Some Byte Oriented Protocols
SMTP Mail transfer agent

- Simple Mail Transfer Protocol
  - telnet host 25
  - 220 server-host-name
    - helo your-host-name
  - 250 hostname ok [ip-addr]
    - mail from: <user@host>
  - 250 X Address OK
    - rcpt to: <user@host>
  - 250 X user@host ok
    - data
  - 354 Enter mail, end with “.”
Some SMTP limits

- Best effort delivery
  - Postmasters
    - “The mail must go throught!”
  - Junkmail effects
- No Sender authentication
  - Junk mail return addresses
- Relaying
  - SMTP login
- Mailing List Systems
  - Mailman
Mail encoding

- MIME
  - RFC 1341, 2045-2049
  - MIME version
  - Content-Description:
  - Content-ID:
  - Content-Transfer-Encoding: ascii, base64, quoted-printable
    - Base64: 24bits --> 6 bit ascii
    - Quoted-printable --> “=hex hex” (>127)
  - Content-Type: ascii, text/enriched, text/html, multipart, ...
SMTP Junk Mail

• No laws against junk mail
  • Is junk mail simply unsolicited email?
  • Or does it need to be misleading?
• Filtering tricks
  • Valid sender domain
  • Content filtering
    • Word match
    • Statistical distribution
      • Two delete keys
Email delivery

- SMTP requires full time connection
  - Mailbox protocol
    - POP(3) port 110
      - Authenticate(USER,PASS)
      - Transactions(LIST,RETR)
      - Update(DELE)
    - IMAP port 143
      - Stored mailboxes on server
Email Delivery

• Comparison POP and IMAP
  • Email storage
  • Connect time
  • Server resources
  • Multiple mailboxes
  • Backup
  • Download control
  • Disk quota problems
  • Easy to implement
NNTP

• Network News Transfer Protocol
  • Usenet history
    • News discussion groups
      • Currently 52,875
  • NNTP on port 119
    • Feeds between servers
    • News reading from clients
      • Both controlled by IP based configuration files
  • Use for other functions
NNTP commands

- list
  - List of news groups and last message #
- group <group>
  - response: 211 #articles, first article, last article, group name
- head XXXXX
  - Message IDs
    - Integer sequence for local id
    - Unique id: current time,$PID,@hostname
- body XXXX
- quit
Distributed File Systems

- Network File System
  - Heterogeneous Computers
    - Homogeneous systems, such as AppleShare AFS
  - NFS still based on UNIX file systems
    - Byte Range
    - Open-read-write-close paradigm
  - Directory Structure
    - File metadata in inode
    - Stat() call
NFS

- File Types
  - Special directories
- Client/server structure
  - Client about 10 time more complex
- NFS Mount
  - houst:/remote /local type nfs (options: rw, inter, gb, quota, retries, etc.)
    - NFS handles
      - Directory traverse requires handle for each directory
Statefull vs Stateless

- File positioning
  - File pointer only on client
- Reading a directory
  - Position indicator
  - Magic cookie
State implementation issues

- Retry model
  - Duplicate requests
    - Idempotent request no issue
    - Non-idempotent requests
      - Writes are the biggest problem
        - Destructive vs non-destructive
      - Multiiple daemon issues
        - Rpc xid cache in server kernel
        - Create, remote, link, mkdir, rmdir, write
        - On dups, send ack to client
Statefull System issues

- RFS, Appleshare, etc.
  - Full cache consistency-rw
    - Invalidate cache during other writes
    - Version numbers for close consistency
      - Check version number before use of cache
- Crash recovery
  - Client
  - Server
- NFS lock manager
- Mixed environments
  - Nfs for Mac
Caching

- NFS client cache--5x-ro
  - Reading/writing issue
- Caching vs. replication
  - Use prediction
    - locality
    - Inertia
    - Read entropy
- Concurrency
  - Bounded
    - One copy serializability
- Cache Hierarchies
NFS hardware enhancements

- Write caching
- NFS protocol hardware
- Distributing issues
  - Soft links
    - Automounter
  - Automounter map
- Andrew File System
  - Subdivide partitions into volumes
  - Tokens
Attribute based distributed file systems

- Metadata beyond name, date etc.
  - File System as database
    - Sort on other than name
- Interface Issues
  - Search vs visual presentation
- Data Issues
Designing network protocols

- Designing by service
- Designing by distributing an application
- Designing by data structures and procedures