A collection of items including a chessboard, medals, a compass, and glasses. The chessboard is in the top left, with several pieces visible. There are two medals: one with a red ribbon and a white star, and another with a blue ribbon and a white star. A compass is in the bottom left, and a pair of glasses is in the center. The background is a light-colored surface.

# *Open Source Applications in Networking*

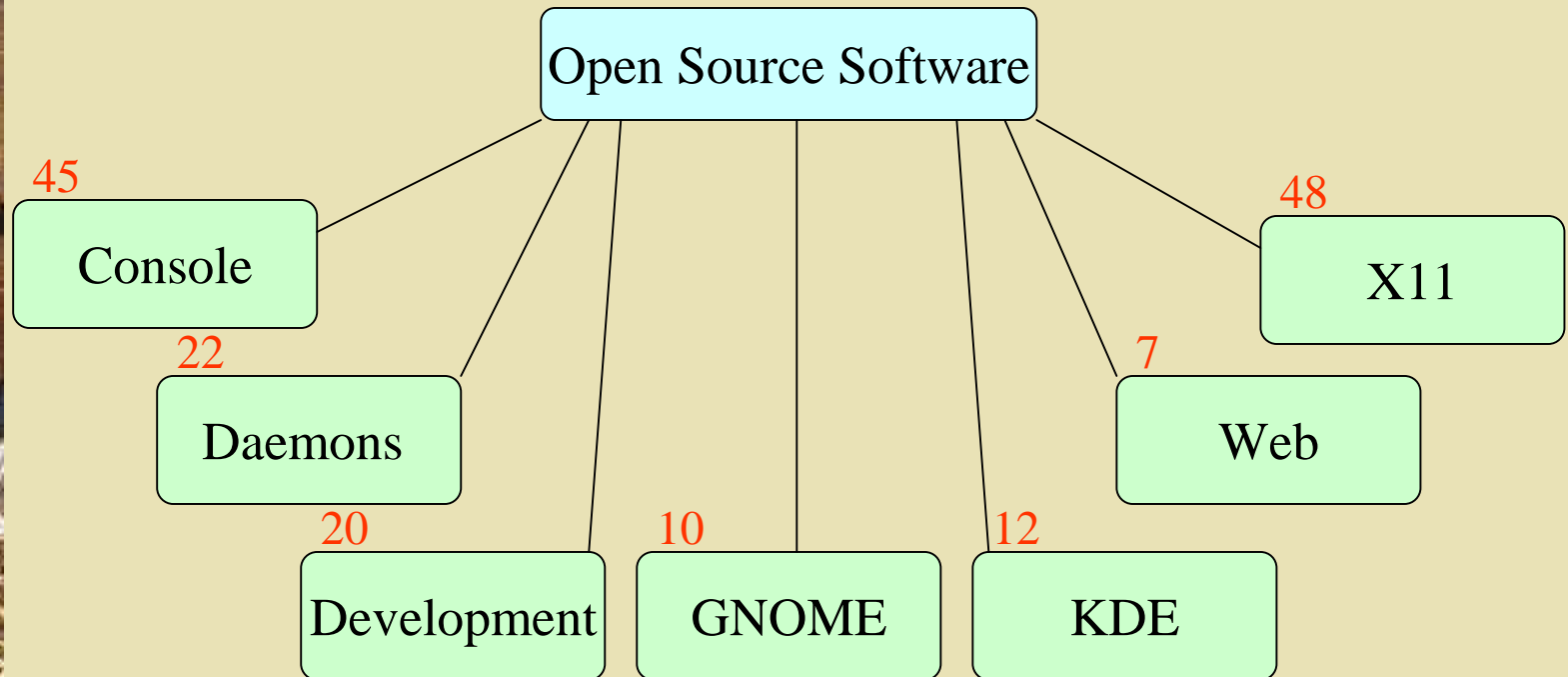
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**August 4, 2001**



# Agenda

- ◆ Open Source Resources
  - Taxonomy of over 10,000 packages
  - Business models
  - Why open source solutions?
- ◆ Product Lines
  - General categories: client, networking, server
  - Networking devices: access, core, service
- ◆ Live Examples from My Lab at NCTU
  - Policy-based bandwidth manager
  - Security gateway with VPN, firewall, IDS
  - Mail server clustering for enterprise outsourcing services

# Open Source “Repository”



*For an up-to-date review of the development, licensing, and business models of open source, see “Ming-Wei Wu and Yind-Dar Lin, An Overview of Open Source Development, IEEE Computer, June 2001”.*





# *Hierarchy of [Console/GNOME/KDE/X11]*

68

Console/ GNOME/KDE/X11

[247] Administration  
[019] AfterStep applets  
[019] Anti-Spam  
[119] Applications  
[048] Backup  
[008] Browser Addons  
[023] CAE  
[034] CD Writing Software  
[196] Communication  
[030] Compression  
[009] Core  
[130] Database  
[063] Desktop  
[027] Development  
[006] Dialup Networking  
[055] Documentation  
[108] Drivers  
[088] Editors  
[062] Education  
[165] eMail  
[008] Embedded  
[088] Emulators  
[068] Encryption

[028] Enlightenment Applets  
[023] FTP Clients  
[044] File Managers  
[052] Filesystems  
[051] Financial  
[179] Firewall and Security  
[026] Fonts and Utilities  
[593] Games  
[277] Graphics  
[008] Home Automation  
[103] IRC  
[053] Java  
[074] Log Analyzers  
[208] MP3  
[010] Mail Clients  
[051] Mini Distributions  
[021] Mirroring  
[351] Misc  
[028] Modelling  
[007] Modem gettys  
[184] Monitoring  
[003] Motif

[032] Multimedia  
[480] Networking  
[048] News  
[053] OS  
[048] Office Applications  
[042] Packaging  
[053] Printing  
[189] Scientific Applications  
[007] Screensavers  
[031] Shells  
[265] Sound  
[136] System  
[041] TV and Video  
[011] Terminals  
[190] Text Utilities  
[665] Utilities  
[004] VRML  
[033] Video  
[038] Viewers  
[684] Web Applications  
[038] Web Browsers  
[121] Window Maker Applets  
[039] Window Managers

# *Hierarchy of [Daemons]*

24

## Daemons

[007] Anti-Virus  
[005] Batch Processing  
[030] BBS  
[010] Chat  
[032] Database  
[026] DNS  
[015] Filesharing  
[009] Finger  
[022] FTP  
[006] Hardware  
[097] HTTP  
[013] Ident  
[013] IMAP

[050] IRC  
[015] Mailinglist  
Managers  
[231] Misc  
[027] MUD  
[009] Network  
Directory Service  
[013] NNTP  
[023] POP3  
[071] Proxy  
[031] SMTP  
[005] SNMP  
[002] Time

23

## Development

[010] Bug Tracking  
[068] Compilers  
[014] CORBA  
[073] Database  
[038] Debugging  
[084] Environments  
[028] Game SDK  
[048] Interfaces  
[173] Java Packages  
[028] Kernel  
[001] Kernel Patches  
[121] Languages  
[485] Libraries

[100] Perl Modules  
[008] PHP Classes  
[001] Pike Modules  
[057] Python Modules  
[031] Revision Control  
[019] Tcl extensions  
[017] Test Suites  
[558] Tools  
[178] Web  
[055] Widget Sets

# *Business Models (1/2)*

## *with Open Source Solutions*

### Case 1 Software (desktop clients/servers)

**Free core** Non free accessories

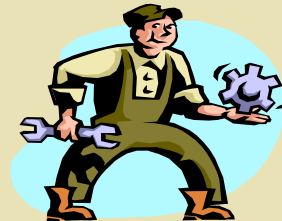
e.g. Sendmail Inc.

### Case 2 Services



Free software

Charged service



e.g. RedHat

### Case 3 ASP



Appz



e.g. lots of portals,  
ASP, and ...  
MSN hotmail !!

# *Business Models (2/2)*

## *with Open Source Solutions*

### Case 4 **Embedded clients/servers/networking**



e.g. Cobalt (Sun),  
VA Linus, Juniper,  
Packeteer, F5, Sitara,  
and a lot more....

### Case 5 **User Feedback**



free →



← money

if satisfied

### Case 6 **Add-on values**



e.g. RedHat  
Roller coaster!! \$151 ~ 1





# *Why Open Source Solutions?*

- ◆ Abundant open source resources
  - Over 10,000 packages
- ◆ Cost of development and ownership
  - No license fee, royalty
- ◆ Better code quality and higher availability
  - Worldwide contributors, fast patches
- ◆ Time to market



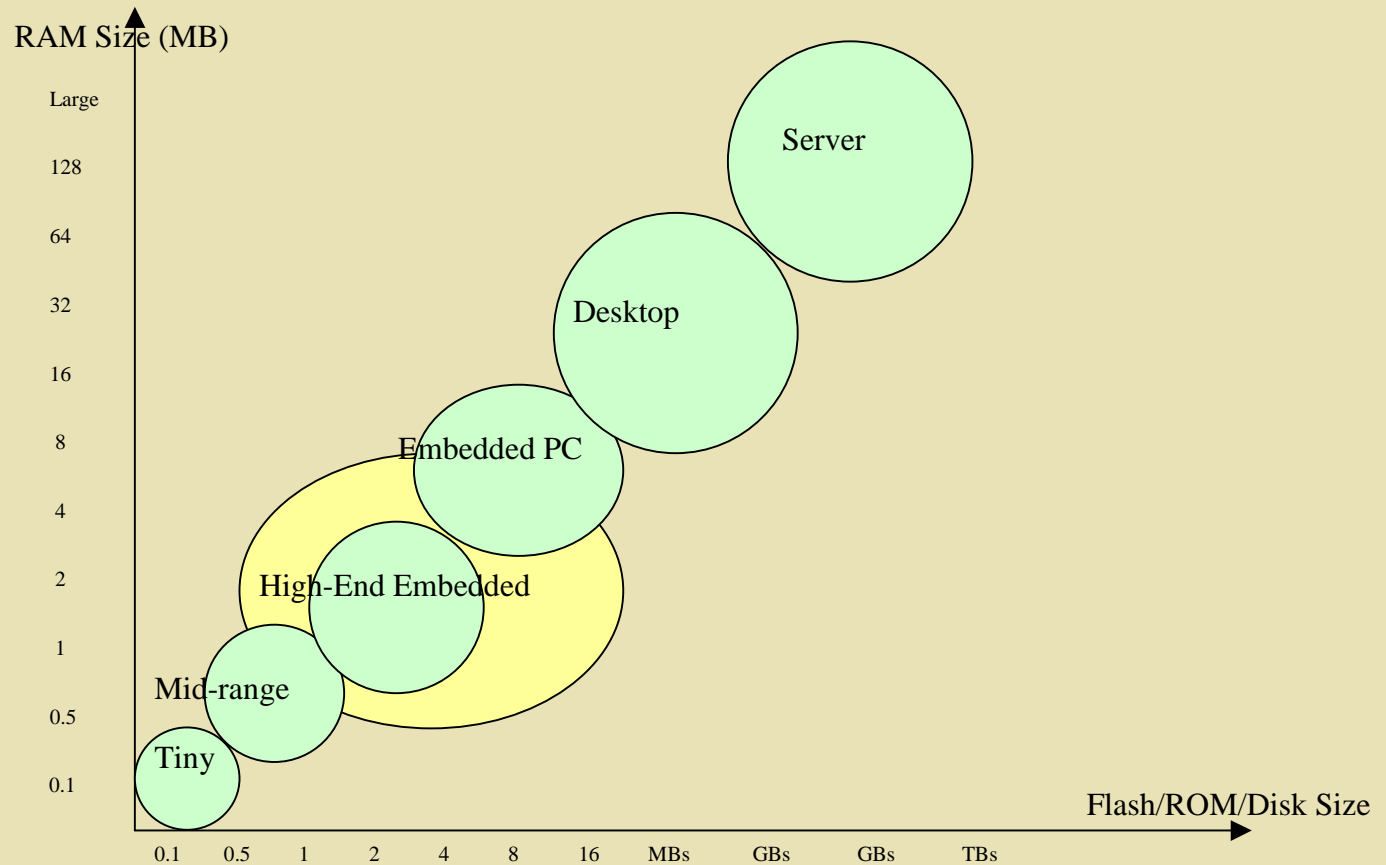
# Commercial Embedded OSs

## VxWorks, QNX, ChorusOS, pSOS, WinCE

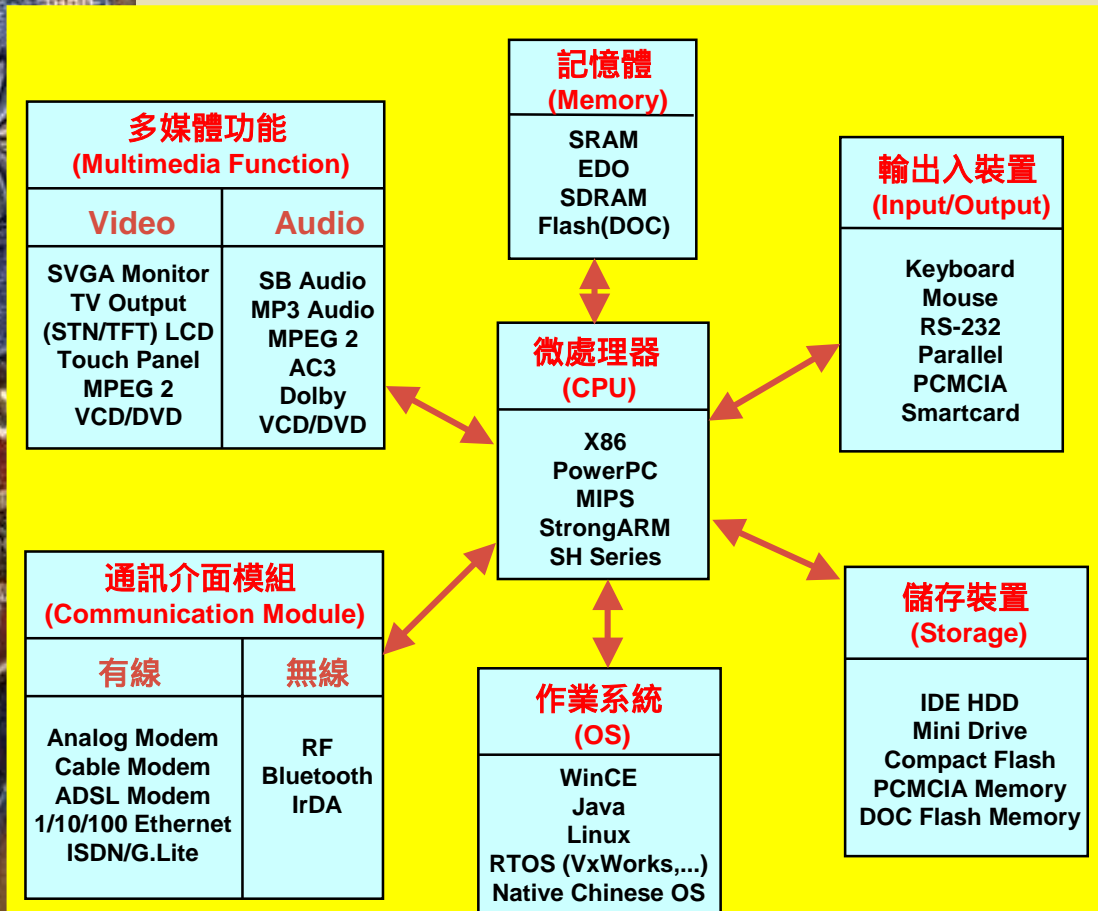
	VxWorks	QNX	ChorusOS	pSOS	Windows CE
Sales	\$130M (\$20M royalty)	\$20M	\$20M	\$105M (\$15M royalty)	\$3M royalty (FY99) \$2M Tools
Profit Margin %	8.7% (SEC filing)	<i>Unknown. &lt;10%</i>	<i>Unknown</i>	9% (SEC filing)	
Direct Sales Force	Approx 250 (Worldwide)	Approx 40	<i>Original sales force, around 20 + Sun influence</i>	<i>Approx 200 (Worldwide)</i>	<i>Approx 12 (Worldwide)</i>
Market Share	15%	2%	2%	12%	<2%
Tools Price (per seat)	\$7,500 - \$10,000 (Based on a 10 seats license)	\$2,995 per seat (3 <sup>rd</sup> party tools)	\$23,000 initial seat, \$4,000 for the following seats	\$4,995 by seat Depends on the options	\$995
Royalty	\$1-\$35 There is no real fixed price for licensing	Component-based pricing \$3-\$80	Low-end \$15 Mid-Range \$58 High-End \$109	Range from < \$1 up to \$30	Range from < \$5 up to \$30+
Distribution Model	Direct; 3 distributors in Japan	Mixed – direct for large market; 40 distributors for smaller market	Direct only	Direct; 16 distributors	Direct (>25,000 units) Distributors
Focus	Digital imaging, telecom/datacom, CE, automotive	Industrial automation, medical systems, CE, telecom/datacom	Telecommunications	Automobile industry, some CE (interactive television)	Higher-end applications; ADCU has focused on Manufacturing, Retail, Healthcare
Strengths	<ul style="list-style-type: none"> <li>◆ Most complete integrated environment</li> <li>◆ Largest coverage of CPU and hosts</li> </ul>	<ul style="list-style-type: none"> <li>◆ True micro-kernel architecture</li> <li>◆ Complete POSIX compliant</li> <li>◆ Most scalable</li> </ul>	<ul style="list-style-type: none"> <li>◆ Exceptional reliability and high availability</li> <li>◆ Optimized for telecommunications</li> </ul>	<ul style="list-style-type: none"> <li>◆ Integrated development environment</li> <li>◆ Optimized for Motorola processors and DSPs</li> </ul>	<ul style="list-style-type: none"> <li>◆ Win32</li> <li>◆ NT Connectivity</li> <li>◆ Robust graphics/UI</li> </ul>

Ying-Dar Lin

# *Product Line: Size Matters*



# Components for Embedded Systems



## 處理器 (CPU)

2 bit CISC/RISC architecture  
performance (MIPS)  
Power Consumption

## 記憶體 (Memory)

-128MB DRAM (SDRAM/EDO)  
- 16 MB Flash Memory  
various size for different applications

## 儲存裝置 (Storage)

IDE HDD (large capacity)  
small form drive  
Flash Memory (PCMCIA/DOC/Compact)

## 通訊介面模組 (Communication Module)

dedicated (analog modem/Cable/ADSL/Ethernet/ ISDN)  
wireless(RF/Bluetooth/IrDA)  
dedicated media for various applications



# Product Lines: Client-Side

*Analog Modem*  
*Cable Modem*  
*ISDN Modem*  
*XDSL Modem*  
*G Lite*  
*ATM*



**Set up Box**



**Thin Client &  
Windows-based Terminal**



**Home Entertainment**



**Web Phone**



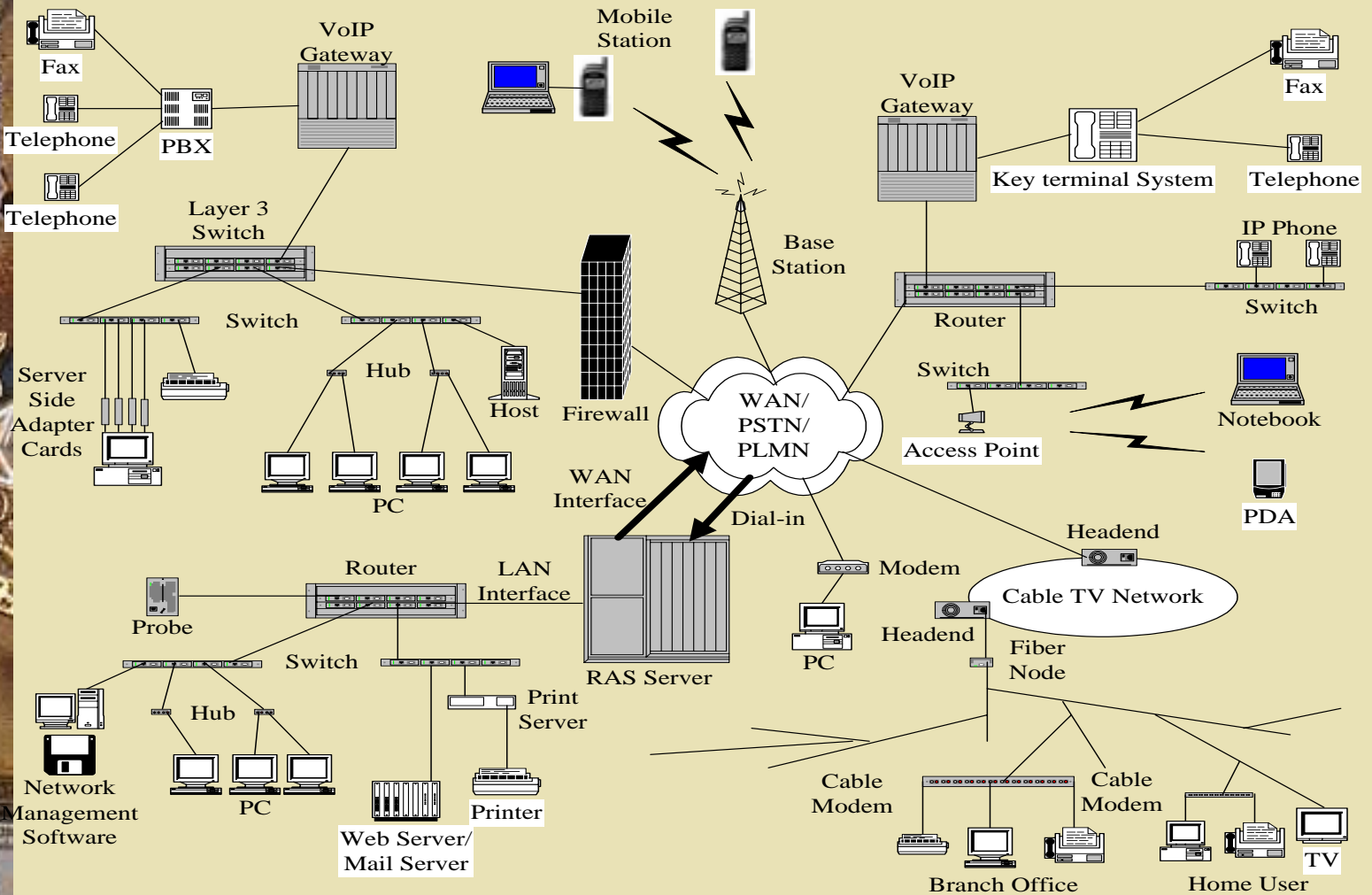
**Internet Box**

**ANATOMY OF A POS SYSTEM**



**Point of Sales**

# Product Lines: Network-Wide



# Network Equipment Providers

## Access

### LAN

Adapter  
HUB  
Layer 2 switch

### WAN

Modem  
56K  
ISDN  
DSL  
Cable

### STB

Access Server  
RAS  
Broadband Access Headend

### Wireless

Adapter Card  
Access Point  
Mobile handset/PDA  
Blue tooth

### Tx Media

Gbit Ethernet  
DWDM  
SONET

## Core

### Router/ Multilayer Switch

Pure Router  
MPLS Switch

### Intranet

Network Security  
Bandwidth Management  
Home Gateway  
Layer 4-7/Web Switch

### IP Telephony

IAD  
VoIP Gateway  
IP Phone

## Service

### Enterprise Server

App. Server  
Web Server  
Mail Server  
Proxy Server  
NAS

Mng. Server  
DHCP Server  
DNS Server

### Remote Service/ Content Provider

ASP  
IDC  
UMS  
E-commerce  
Net Game  
portal  
media



# Network Service Providers

## Access

## Core

## Service

### Dial-in

### Wireless

GPRS

CSD

SMS

### Leased Line

64K

T1

T3

OC3

OC12

### Broad-band

ADSL

Cable Modem

### Infrastructure (lines)

optical

Micro-ware

satellite

### ISP

### Inter-ISP

### Service

Message

UMS

Storage

IDC

ASP

E-commerce

game

### Content

Portal

Media



# *Hot Products*

- ◆ Client:
  - STB, Web TV, Web phone, Web terminal, PDA, WAP handset, MP3 player, etc.
- ◆ Server:
  - All-in-one intranet server, mail server, FAX server, message server, proxy server, cache server, storage server, directory server, streaming server, etc.
- ◆ Network:
  - Security gateway, home gateway, bandwidth manager, Web switch, etc.



## *Live Examples in My Lab at NCTU*

- ◆ Policy-based bandwidth manager
- ◆ Security gateway with VPN, firewall, IDS
- ◆ Mail server clustering for enterprise outsourcing services

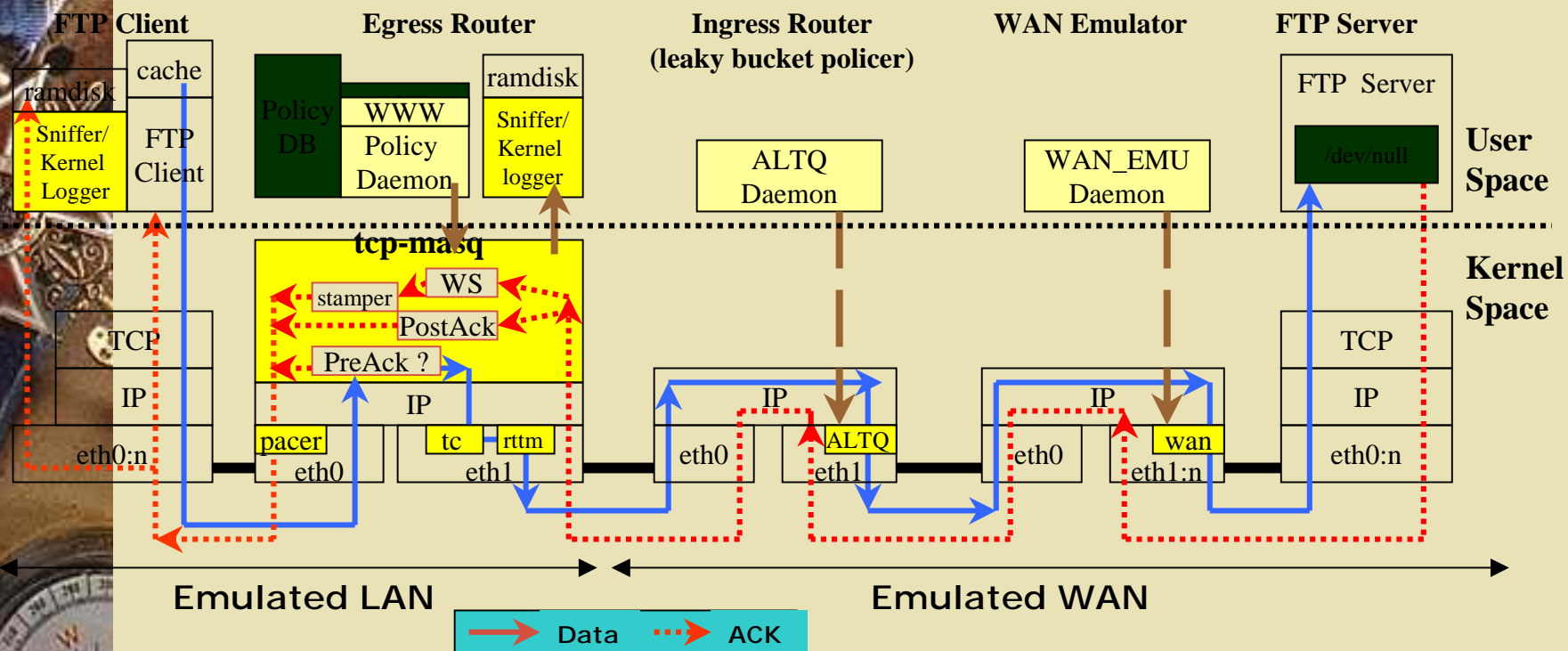
*.... to be released by the end of 2001!!*



# Policy-based Bandwidth Manager for TCP Rate Control at edge gateway

Objective:

Enforcing per-class/per-flow bandwidth management policy at edge routers, using new techniques (PostAck, PreAck) for low buffer requirement and stable TCP rate control

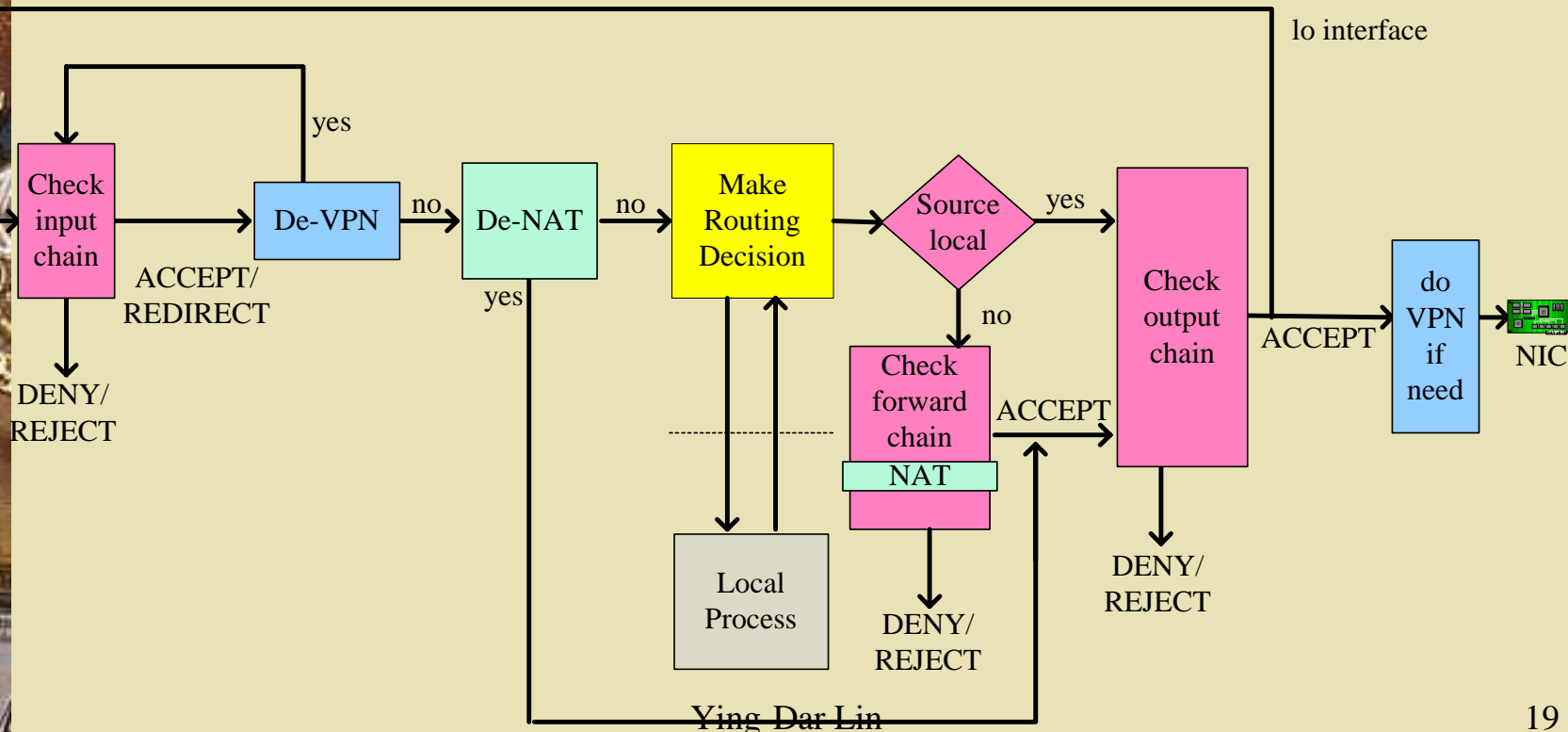


# Security Gateway

## Integrating VPN, Firewall, NAT, Routing, IDS

Objectives:

- (1) Integrating IPsec-based VPN, firewall, routing into Linux kernel
- (2) Creating a common platform for future QoS and security features





# *Packages used in Security Gateway*

Package Name	User-space Program	Kernel-space Program	Function	Package Size	Version
ipchains	Management tool	Kernel build in	Packet filtering firewall, and IP masquerade (MASQ)	63KB	1.3.9
Squid	Daemon	No	Cache server, transparent proxy, and URL filter	1104KB	2.3
TIS	Daemon	No	Application proxies, and web content filter	476KB	2.1
FreeS/WAN	Pluto Daemon	KLIPS kernel patch	IPSec with encryption, authentication, and Internet key exchange (IKE)	1252KB	1.5
Snort	Daemon	No	Intrusion detection	644KB	1.7

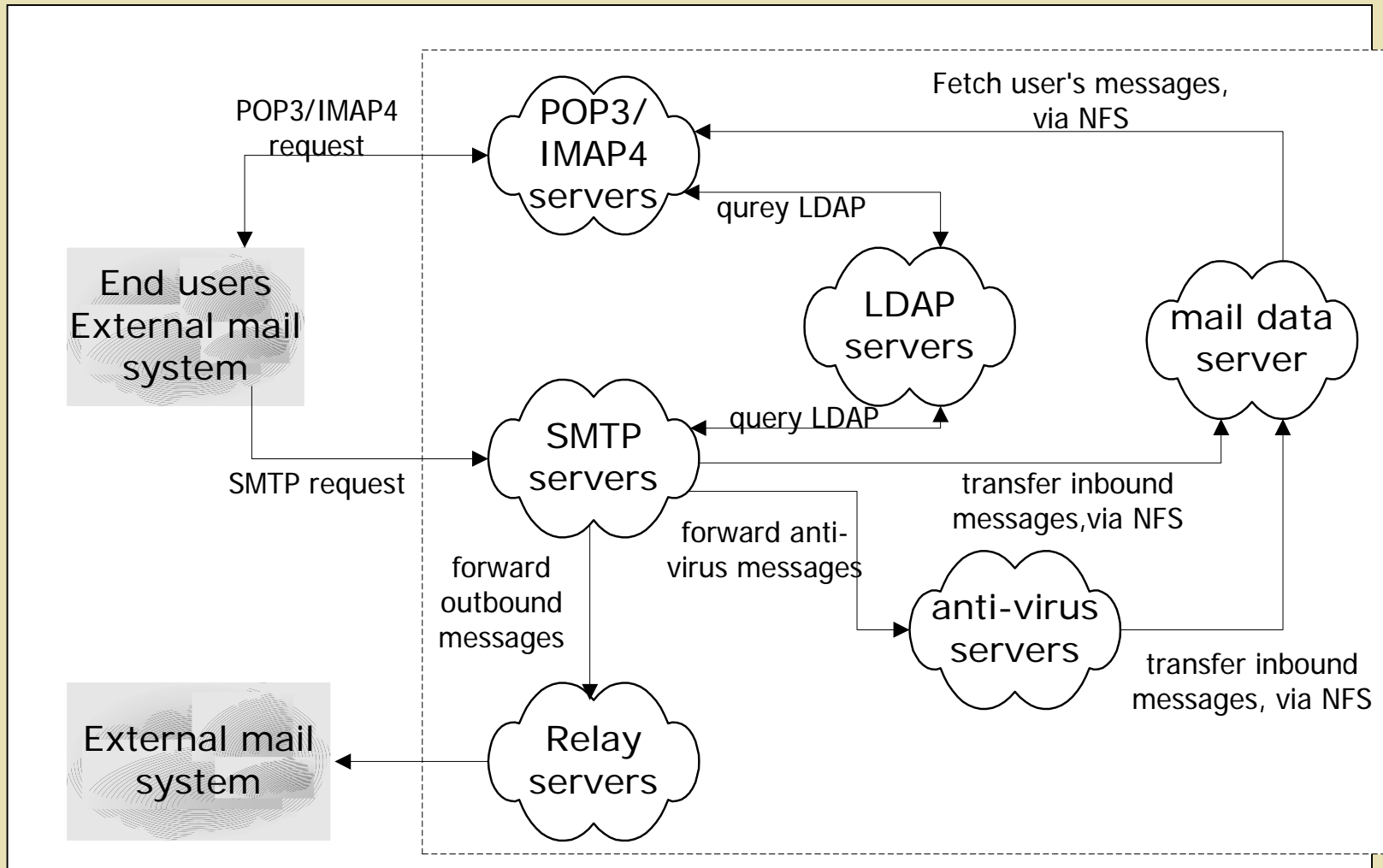
# *Mail Server Clustering for Enterprise Outsourcing Services*

Service provider	Web access	POP3 access	IMAP4 access	Anti-virus	Anti-spam	SSL support	Domain hosting	Account migration
Yahoo!mail [5]	Yes	Yes	No	Yes	Yes	Web access	Yes (for individuals)	No
Hotmail.com [6]	Yes	Yes	No	Yes	Yes	Web access	No	No
Critical Path [4]	Yes	Yes	Yes	Yes	Yes	Web/POP3/IMAP4 access	Yes (for enterprises)	No
USA.net [7]	Yes	Yes	Yes	Yes	Yes	Web/POP3/IMAP4 access	Yes (for enterprises)	Yes
Our system	Yes	Yes	Yes	Yes	Yes	Web/POP3/IMAP4 access	Yes (for enterprises)	Yes



# Architecture for Mail Server Clustering

## SMTP, POP3, IMAP4, LDAP, NFS Servers





# *Final Remarks*

- ◆ Abundant resources in open source communities
- ◆ Penetration of open source solutions
  - Server > networking > client
- ◆ Technical barrier of utilizing open source resources (domain knowledge + hands-on skills)
  - Networking > client > server
- ◆ 10% of your codes, leveraged by 90% of existing codes
- ◆ Be an open source user, administrator, and ... contributor/programmer!!