The background of the slide features a collection of items: a chessboard with several pieces, a red ribbon with a circular emblem, a blue ribbon with a circular emblem, two medals (one with a star and one with a cross), a pair of glasses, and a compass.

Open Source Applications in Networking

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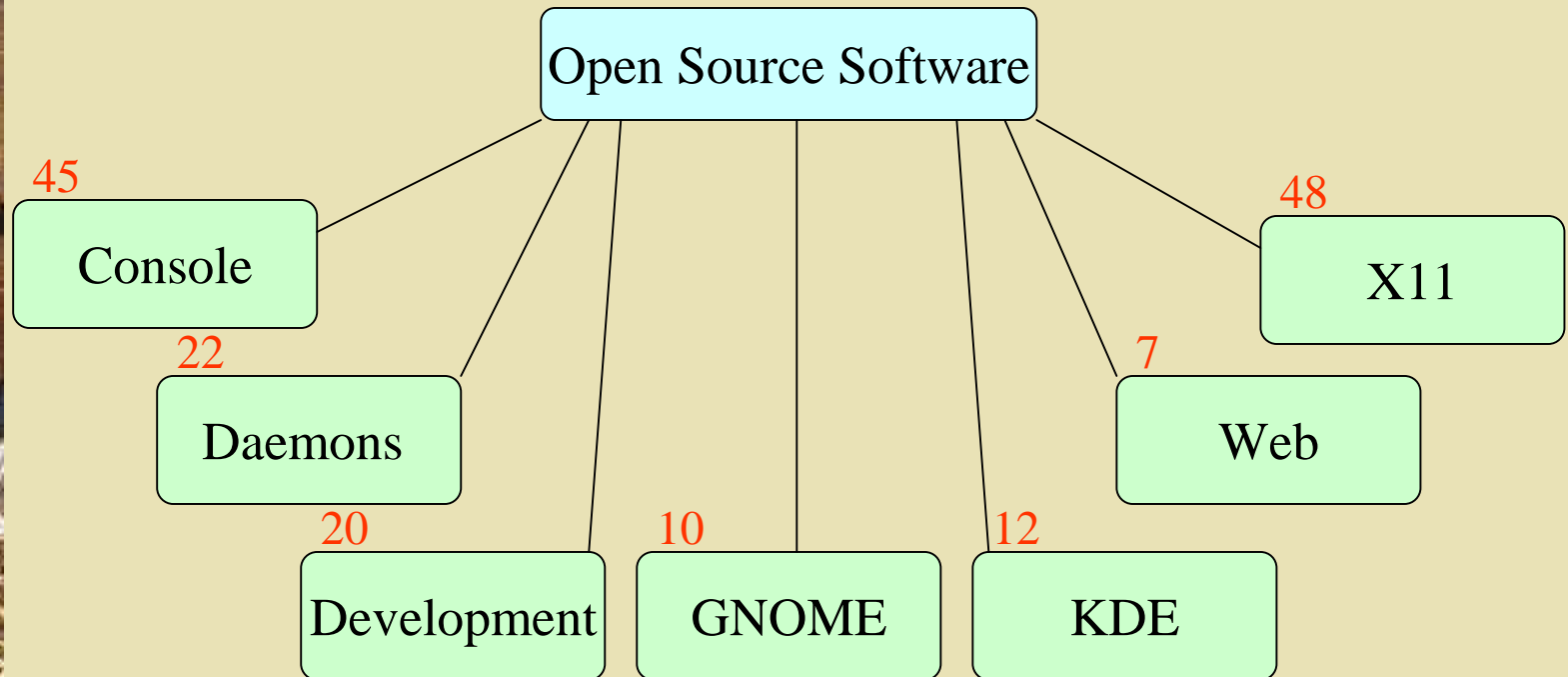
August 4, 2001



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

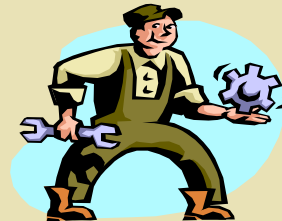
e.g. Sendmail Inc.

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

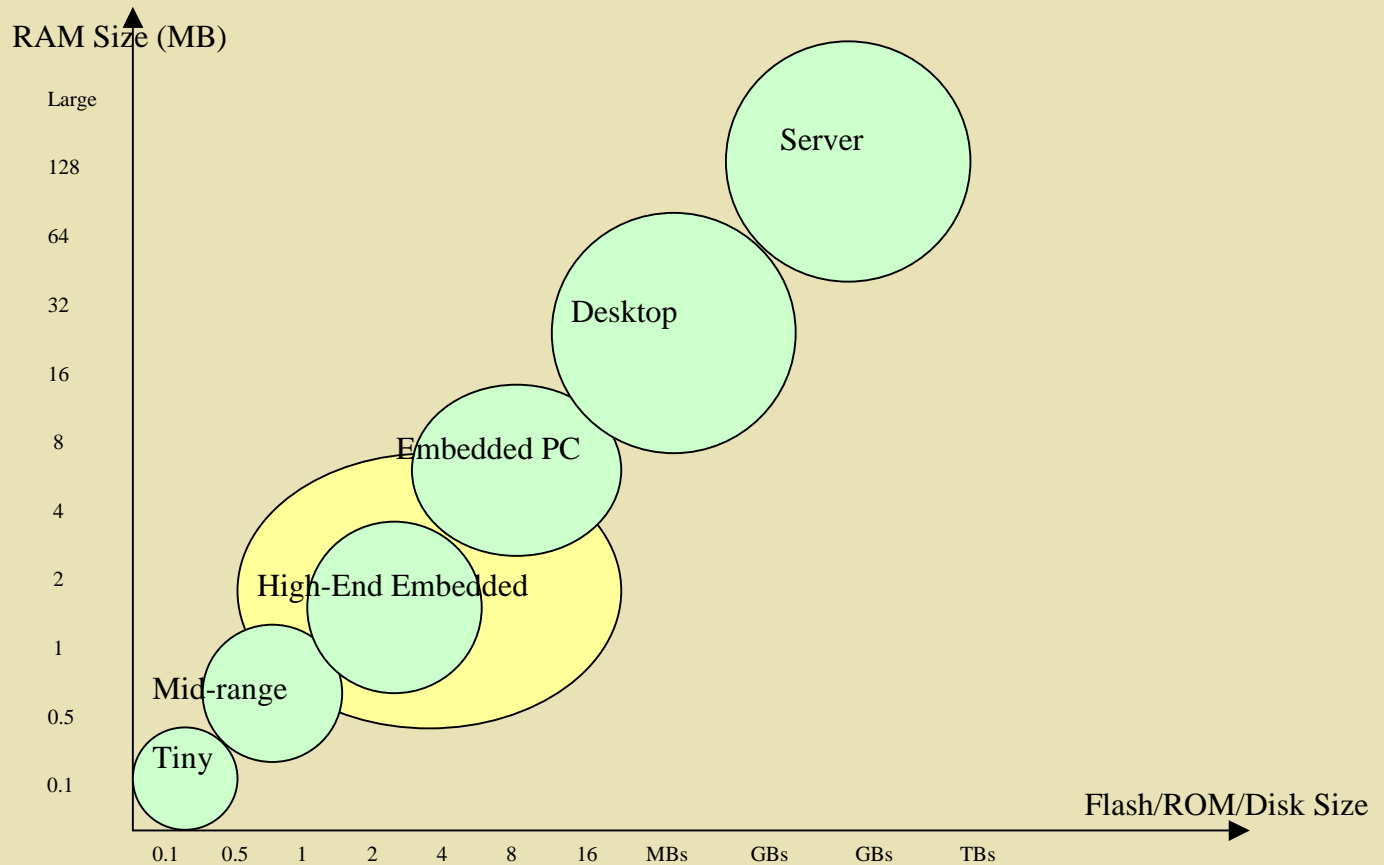
Commercial Embedded OSs

VxWorks, QNX, ChorusOS, pSOS, WinCE

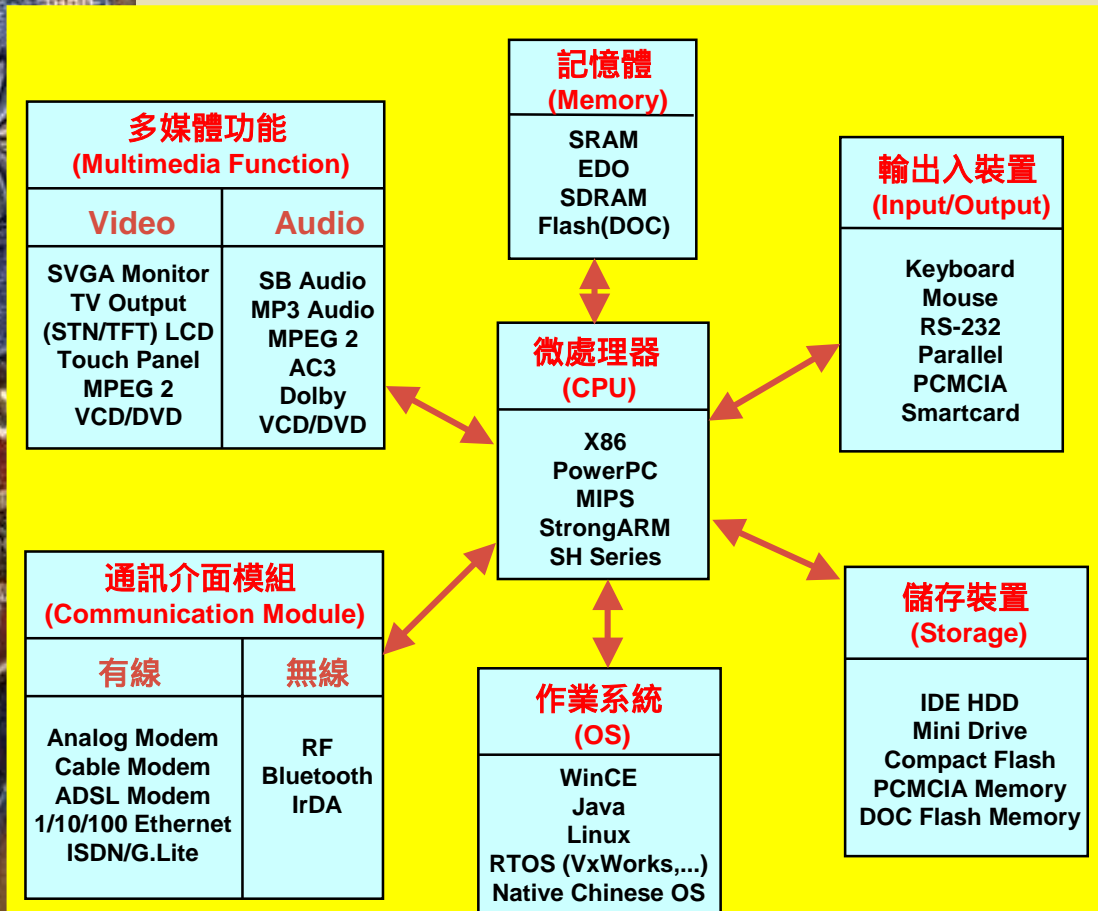
	VxWorks	QNX	ChorusOS	pSOS	Windows CE
Sales	\$130M (\$20M royalty)	\$20M	\$20M	\$105M (\$15M royalty)	\$3M royalty (FY99) \$2M Tools
Profit Margin %	8.7% (SEC filing)	<i>Unknown. <10%</i>	<i>Unknown</i>	9% (SEC filing)	
Direct Sales Force	Approx 250 (Worldwide)	Approx 40	<i>Original sales force, around 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 rd 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"> ◆ Most complete integrated environment ◆ Largest coverage of CPU and hosts 	<ul style="list-style-type: none"> ◆ True micro-kernel architecture ◆ Complete POSIX compliant ◆ Most scalable 	<ul style="list-style-type: none"> ◆ Exceptional reliability and high availability ◆ Optimized for telecommunications 	<ul style="list-style-type: none"> ◆ Integrated development environment ◆ Optimized for Motorola processors and DSPs 	<ul style="list-style-type: none"> ◆ Win32 ◆ NT Connectivity ◆ Robust graphics/UI

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)

- Wired (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



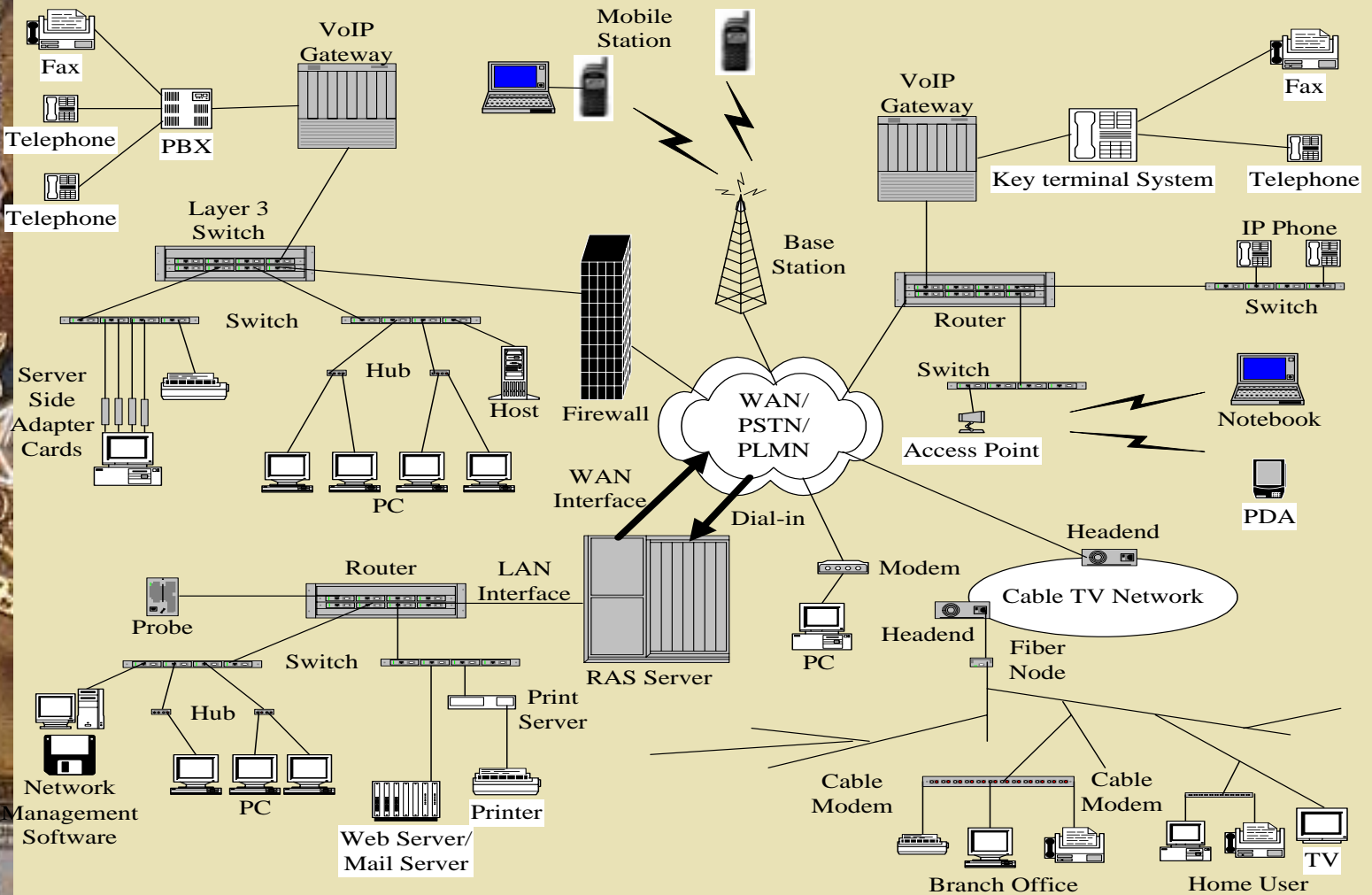
Internet Box

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

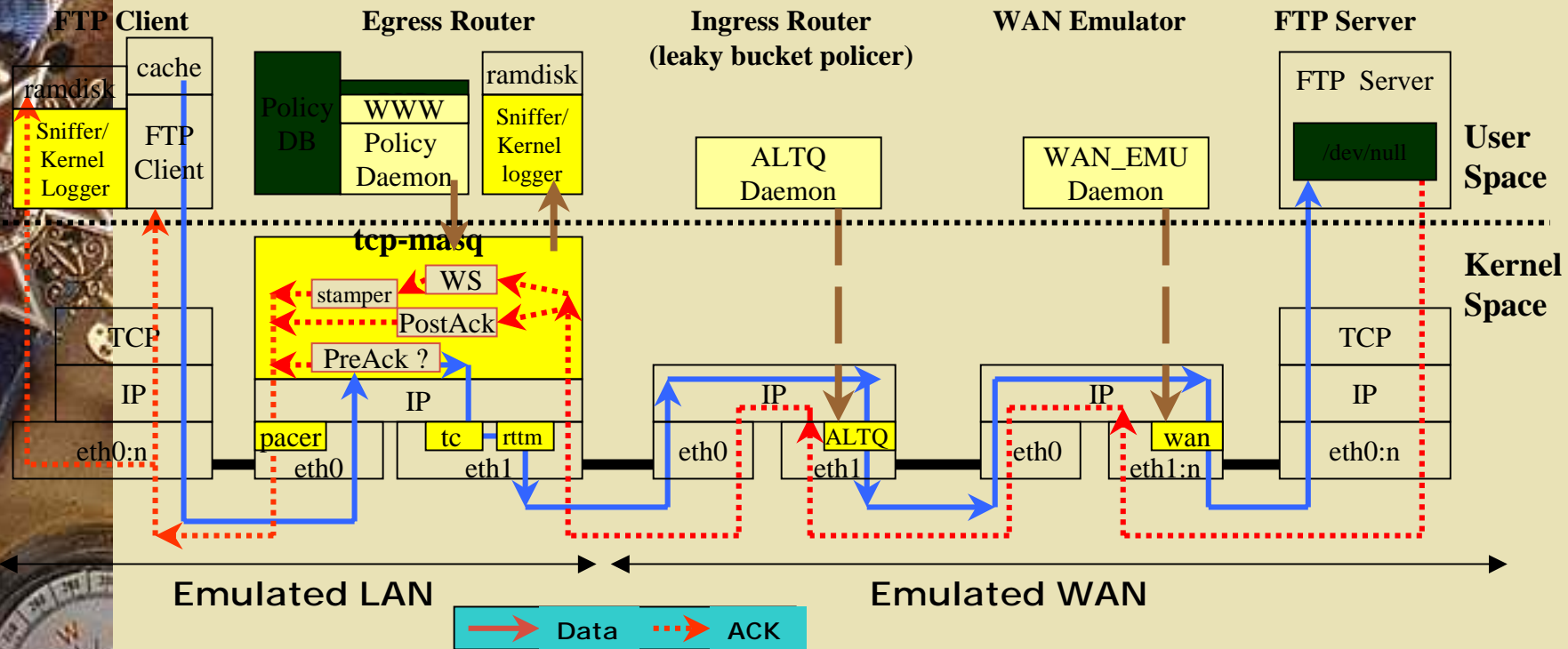
- ◆ Policy-based bandwidth manager
- ◆ Security gateway with VPN, firewall, IDS
- ◆ Mail server clustering for enterprise outsourcing services

.... 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

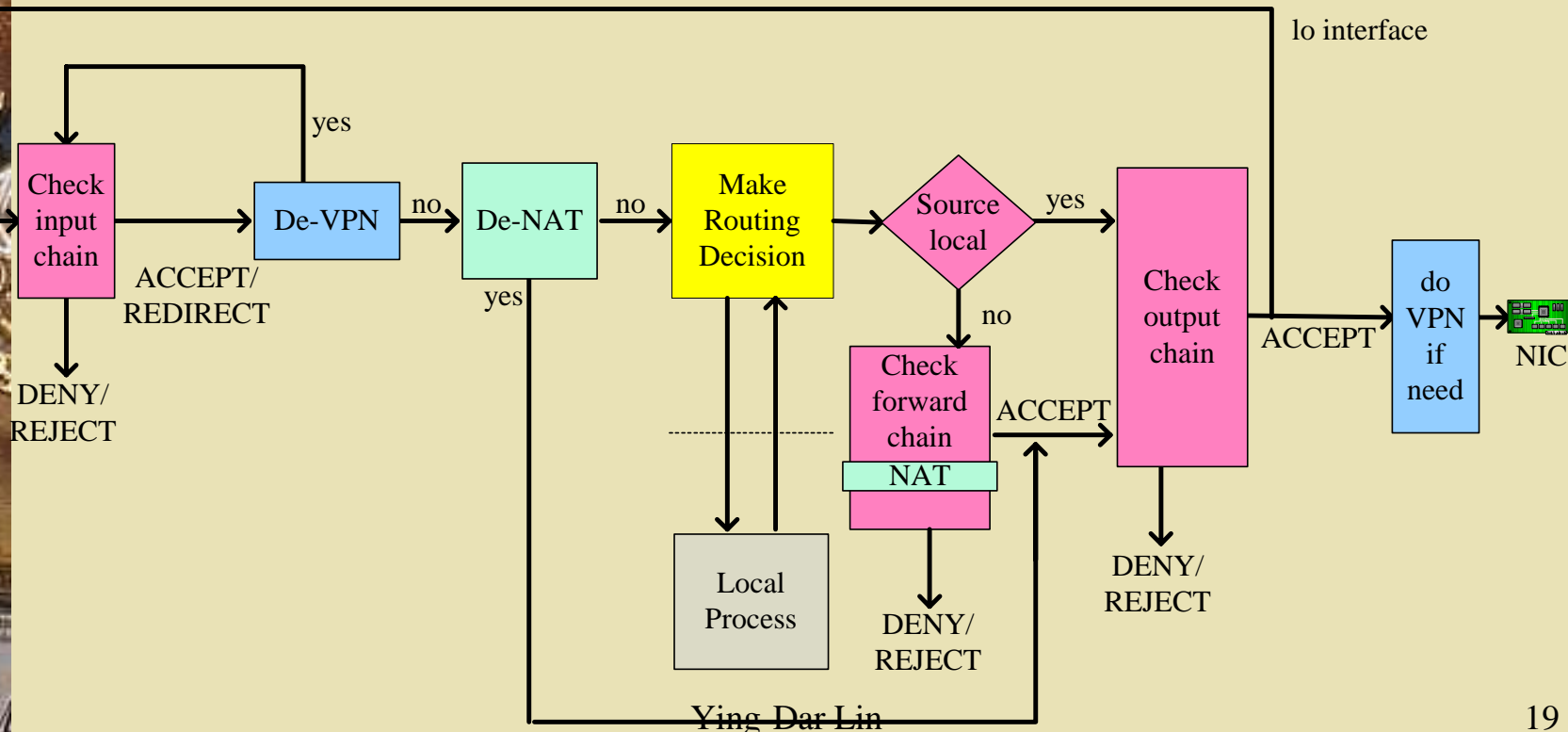


Security Gateway

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

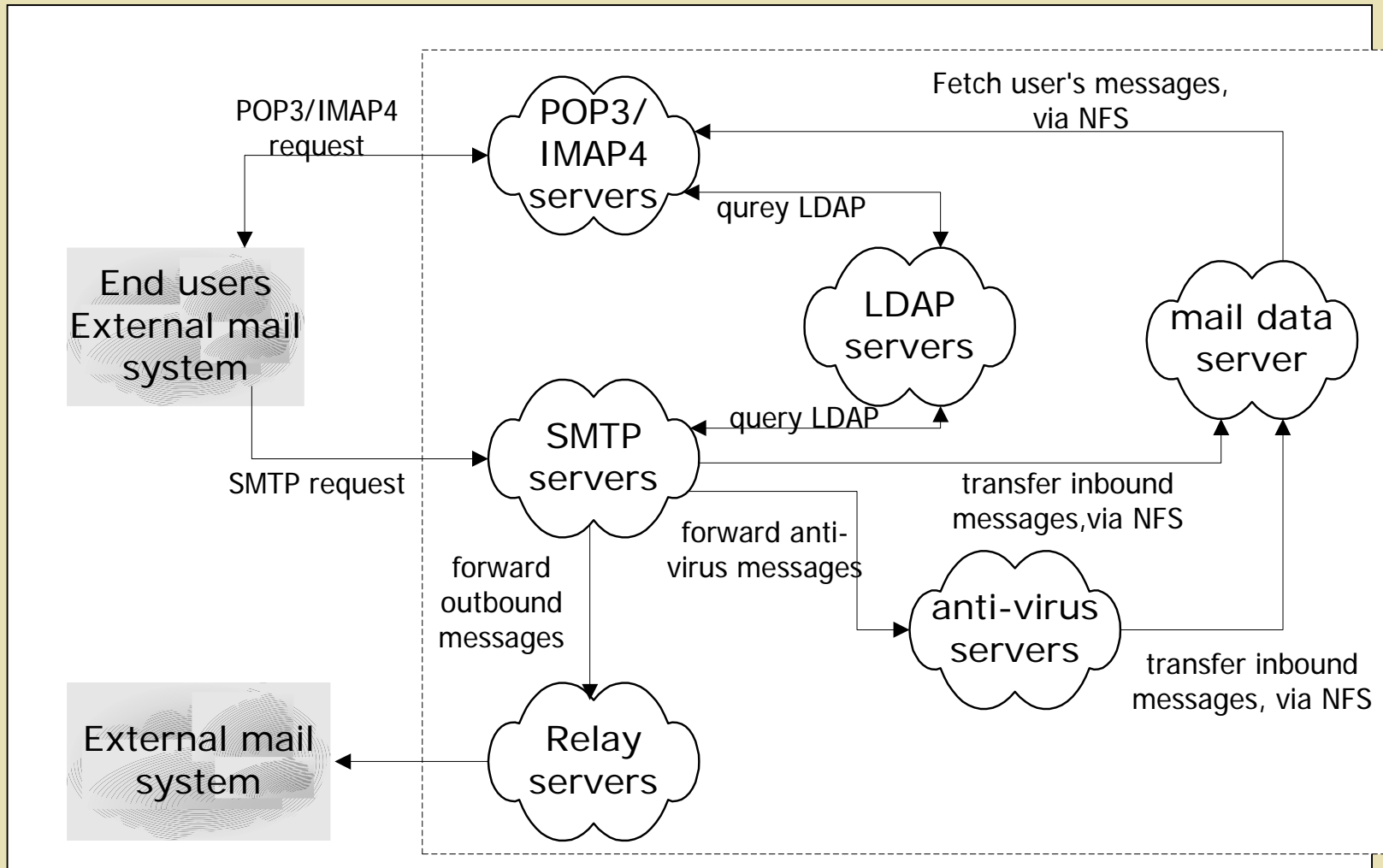
Package Name	User-space Program	Kernel-space Program	Function	Package Size	Version
ipchains	Management tool	Kernel build in	Packet filtering firewall, and IP masquerade (MASQ)	63KB	1.3.9
Squid	Daemon	No	Cache server, transparent proxy, and URL filter	1104KB	2.3
TIS	Daemon	No	Application proxies, and 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!!