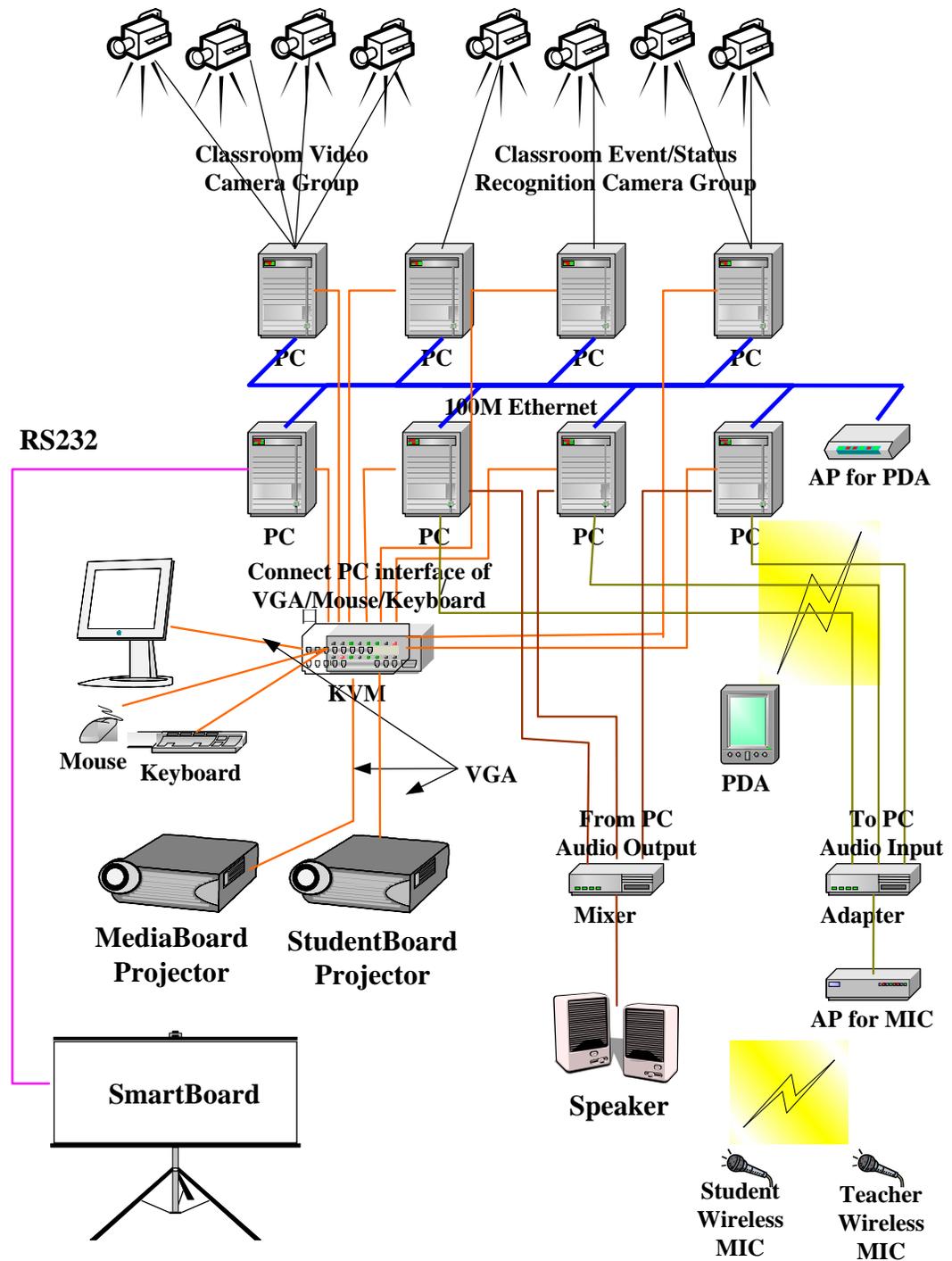
- Interaction with remote students

- Post-edit

The screenshot shows a software interface for post-editing. It includes a video window on the left showing a person speaking. A central window displays a slide titled "Pervasive Computing" with text: "Pervasive computing is about making pervasive of Human-Computer Interaction and Media Integration CS Dept. U". Below the slide is a text box with the text: "Pervasive computing is the computing paradigm in future, which enable us doing computation anyhow, at anywhere, anytime without knowing that we are computing. With caring about human being and...". On the right, an "Event Properties" window shows a table with columns "Name" and "Value". The table contains: "events" with value "148, 209, 150, 209, 151, 209, 152, 209, 155, 209, 156, 209, 157, 209, 158, 209, 159, 209, 160, 209, 161, 209, 162, 209, 163, 209, 164, 209, 165, 209, 166, 209, 167, 209, 168, 209, 169, 209, 170, 209, 171, 209, 172, 209, 173, 209, 174, 209, 175, 209, 176, 209, 177, 209, 178, 209, 179, 209, 180, 209, 181, 209, 182, 209, 183, 209, 184, 209, 185, 209, 186, 209, 187, 209, 188, 209, 189, 209, 190, 209, 191, 209, 192, 209, 193, 209, 194, 209, 195, 209, 196, 209, 197, 209, 198, 209, 199, 209, 200, 209, 201, 209, 202, 209, 203, 209, 204, 209, 205, 209, 206, 209, 207, 209, 208, 209, 209, 209, 210, 209, 211, 209, 212, 209, 213, 209, 214, 209, 215, 209, 216, 209, 217, 209, 218, 209, 219, 209, 220, 209, 221, 209, 222, 209, 223, 209, 224, 209, 225, 209, 226, 209, 227, 209, 228, 209, 229, 209, 230, 209, 231, 209, 232, 209, 233, 209, 234, 209, 235, 209, 236, 209, 237, 209, 238, 209, 239, 209, 240, 209, 241, 209, 242, 209, 243, 209, 244, 209, 245, 209, 246, 209, 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Hardware Infrastructure for Smart Classroom





Ubiquitous or Pervasive

- **Seamless Mobility**

- From stay in touch to seamless handover

- **Smart Environment**

- From anytime, anywhere, any service to right time, right person, right service

- **Strengthen Human Intelligence**

- Computer systems as human brain extension
- Networked people with stronger thinking power





Related Effort (I)

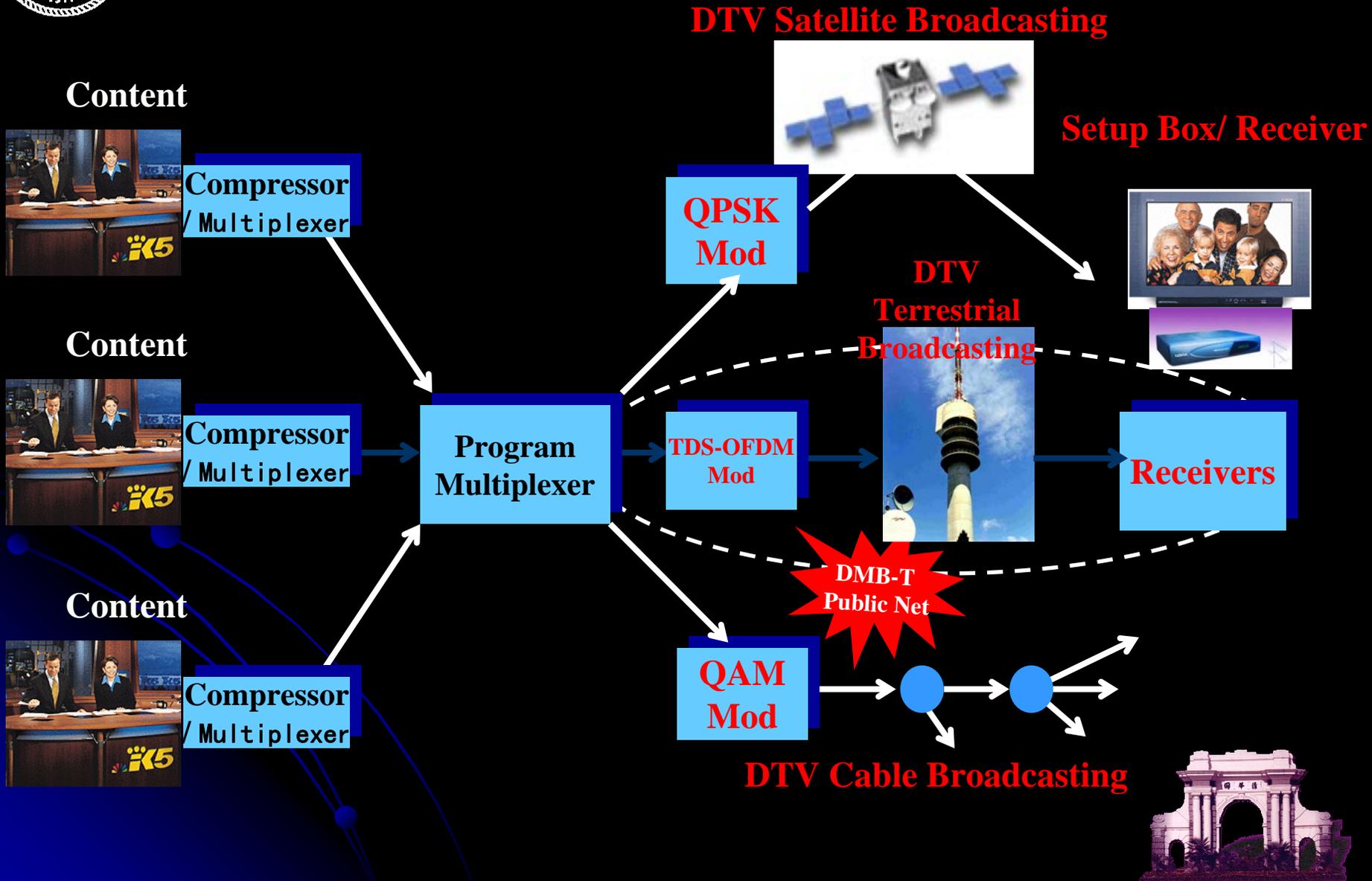
● DTV

- **Broadcasting channel coding standard**
- **UTI: “SIM” card for set-top boxes**
- **DRM: Digital Right Management**
- **CA: Conditional Access**
- **EPG: Electronic Program Guide**
- **GridMedia: IPTV broadcasting**
- **Mobile and handheld DTV**
- **SDR: Software defined radio DTV receiver**





Digital TV Broadcasting



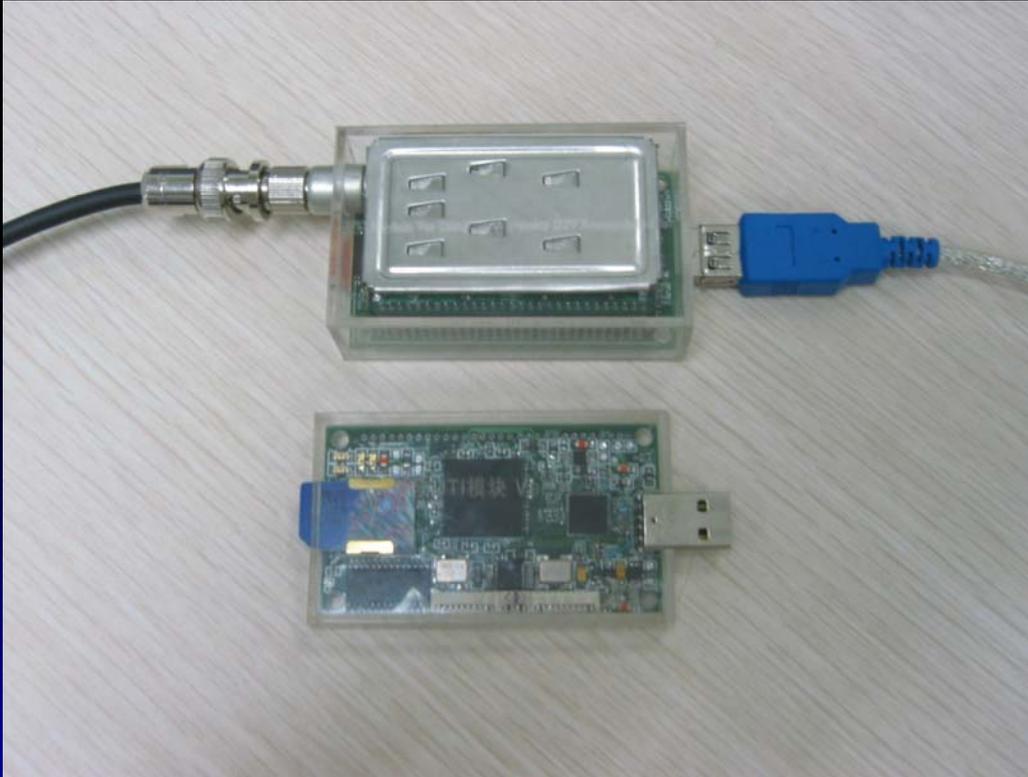


DMB-T



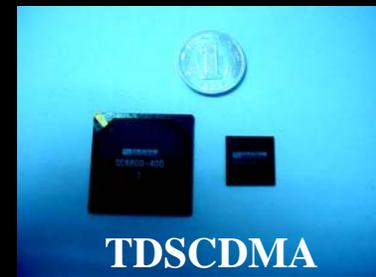


UTI





Wireless Overall

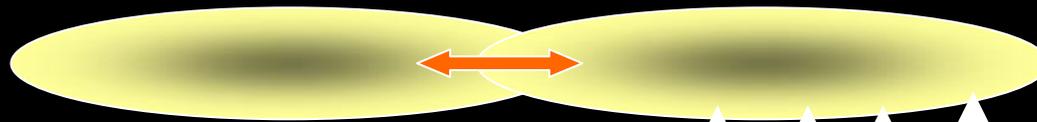


TDSCDMA

Mobility
Coverage
Security

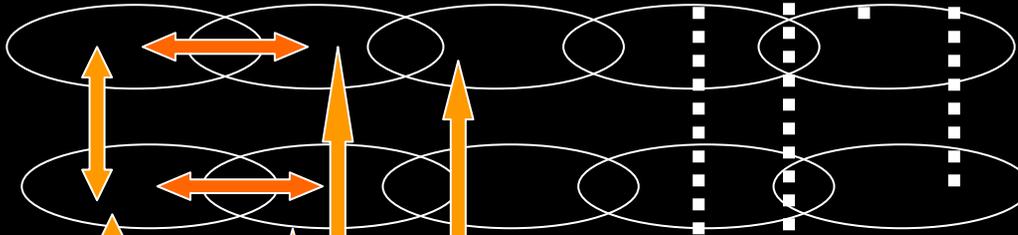


DVB



2G

3G



WLAN

PCS



WPAN

Bluetooth

UWB



xDSL

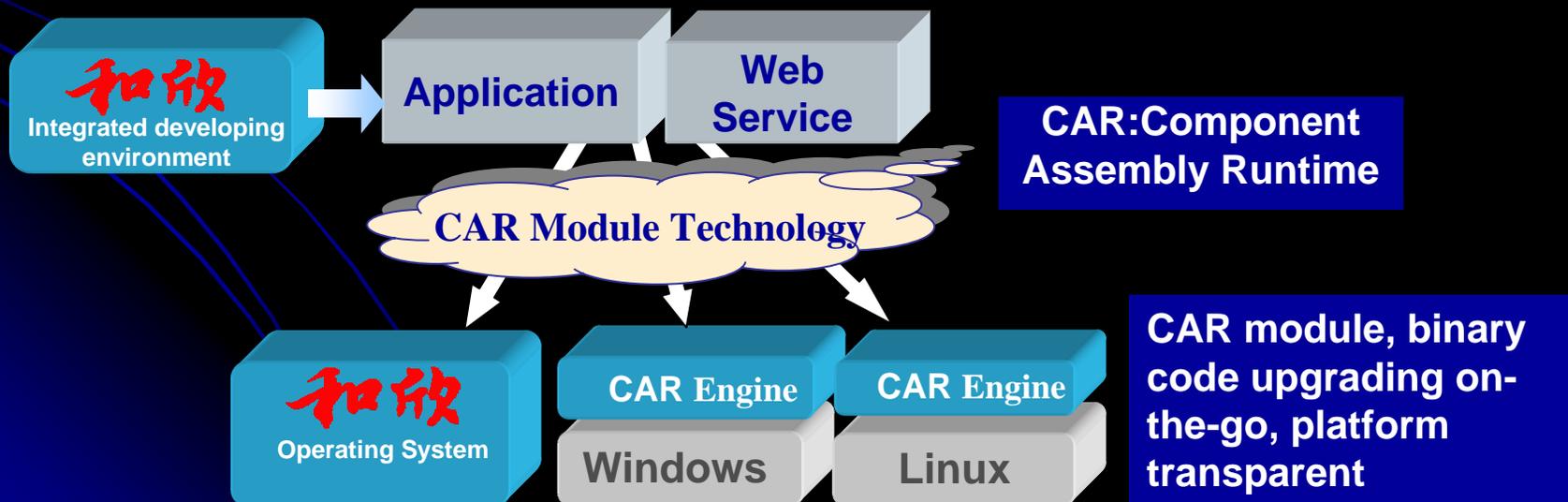


←→ Hori. Roaming ↑↓ Vert. Roaming ↑ Uplink Request



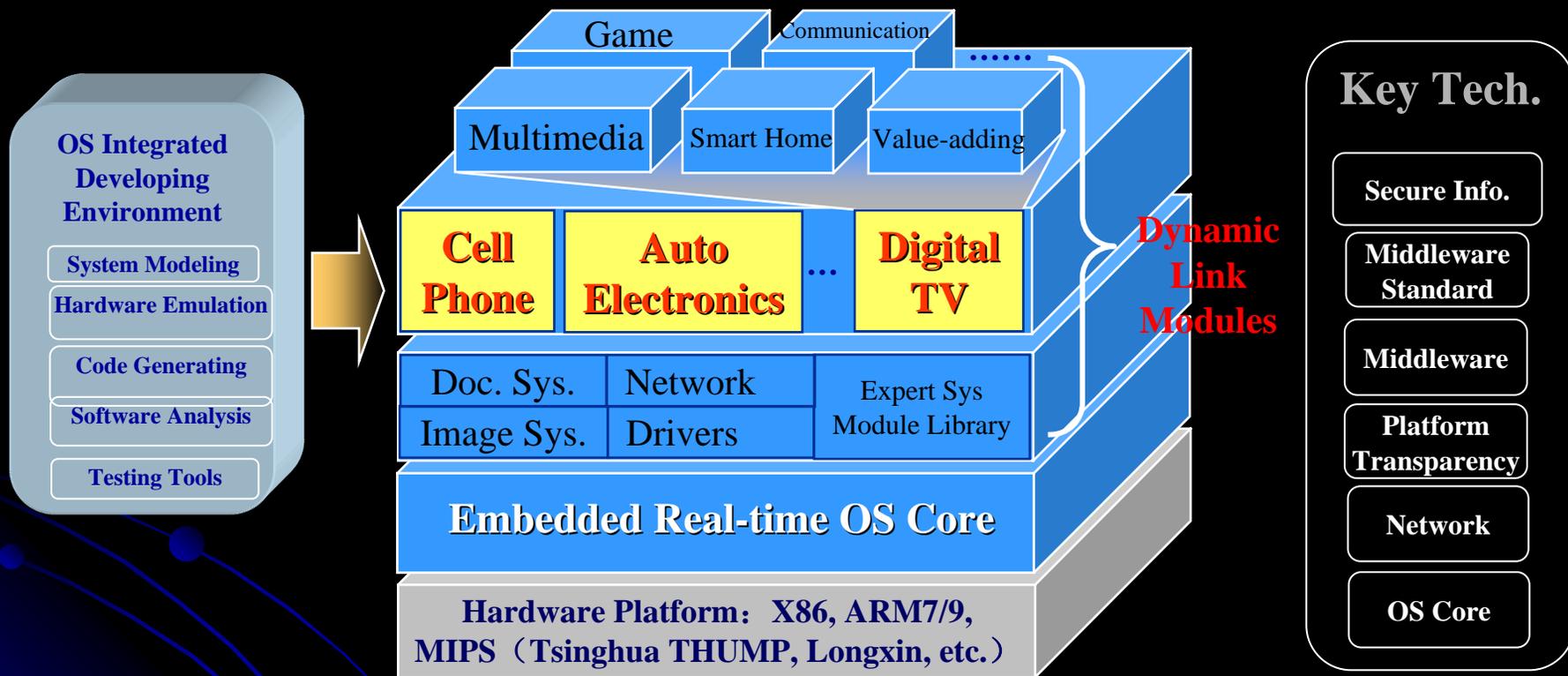
Related Effort (II)

- OS and SoC
 - Elastos
 - THUMP
 - NC: Network Computer
 - \$100 laptop





Elastos





Related Effort (III)

- **Security and Privacy**
 - TCG & TNC
 - End-point security
 - Policy/compliance enforcement
 - SSO: Single Sign On
 - High-speed security algorithms
 - NPU based implementation





Conclusion

- **On the way of revolution from machine computing to machine intelligence, we need symbiotic evolution**
- **A harmonious information society requires seamless mobility and smart environment**
- **Network convergence, natural interface, security and privacy are important research areas among others**





Thank You

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