Dialup IP: The Next Wave

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Network "Pipes" track

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Abstract

We are now seeing a proliferation of low-bandwidth solutions that make it much easier to extend IP networks into the realm of dialup networking. In this session, we hear from three perspectives: a technologist who explains how this technology integrates into existing network architectures, a network provider who addresses the challenges of adding dialup IP to a service offering, and a user who discusses the impact of this technology on his company's networking capabilities.

Overview

- Moderator: Robert A. Sutterfield, Morning Star Technologies

- The Technology: Steven M. Bellovin, AT&T Bell Laboratories

  Where does dialup IP fit into the existing network infrastructure?

- Network Service: Paul A. Ebersman, UUNET Technologies Inc.

  How would you use dialup IP for Internet access?

- Effect on Users: Gordon C. Galligher, Swiss Bank Corporation

  How does dialup IP affect corporate computer and network users?

How to reach the moderator

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Implications of PPP

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What's a PPP?

- "Point-to-Point Protocol"

- Link layer and below; no effect on IP or above

- Connects routers to routers, and hosts to servers

- Usable from 9600 bps to DS1 and above

Where PPP Fits

Applications
TCP or UDP
IP
Ethernet or PPP

$\Leftrightarrow$

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Ethernet or PPP
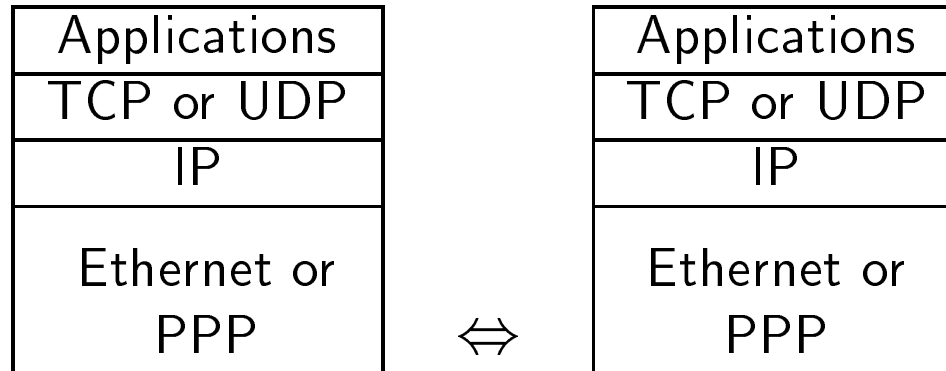
Implications

- *All* standard applications work

- No special protocols needed for mail, file transfer, X11, etc.

- Some work better than others over low-speed links — semantic model of bandwidth is wrong

$\Longrightarrow$ But they do work

New Abilities

• Able to interconnect different brands of routers (boring — doesn't change what we can do)

• Dialup IP — users are everywhere

$\Longrightarrow$ Speak IP anywhere there's a phone — cellular IP

• Logical topology no longer matches physical topology

Challenges of PPP

* Intermittent availability

* Address space

* Routing protocols

* Security

* Heterogeneous mix of clients

* Performance

Intermittent availability

- What should be done about mail? Queue it for eventual delivery? Use file servers or mail servers? (Violates the "no change" claim)

- What policies should be followed for connection management? What about retransmitted packets queued during redial attempts?

- Who should pay for the calls?

Address Space — How Do We Allocate IP Addresses?

• An IP network for each link? Wastes a scarce resource

• An IP subnet for each link? Better, but same general problem

• An IP network for each collection of dialup hosts? Hard to rehome clients for load-sharing, or if server dies

• Proxy ARP? Violates layering, but often the best solution

Routing Protocols

- What do we advertise for dialup links? Can we use multiple servers?

- Routing protocols can consume a lot of bandwidth — can we afford it on clients?

- What about clients with several different servers? Several different servers simultaneously? (ISDN is coming...)

- Do we need a proxy routing protocol?

Security Issues

- Address- and privilege-based security mechanisms (i.e., `rlogin` and friends) become much weaker

- Physical security buys you much less — you don't know what's at the other end of the line

- Strong filtering capabilities are *mandatory* (But supporting complex topologies in the presence of filters is hard)

- PPP provides strong authentication capabilities, but they have to be *used*

- Opportunity to bypass firewalls — set up PPP link over `telnet` connections

Why PPP?

- Potential for strong security

- Negotiable parameters

- Multi-protocol — IP, OSI, etc.

- Link quality management

Parameterization

- Different clients have different needs — but maintaining central configuration files is difficult

$\Longrightarrow$ With PPP, most parameters can be negotiated at link start-up

- Parameters include packet size, client address, header compression

Address Negotiation

• Simple configuration — client can announce its own address

• Or server can assign dynamic address to anonymous clients

• Server can announce its own address; permits easy load-sharing

PPP Security

- Allows multiple styles of authentication (including none)

$\Longrightarrow$ Challenge/response authentication guards against wiretappers

- Authentication integral to PPP; can be bound to address

Link Quality Management

• Loopback detection

• CRC check on every packet (good with some UDPs)

• Link statistics exchanged

$\Longrightarrow$ Allows line manager to notify humans, redial, etc.

Performance Issues

- Typical TCP/IP headers: Fat and Repetitive

  - typically 40 header bytes around a 1-byte telnet packet
  - few change from one packet to the next

- Exploit natural redundancy in a stream, send only the changes

- "VJ" TCP header compression $\Longrightarrow$ three to five header bytes!

- Can't compress UDP packets, so NFS is very slow

Implications of PPP

Questions?

Using Dialup IP for Internet Access

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Why use dialup IP?

• Can use hardware you may already have

• Hardware and software less expensive than leased line equipment

• Service provider fees lower

• More and more Internet Service providers are offering it

What do I need?

• Box to act as router

  – Dedicated SLIP/PPP router
  – Workstation acting as router

• Modem

  – Any V.32 or V.32bis modem

Know what you are buying.

Know what a dialup link will and won't do for you.

A dialup connection is a sometimes thing.

(How TCP/IP gets confused when you aren't there)

Things to consider

- DNS, NIS, etc.

- IP addresses

- Who gets your email and news?

- Do you connect from multiple places?

DNS

- Do your machines already do DNS?

- Will you need to use DNS and NIS?

- What nameservers do you use when the link is down?

- Who will act as the nameservers for your domain on the Internet?

- Will someone be running a reverse lookup server for you?

IP Addresses

• Do you always need the same IP address?

• Are you using real IP addresses internally?

• What networks need to know about you (NSFNet access, etc.)?

• Do other people need to get to you over the link?

Email and USENet News

- Mail spooling and retry intervals

- NNTP

- UUCP over TCP

Connecting from multiple places

• Dynamic IP address allocation

• Security (counterfeiting your network)

Using Dialup IP for Internet Access

Questions?

A User Perspective

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Antediluvian Times

• Normal LAN/WAN Setups

• Researched Dialup IP (SLIP and PPP)

Normal LAN/WAN Setups

(photo of dinosaur on terminal)

Disaster Strikes

• The Great [Chicago] Flood

• The CBOT basement flooded

• The Power went out

Equipment/File Retrieval

• Carry Workstations in Darkness

• Raid offices, flashlights in hand

Carry Workstations in Darkness

(photo of carrying workstations down flight of stairs)

Raid offices, flashlights in hand

(photo of raiding an office with a flashlight)

CBOT Recovers (partially)

• Basement pumped

• Partial Electricity restored

Basement pumped

(photo of street and workers pumping basement of CBOT)

Partial Electricity restored

(photo of when trading hours resume, and electrical power)

Setup Shop Off-Site

• In Lunchroom and Kitchen, 40 Miles West

• Aesthetics are not important

• Dining was a problem

In Lunchroom and Kitchen, 40 Miles West

(photo of people crammed into a small room)

Aesthetics are not important

(photo of spaghetti-cables and systems)

Dining was a problem

(photo of munchies, cookies, etc.)

Expensive Solutions

• Tasks phoned into remote office

• Work completed and Limousine transferred

Tasks phoned into remote office

(photo of monitors, telephones, people answering phones, etc.)

PPP Life Jacket

• Workstations in remote office and CBOT Annex

• Tasks executed in remote office

• Printouts immediately in CBOT Annex

Workstations in remote office and CBOT Annex

(photo of neatly setup 6 SS2 workstations and modems)

Greater Functionality

- Terminals attached to CBOT Annex systems

- Jobs executed locally by traders

- Information immediately propagated to Global Network

Benefits of PPP

- Decreased Cost

- Increased Response Time

- Detached Computing

Benefits of PPP (Cont'd)

- Robust (over a week with no interruption)

- Hands-Off Operation

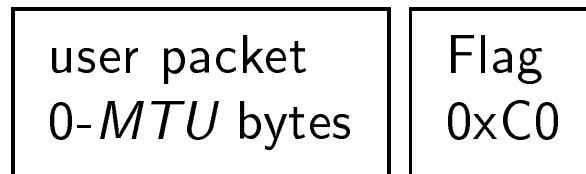- I was allowed to go on vacation

A User Perspective

Questions?

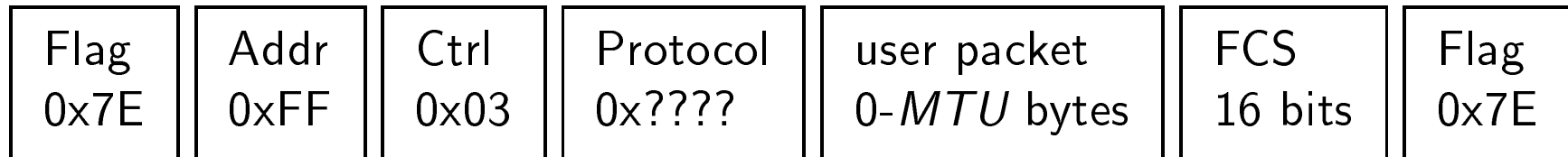# Dialup IP: The Next Wave

Questions?

SLIP vs PPP?

Gee, I'm glad you asked!
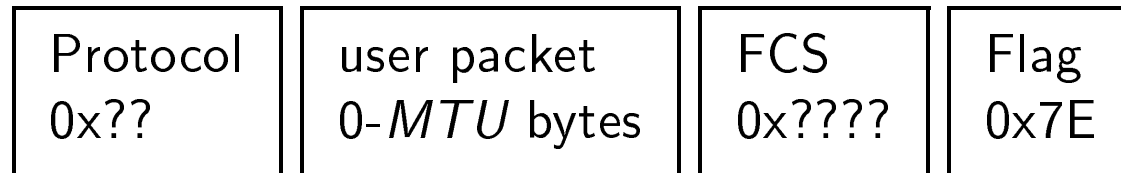
Typical SLIP Packet Format

user packet 0-*MTU* bytes	Flag 0xC0

PPP Packet Format

Full PPP HDLC Frame

Flag 0x7E	Addr 0xFF	Ctrl 0x03	Protocol 0x????	user packet 0-*MTU* bytes	FCS 16 bits	Flag 0x7E

Typical PPP Packet Format

Protocol 0x??	user packet 0-*MTU* bytes	FCS 0x????	Flag 0x7E

Comparing SLIP and PPP

user packet 0-*MTU* bytes	Flag 0xC0

Protocol 0x??	user packet 0-*MTU* bytes	FCS 0x????	Flag 0x7E
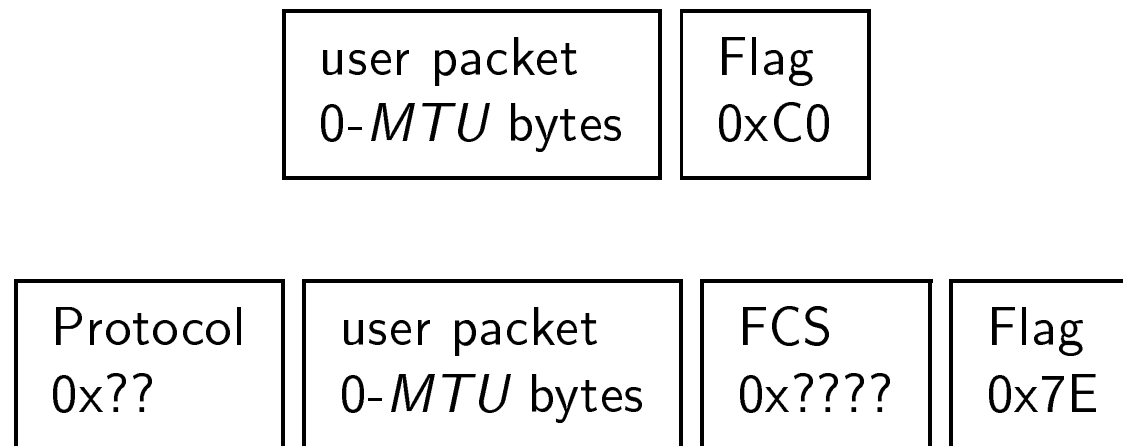
PPP bigger by 3 bytes per frame, of which 2 are error detection

Additional transmission time is in the noise, especially over dialup links

Any user-level performance difference, in either throughput or latency, is unmeasurable and imperceptible