# Dialup IP: The Next Wave

Interop 1993 Spring
Washington DC Convention Center

Global Interop Conference
Network “Pipes” track

March 12, 1993

# 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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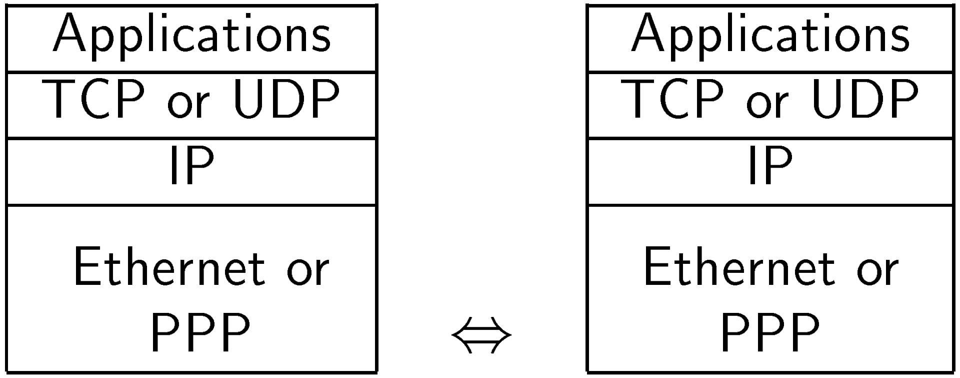
# What's a PPP?

- "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



# 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<br>0-*MTU* bytes | Flag<br>0xC0 |
|---|---|

# PPP Packet Format

Full PPP HDLC Frame

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

# Typical PPP Packet Format

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