P2P SEW: A Cooperative Shared Screen over Semi-Centralized Peer-to-Peer Architecture

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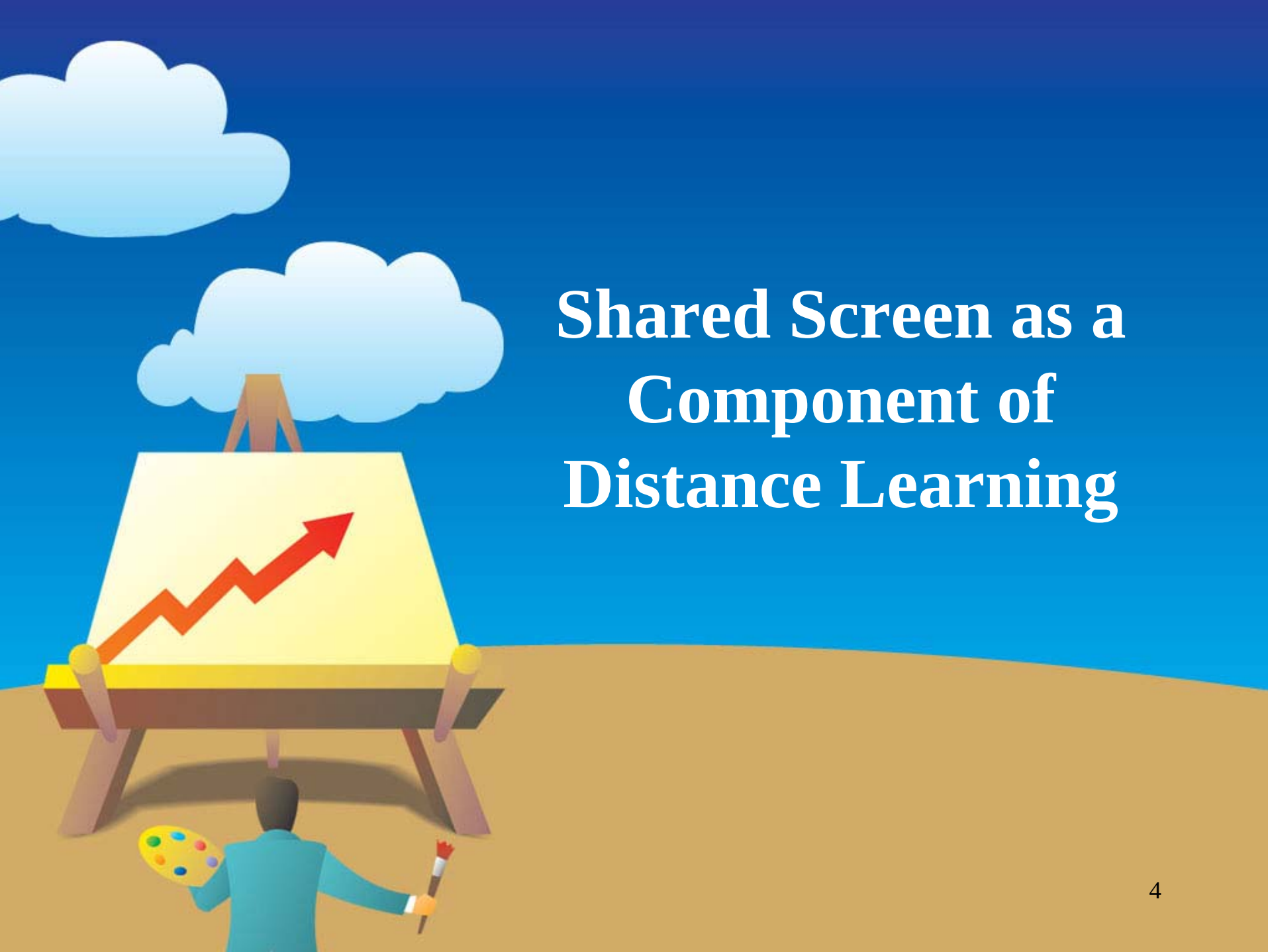
License

Outline

- **Shared Screen as a Component of Distance Learning**
- **Shared Screen as a Personal Communication Tool**
- **Smooth Control Transferring**
- **Patent and License**



Shared Screen as a Component of Distance Learning

Motivation

- **Rapid growth of distance learning applications**
  - PC and access networks have become popular
  - Current trend is "learning at home"
  - A simple tool is needed for instructors to provide learning contents
- **Ultimate goal**
  - Provide remote students with the same experience that in-class students may receive

Screen Sharing

- **PC-based Presentation**
  - Traditional transparency projection
  - Computer-based presentation and demonstration
  - Audio and Video

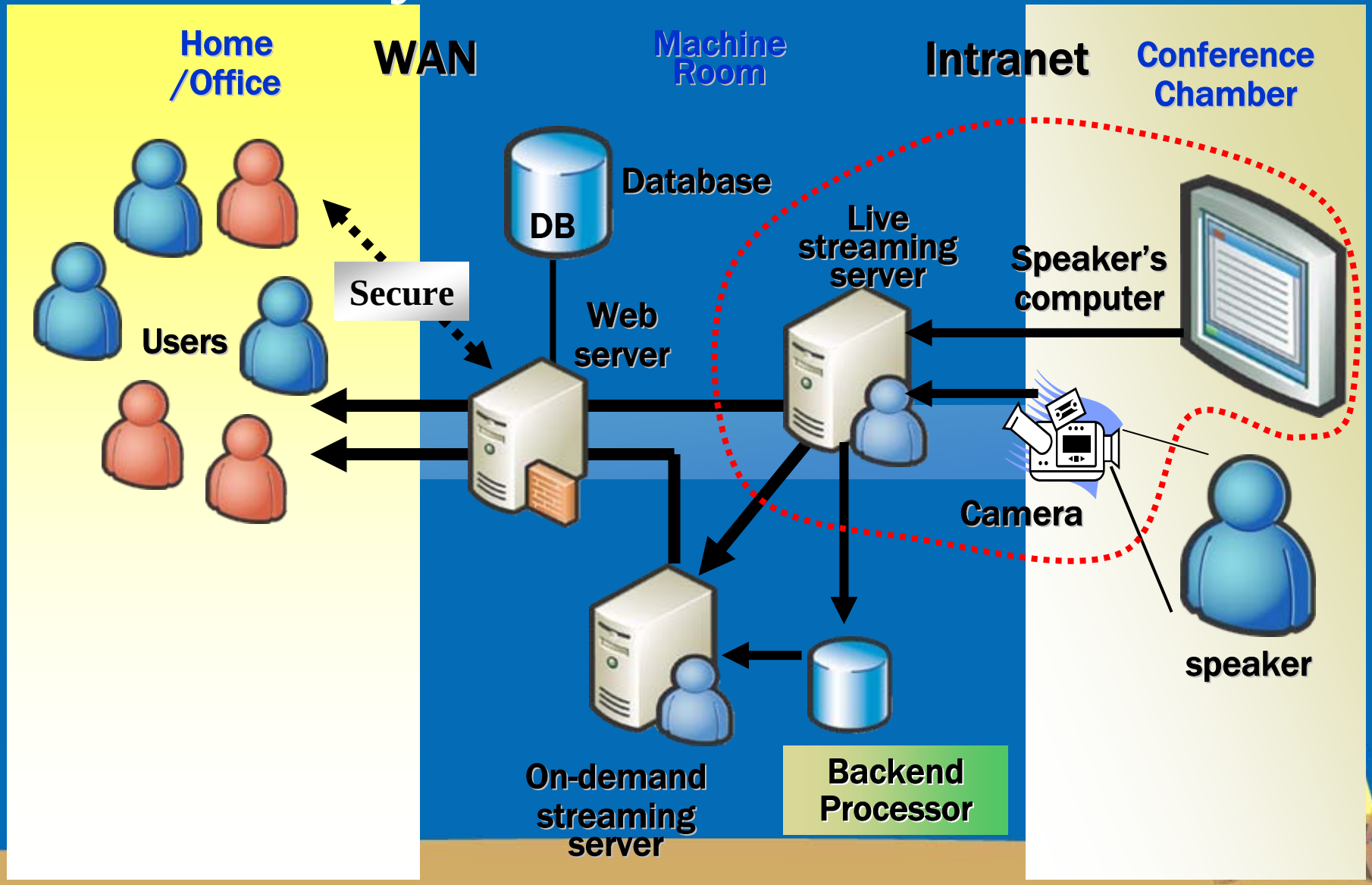
Conventional Distance Learning Systems

- **1th Generation**
  - Video recording
  - Only provide video presentation (popular)
    - Blurred images
  - A director is needed to produce learning contents
    - Location tracking microphone
- **2nd Generation**
  - Video recording
  - Provide video presentation with .ppt slide show
  - Complicated backend process (video +.ppt file)
  - A professional content producer is needed

Design Goals

Applications	Distance Learning, Internal Training, Stockholder's meeting, On-line conference, Manual, and User guide
Usage Types	Live, On-demand, and Local (CD) playback
Compatibility	Full motions on computer screen
Architecture	Standalone and Conference
Security	Content (screen) and Server Protection
Friendliness	Browser interface
Editing	Complete authoring tool

Distance Learning System Architecture



Captured-Screen Streaming Applications

- **On-demand program**
  - Starts at the beginning of a program regardless of user arrival time
  - VCR-like control
  - Each user requests a different portion of the archived program
- **Live program**
  - Start at the current screen of user arrival
  - Maintain a key-frame is at the archive server
  - Every user requests the same portion of the program

Types of Screen Recording

- **Application Layer**
  - Capture bit-map images of a computer screen
  - Join captures into an image sequence
  - E.g. Winstructor, HyperCam and Microsoft Media Encoder
- **Driver Layer**
  - Capture the data sent to the display driver
  - Save into a proprietary format (streaming and archive)
  - E.g. ScreenWatch

Problems

- **Application Layer**
  - (O) Independent of system configuration
  - (X) Cannot record smoothly
- **Driver Layer**
  - (X) System configuration is strongly restricted
  - (O) Record smoothly
- **How to:**
  - Independent of system configuration
  - Record smoothly

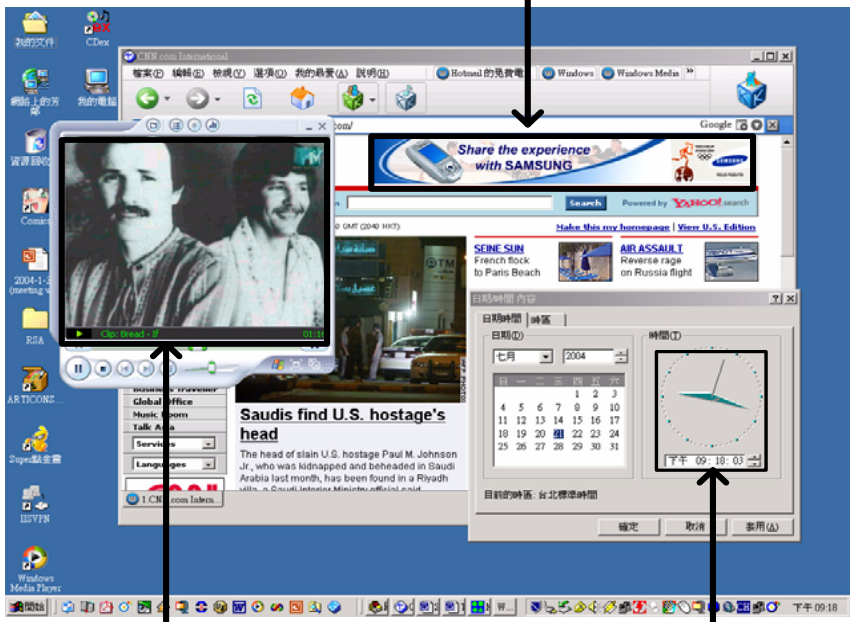
Observation

- **Not every region changes at the same time on a computer screen**

Example

Flash and dynamic banner in the web pages

(1)



Computer Desktop

(2)

Playback a video in the media player

(3)

System clock

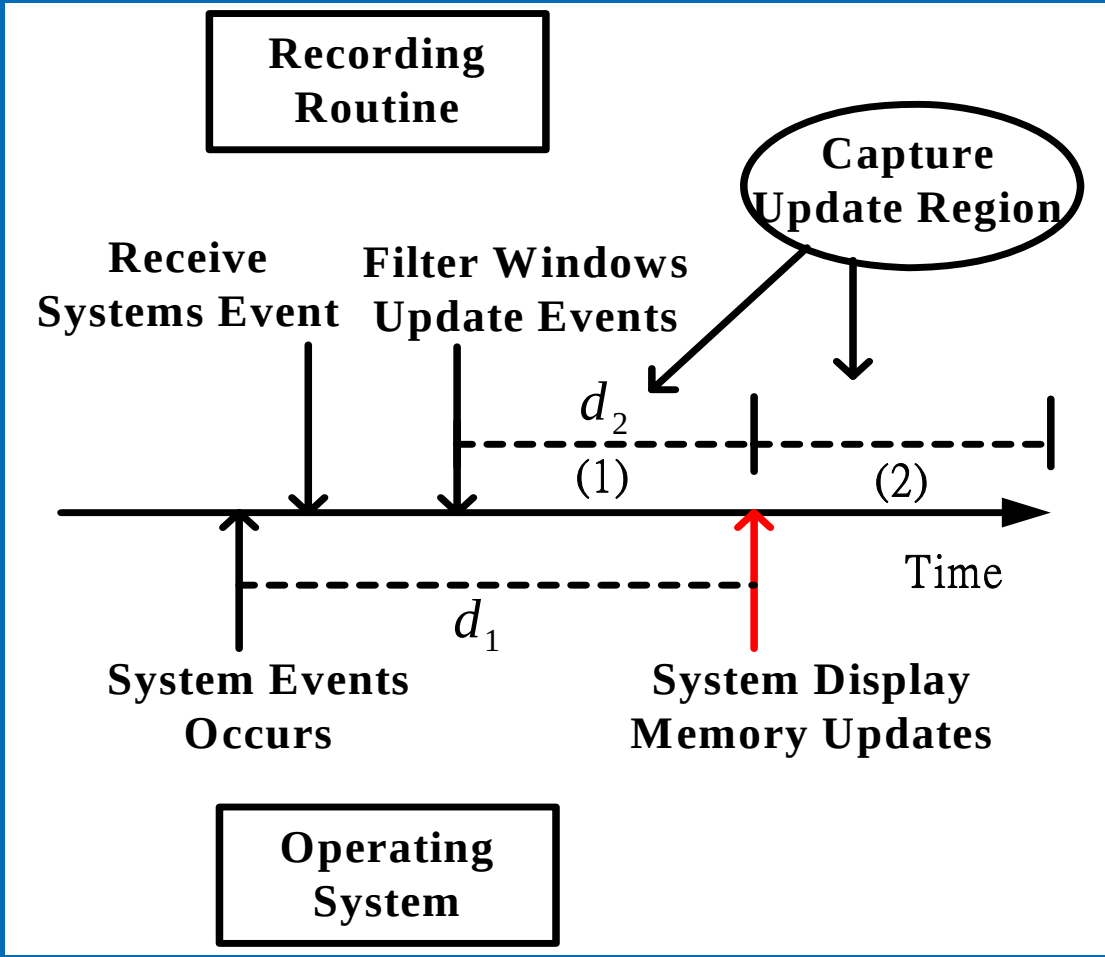
Strategies

- **A closer look at screen update messages**
- **Taking care of exceptions**

Screen Update Messages and Message Inspector

- **Screen Update Messages**
  - MS-windows
  - Some messages are generated with each screen update
  - From parameters associated with these messages, updated regions are identified
- **Message Inspector (MI, a hook function)**
  - Collect all messages
  - Filter those related to screen updates
  - Record the screen modified regions
- **However, there are exceptions ...**

Timing Inconsistency

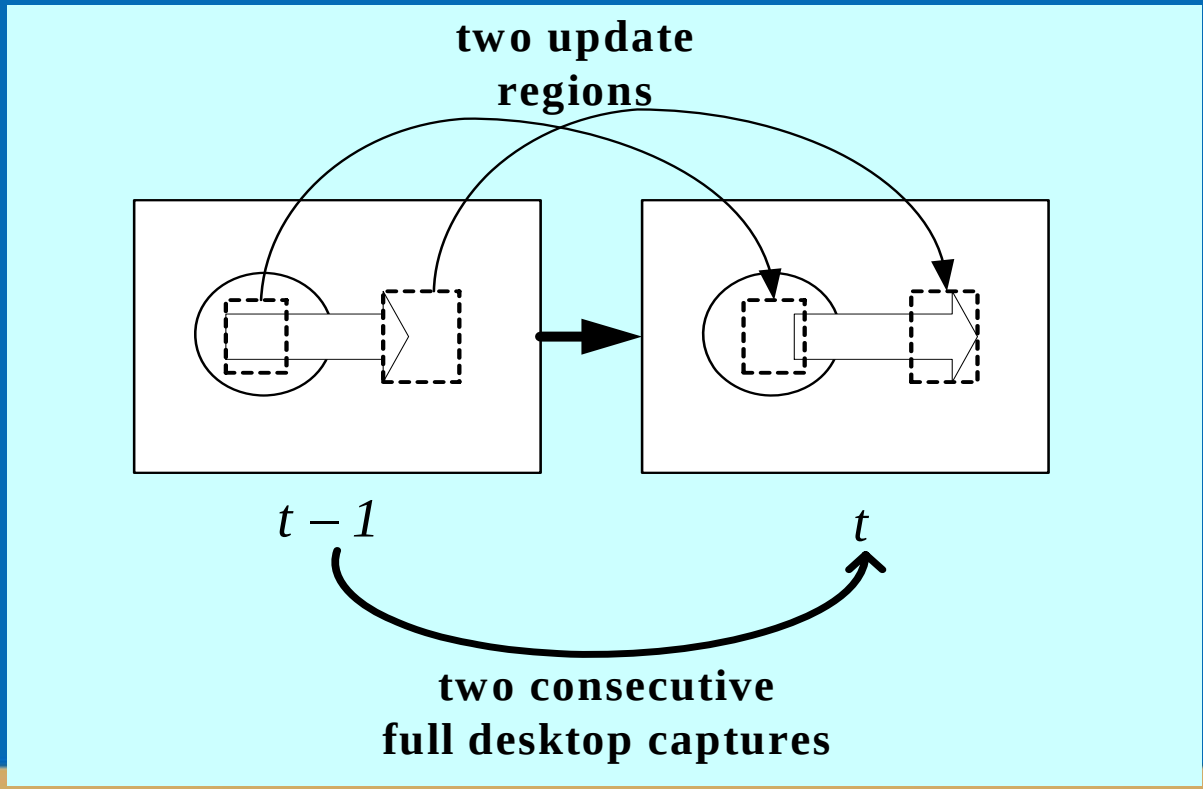


Screen Update without Message

- **Some screen updates do not trigger system messages**
  - Some graphic updates are real-time computed to update display memory directly
    - E.g, the changes of the second hand on the system clock will not trigger any system message
  - Some update regions cannot be identified by using message along

Periodical Desktop Capture (PDC)

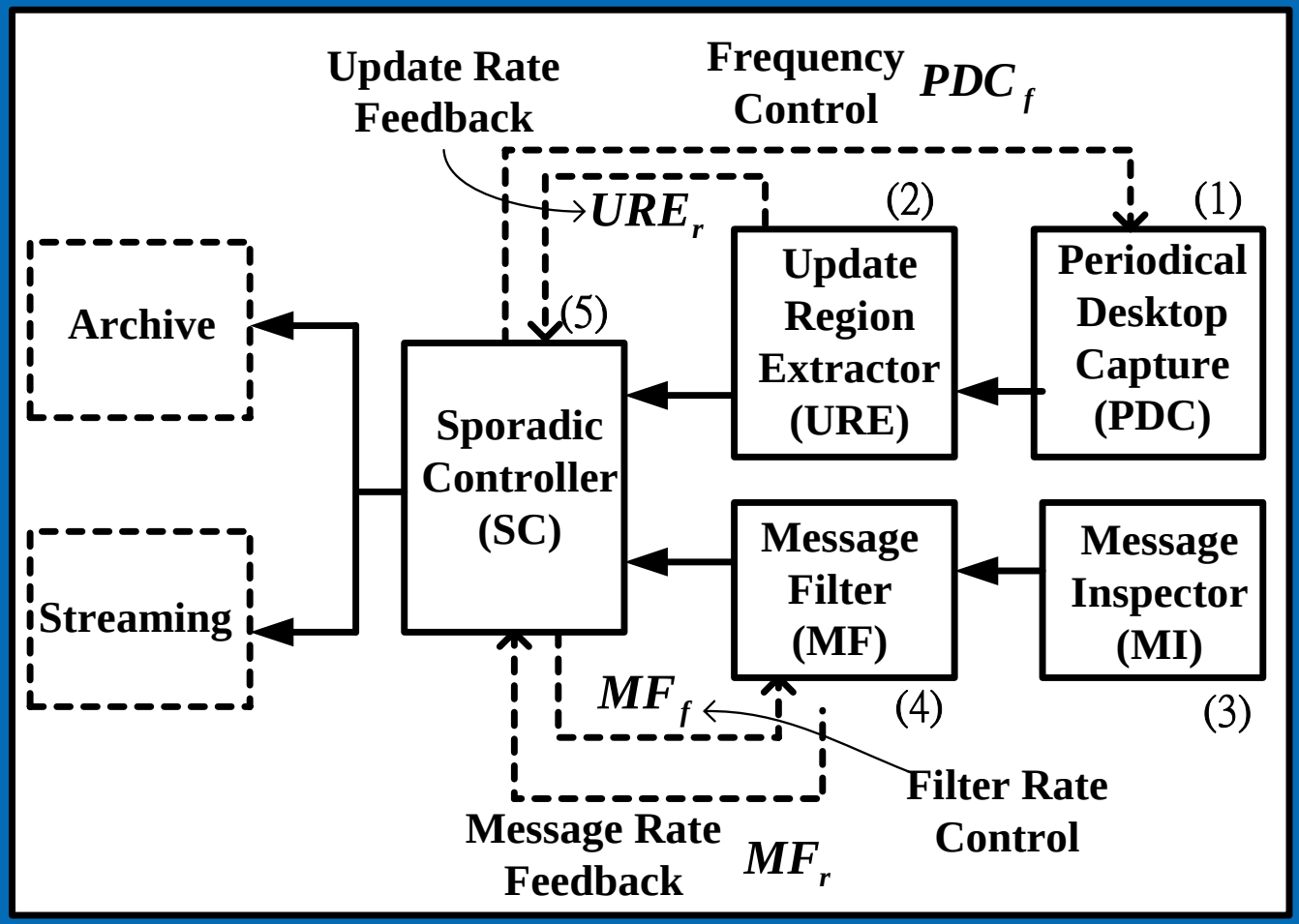
- Periodically capture the whole screen
- Compute the current screen with a previous one for their differences



Performance

- **Scheduling the two screen capture modules**
  - MI & PDC
  - Smooth playback with the presence of application programs and background processes
- **PDC occupies more system workload**
  - Reduce the frequency of PDC
- **Performance Goals:**
  - Transparent to lecture speaker
  - Guarantee screen recording quality

Software Modules



Sporadic Controller

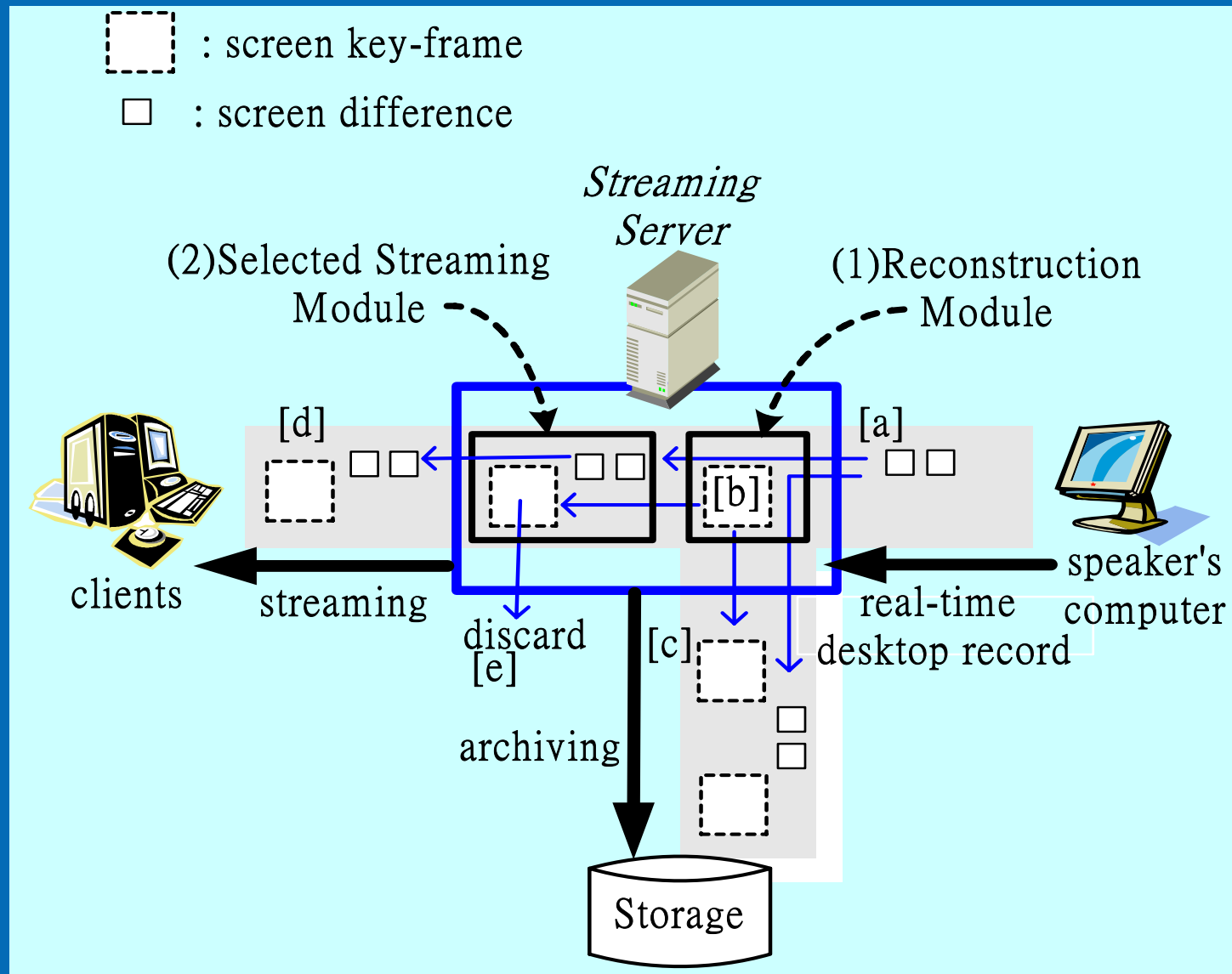
- **Regulate the operations of screen capture modules**
- **Adjust screen capture rates**
  - To generate intra frames at the archive server
    - May archive screen changes to local hard disk (stand-alone) or to a remote dedicated server (client-server)
  - To update the key frame for live broadcasting
  - To merge screen update messages
    - Combine update regions to reduce number of rectangles

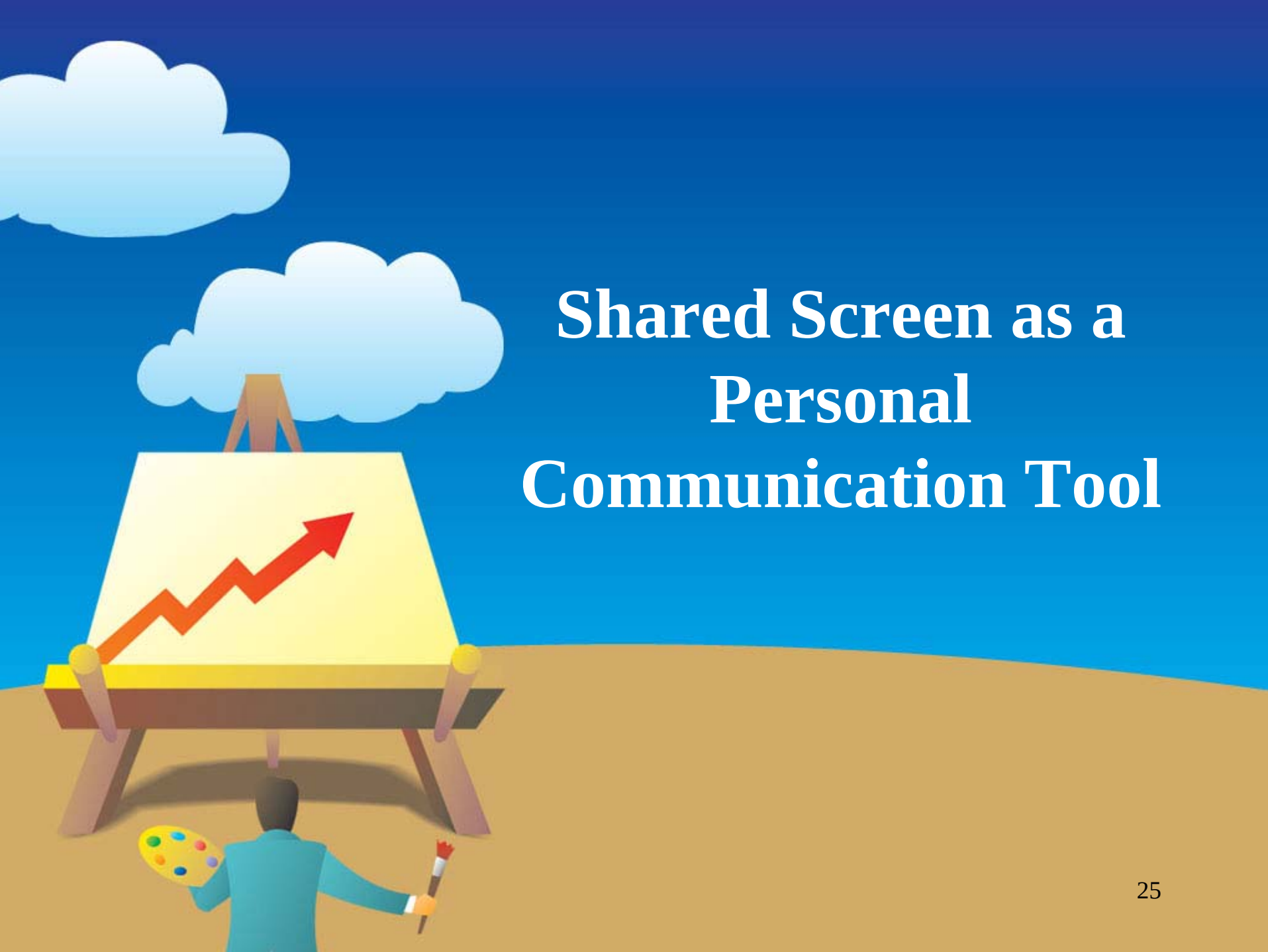
Sporadic Control Algorithm

Sporadic Control (SC) Mechanism:

```
{Set LV /* PDC_f control levels */
Set CB  /*Set CPU utilization bound*/
double feq[LV];
double  cpu_util; /*CPU utilization*/
int level=⌊LV/2⌋; /* initialization is in middle level*/
PDC_f =feq[level]; /*frequency initialization*/
repeat {
    get_cpu_utilization (cpu_util);
    get (MF_f);
    get (URE_f);
    Switch( condition_check(MF_f , URE_f ))
    { case1 :  ((MF_f)↗ && (URE_f)↗)
          level--; break;
     case 2:   ((MF_f)↗ && (URE_f)↘)
          { if (cpu_util  < CB) level++;
            else level- -;} break;
     case 3:  ((MF_f)↘ &&(URE_f)↗)
         level++; break;
     case 4: ((MF_f)↘ &&(URE_f)↘)
          { if (cpu_util > CB) level- -;}
      }
       PDC_f =feq1[level];
      additional_update_capture( );
      region_filter( );
      mf_adjust (MF_f);
} until (recording process end);}
```

Streaming Applications





Shared Screen as a Personal Communication Tool

Bring your friends' desktop to you at one click

- **Network presence management**
  - A directory server keeps track of users' current network positions
  - Users may keep track of his friends on the network
- **Desktop sharing**
  - Share computer screen
  - Share desktop control
  - Multiple access

Components

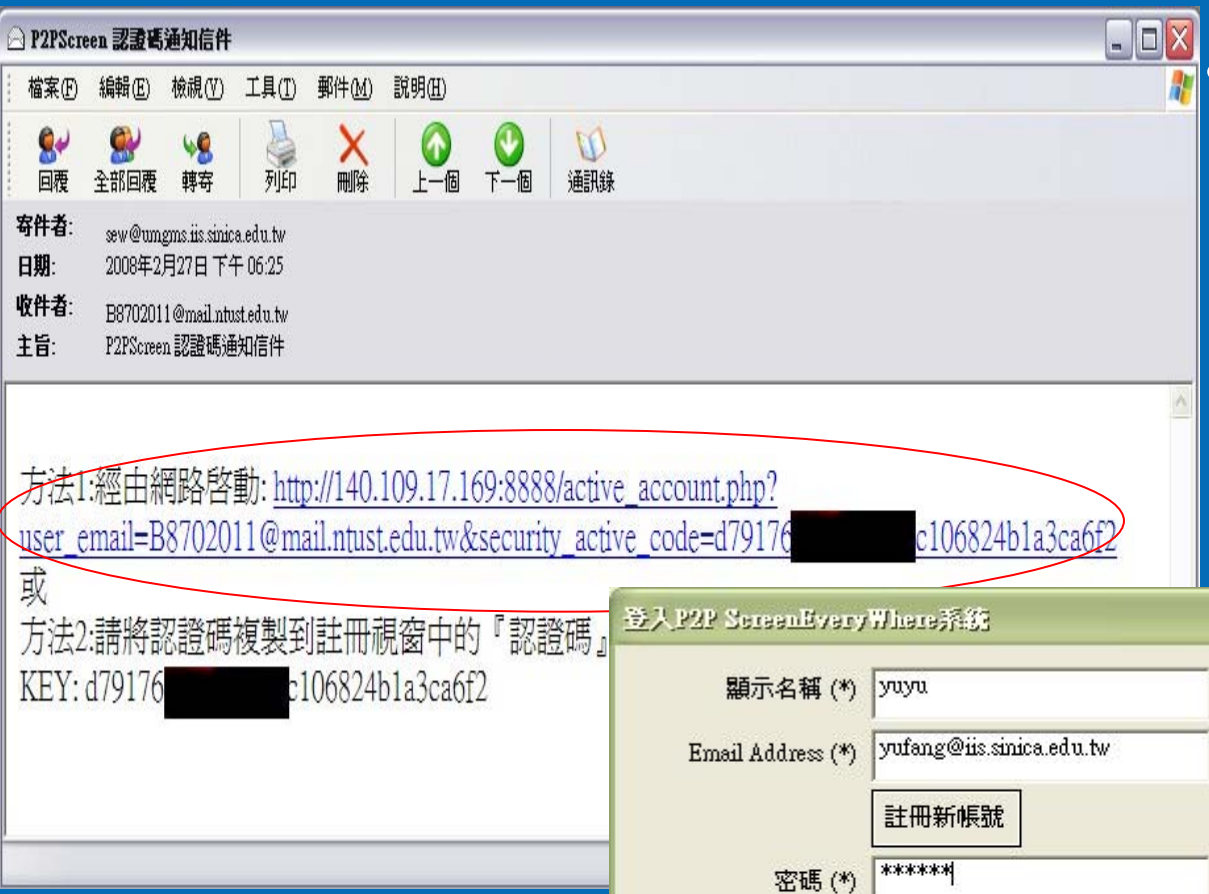
- **Directory Server**
  - Registration and authentication
  - Buddy list of each user
  - User's online status
- **Multiple-access Control Unit (MCU)**
  - Relay screen (1-to-m) and desktop control (m-to-1)
  - Handle many sessions simultaneously (virtual meeting room)
- **User peer**
  - An address book of groups of friends
  - Display remote screen and share the local screen to others
  - Coordinate control requests for the local desktop
  - A text-based chat room
  - System control parameters

User registration

- Name
- E-mail
- Password

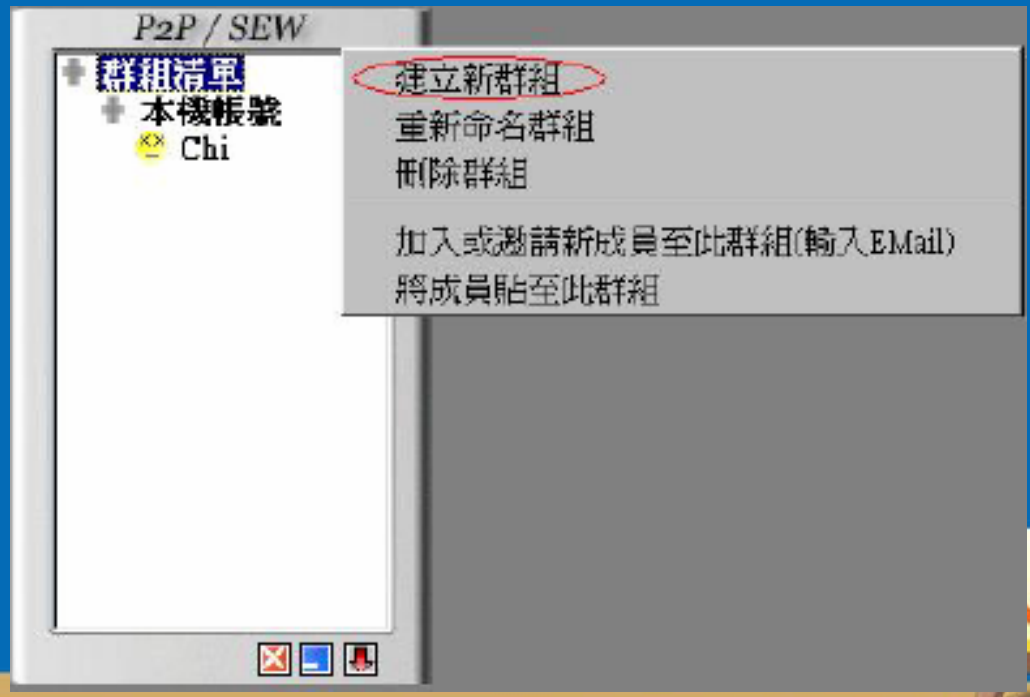
Authentication

- **Account Activation**
  - Hyperlink
  - Authentication code

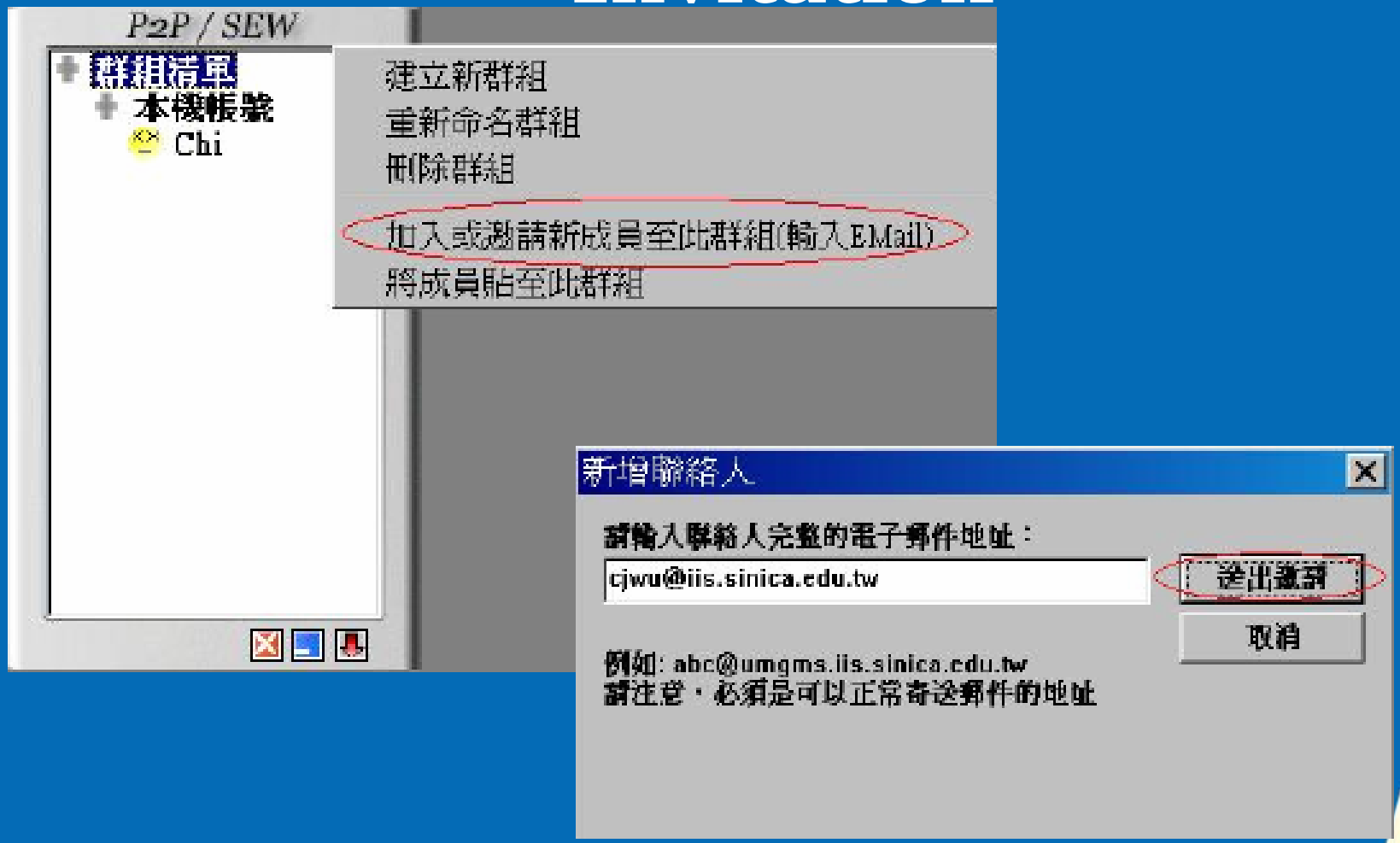


Main Program

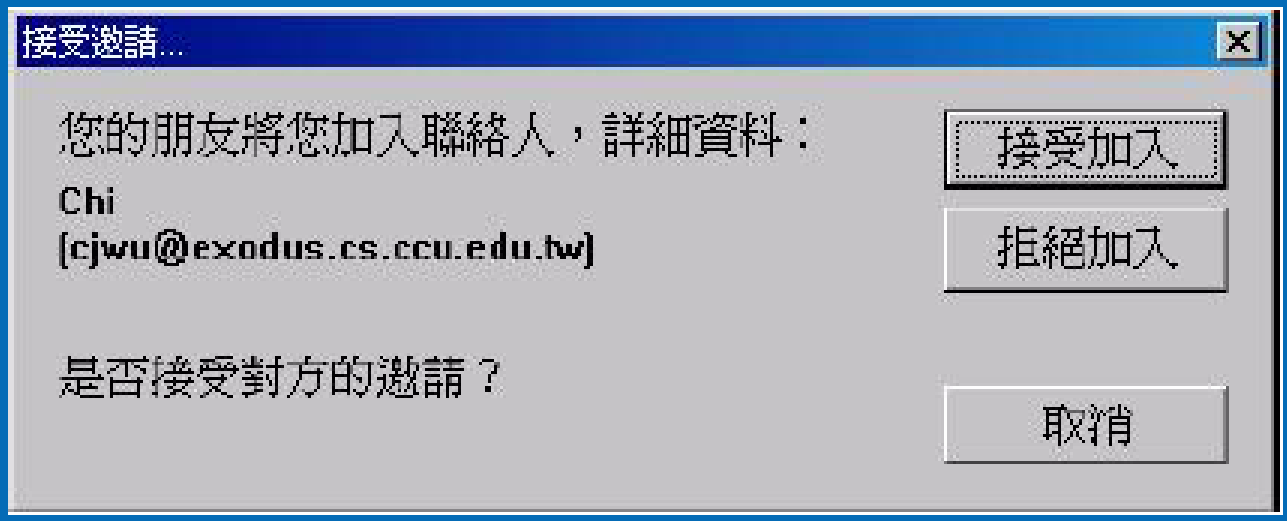
- **Buddy list**
  - Create your own groups



Invitation

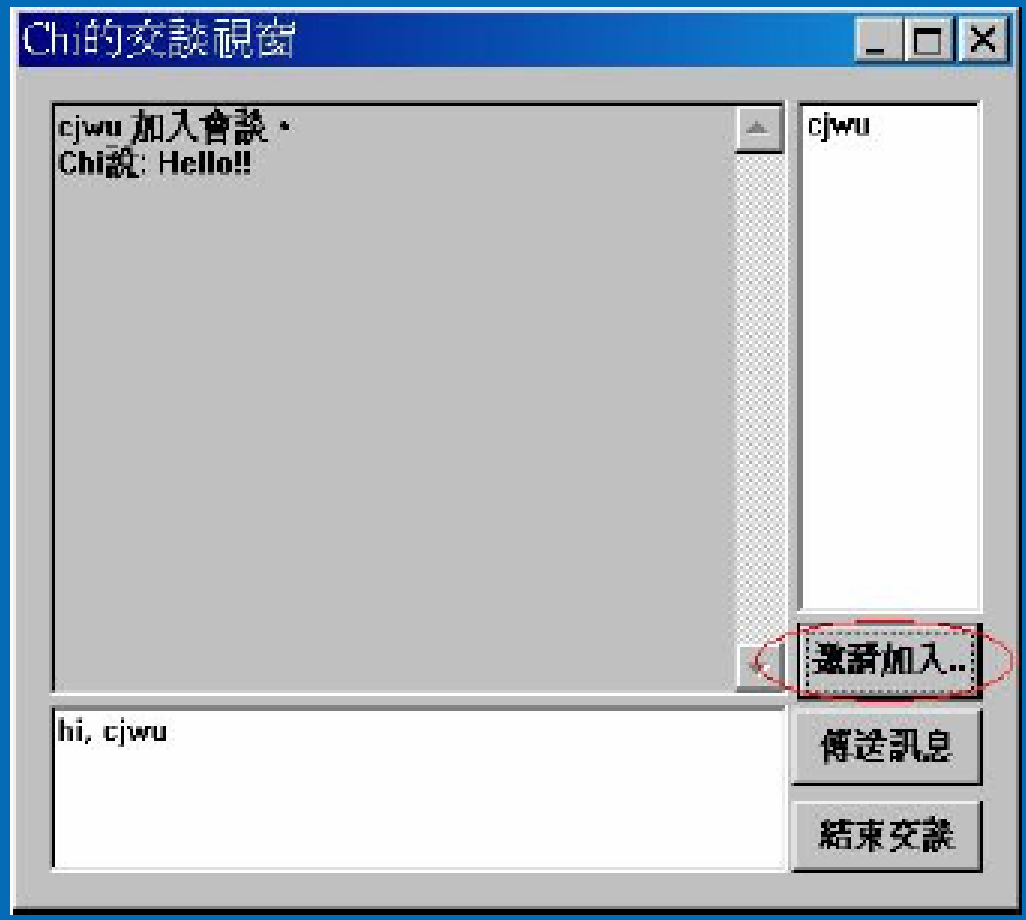

P2P / SEW
群組清單
本機帳號
Chi
建立新群組
重新命名群組
刪除群組
加入或邀請新成員至此群組(輸入EMail)
將成員貼至此群組
新增聯絡人
請輸入聯絡人完整的電子郵件地址：
cjwu@iis.sinica.edu.tw
送出邀請
取消
例如: abc@umgms.iis.sinica.edu.tw
請注意，必須是可以正常寄送郵件的地址

Accept ?

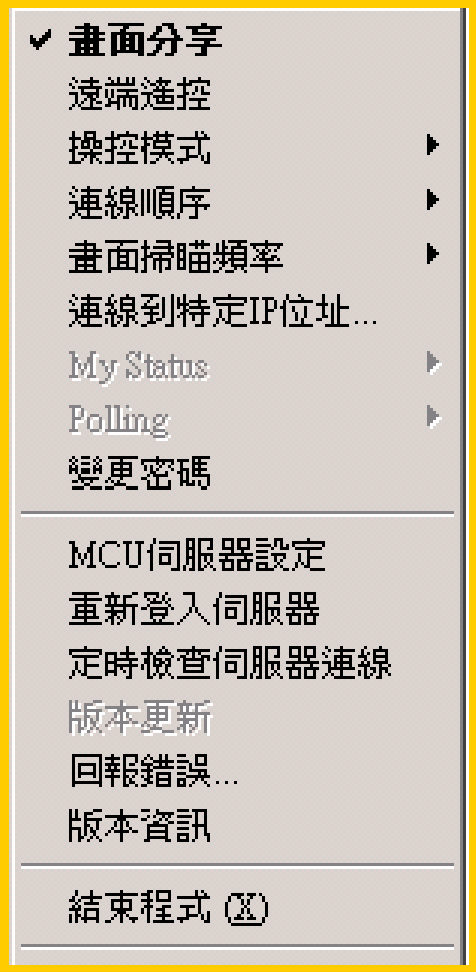

接受邀請...
您的朋友將您加入聯絡人，詳細資料：
Chi
(cjwu@exodus.cs.ccu.edu.tw)
是否接受對方的邀請？
接受加入
拒絕加入
取消


P2PScreen
cjwu@iis.sinica.edu.tw 已接受您的邀請!!
確定

Text-based Chat Room

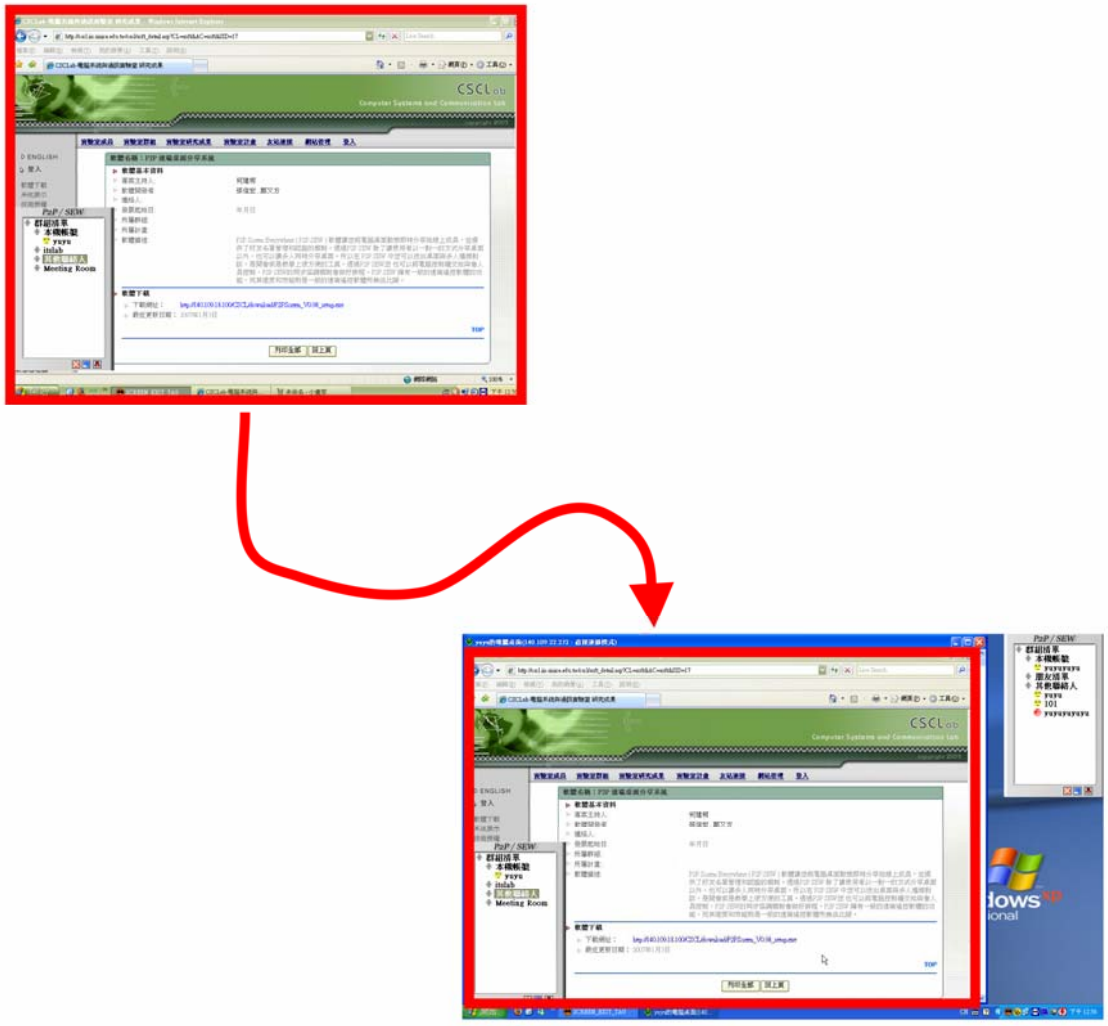


Features

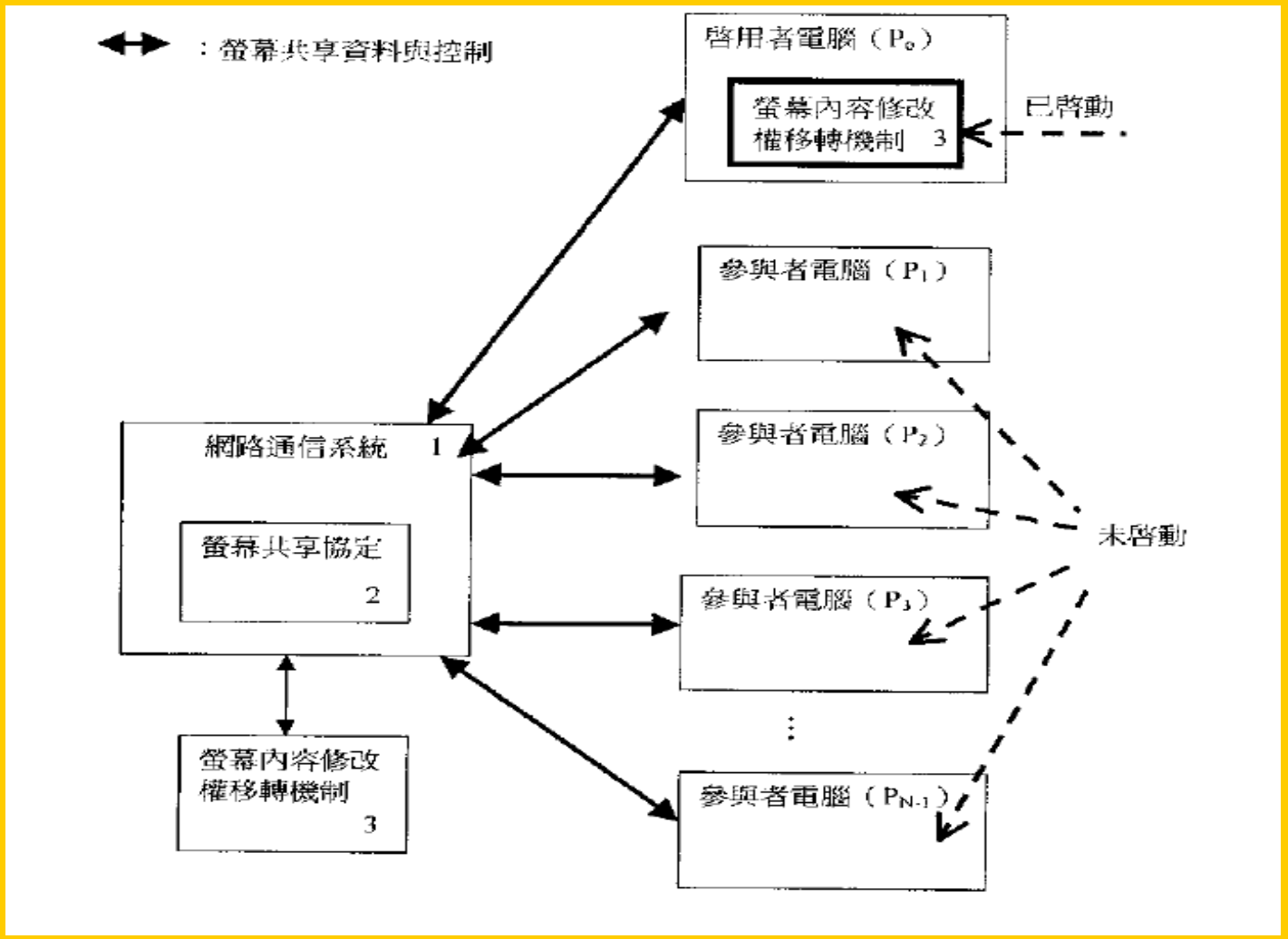


- **P2P mode v.s. MCU mode**
- **Options: Connect by IP address**
- **Remote control**
  - Authenticate or not

Screen Sharing



Active Operation Transfer



Mechanism of Active Operation Transfer

- **When multiple clients sharing a common desktop**
  - The server-side has the primary mouse/keyboard control privilege
  - All of the participating clients could compete for control privilege when server-side is idle

Conclusions

- **An effective application control, called "Sporadic Control " mechanism is presented**
  - Reduces the CPU utilization and guarantee the screen recording quality
  - Smoothly records full motions on screens
- **A "Server-based Key-frame Maintenance" mechanism is presented for supporting live streaming applications**
  - Protect the screen record system and network from instantaneous heavy workload
- **A semi-centralized P2P SEW application**

Patents

- **US 6,864,901, "Real-time Screen Recording System",**
  - Shin-Hung Chang, Shao-Ting Lee, Jan-Ming Ho
- **TI235333, "即時螢幕擷取系統",**
  - 張信宏, 李紹鼎, 何建明
- **TI268071, "供多人共同操作單一電腦螢幕之主動式操作控制權轉移裝置及方法",**
  - 張信宏, 何建明

Technology Licensing

- **Gormmy Technoology (Taiwan)**
  - Distance Learning System
- **Proxy Network (USA)**
  - P2P Screen Everywhere System
  - Conference application

Future Work

- **Better system scalability**
  - P2P presence directory