ECE 435 – Network Engineering Lecture 7

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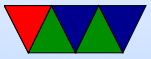
12:30pm, Barrows 125

6 February 2024

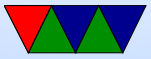
Announcements

- HW#3 was posted, due Thursday. Encryption.
- Might be delay on HW#2 due to interviews, Lovebyte Deadline



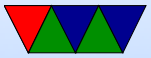
HW#1 Grading Note

- Sorry for delay
- Very different issues than previous years, had to re-write assignment for next time
- Main issue is making sure send one line, get full request without having to type anything. Easy way is to just send one transaction back from server that will *often* work. Proper solution is to specify a response only ends at linefeed and loop reading until it is received or timeout

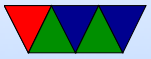


HW#3 – md5 collision (extra credit) note

- md5 is broken, but it's still not possible to "reverse" a hash in a reasonable (less than billions of year) time. (i.e., given a hash you can't make a file that creates it)
- It is trivial (less than a second) to make two random files that have the same md5sum
- A chosen-prefix attack is also possible (hours?), where given two files you can append garbage at the end until you find a matching md5sum for them
- The "include md5sum in itself" and the "make

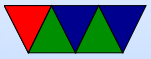


two images with same md5sum" use weaknesses in various file formats where parts of files can be ignored/commented and also bit changes can trigger colors or patterns to change in a way that has the desired effect

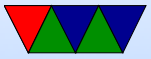


RSA Replacements (from last time)

- RSA 2048 bit but even that might not be enough
- DSA (NIST 1991 / FIPS 1993)
  - built on modular exponentiation / discrete logarithms
  - Roughly same security with keysize as RSA
- ECDSA – elliptic curve cryptography (ECC) (1999)
  - Algebraic structure of elliptic curves on finite fields
  - Can provide same security with smaller keys than RSA/DSA
  - Endorsed by NSA

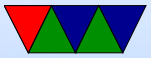


- 1024 bit RSA equivalent to 160 bit ECC



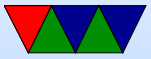
Internet e-mail

- Traditional Federated service (though spam + google means maybe that's on the decline)
- Compose text message, send to outgoing server
- user@host.network
- server delivers to destination mailbox
- user downloads and reads
- Send/store, can wait on server (as opposed to an instant-message type system where both users have to be active)



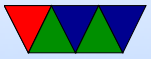
e-mail history

- Been around since more or less start of networks
- First internet/ARPANET
  - Ray Tomlinson credited with first modern e-mail around 1971,
  - decided to use '@' char
  - First e-mail was just keyboard poundings while testing
  - Wasn't even supposed to be working on e-mail, just thought it would be cool

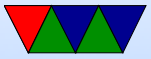


local UNIX e-mail

- UNIX mail, just a mail spool on your computer. Could use command line "'mail" to send it. `/var/spool/mail/username`
- `biff` to interrupt you when mail came in (used to be exciting)
  origin of name
- mbox vs maildir war; mbox format, tell each new e-mail via From:. So has to be escaped, you'll see this sometimes.

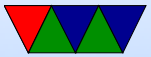


- Locking



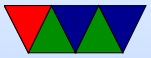
Could you send across the network?

- Want to send machine-to-machine e-mails. Various ways to do this. UUCP, etc.
- UUCP bang paths foo!bar!ucbvax!user



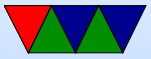
SMTP vs x.400

- As with OSI layer, the big formal ISO definition was made but the hacked-together SMTP won out.
- “Worse is better?”



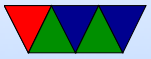
x.400

- x.400 much better in many ways
  built-in security (encryption before SMTP got it)
  could tell you once e-mail was delivered
  can send binary files without hacks
- x.400 had horrible e-mail addresses
  C=country, A=administrator (like ISP?can be blank),
  P= Private Domain, etc
  C=US;A=;P=UMaine;O=ECE;S=Weaver;G=Vince;
- x.400 actually used a lot in some situations. Microsoft



exchange did for a while

- x.400 so complex that making a working setup was hard so people gave up and used SMTP



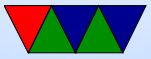
SMTP – simple mail transfer protocol

- RFC 821 (J. Postel) in 1982
- connect port 25. Text. All commands 4 chars (no one remembers why)

  `S: 220 maine.edu SMTP service ready`
- `HELP`
- `HELO a.com`

  `S: 250 maine.edu says hello to a.com`

  There is an extended SMTP. You can detect by sending `EHLO` instead



- `MAIL FROM: <xyz@maine.edu>`

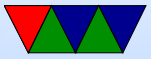
  `S: 250 sender ok`
- `RCPT TO: <abx@maine.edu>`

  `S: 250 recipient ok`
- `DATA`

  Put data. . on line by itself is end

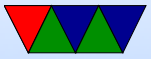
  `S: 250 message accepted`
- `QUIT`

  `S: 221 maine.edu closing connection`
- Respond with 3-digit code
  - 2xx = successful



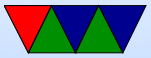
- 3xx = intermediate reply (waiting for more data)
- 4xx failed
- 5xx error in command

- In theory supposed to keep retrying to send for up to 4days

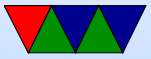


SMTP e-mail layout

- RFC 822/2822/5322
- Envelope first (RFC 821)
- Headers, blank line, body
- originally plain 7-bit ASCII, anything more needs MIME and other extensions
- Headers
  - To:
  - CC: (carbon copy)
  - BCC: (blind carbon copy)

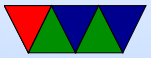


- Message-In:
- In-Reply-To:
- From: / Date: are required
- Reply-to:
- Received: (each transfer agent adds in)
- Return-path:
- Subject:
- X-* (optional extension, people get creative)



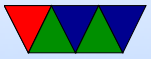
MIME

- Multipurpose Internet Mail Extensions (RFC-1341)
- How do you send Unicode/8-bit ASCII (accents) or Chinese/Japanese
- How do you attach audio/images?
- Backwards compatible
- Message headers:
  - MIME-Version:
  - Content-Description:
  - Content-Id:



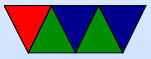
- Content-Transfer-Encoding:
- Content-Type: (text/plain video/mpeg, etc)

- Encodings:
  - regular: 7-bit ASCII lines, each less than 1000 chars
  - Same, but 8-bit
  - base64 – groups of 24 bits broken into 4 6-bit parts, each a legal ASCII. A=0 B=1 then lower case digits, + /
  - quoted-printable – 7-bit ASCII but higher characters encoded with = sign (hex digits) equal sign =3D
  - multipart



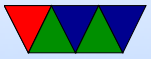
e-mail process

- MUA (mail user agent) on sending machine sends by SMTP (simple mail transport protocol) to
- MSA (mail submission agent) which determines the destination to send to if not local.
- The MSA uses DNS to look up mail server for destination, then sends it to the receiving MTA (mail transfer agent)
- The MTA sends it on to the MDA on the receiving end
- The final receiving MDA (mail delivery agent) puts into



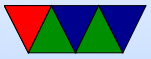
file/mailbox for user

- Receive MUA on local machine via POP3/IMAP

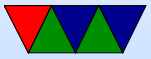


e-mail applications

- MUA – editor (optional) mutt/pine/thunderbird/outlook
  Often these days replaced by browser app
  can you use telnet as MUA?
- MSA – sometimes just part of MTA
- MTA – sendmail/qmail/postfix
  speaks SMTP. sendmail was standard, has more or less incomprehensible config setup
- MDA – fetchmail? deliver mail to mailbox. Possibly just a single file, can also be series of directories

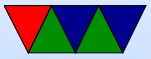


- MUA – retrieve e-mail via IMAP or POP



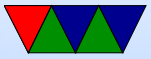
POP/IMAP

- POP (post office protocol) RFC 1939
  - port 110 (default) 995 (secure)
  - download mail to local machine which stores locally
- IMAP (internet message access protocol) RFC 2060
  - port 143 (default) 993 (secure)
  - manipulate mail on server
  - gmail can present as IMAP. tags are really imap "folders". Can actually download local (I do).



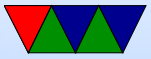
e-mail security

- In early days, "open relays" if an e-mail came in the server would take mail from anyone and try to deliver it to anyone. Not a good idea (spammers)
- mail spoofing (What's to stop you from putting someone else's address at FROM? how can you catch this?)



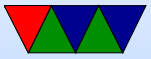
e-mail SPAM

- Unsolicited commercial e-mail
- Trusting / open-relay nature of e-mail ripe for abuse
- Origin of term SPAM?
  First commercial spam (usenet) March 5, 1994 Law Firm, Green Card Spam
- Spam/Virus filtering (joke of getting viruses via e-mail)



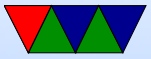
SPAM countermeasures

- On the sysadmin side, make sure systems are secure. Many ISPs block outgoing port 25
- SPF records in DNS, say which machines in your network are allowed to send e-mail. Downside, if user has bought a domain and uses it but the ISP doesn't support SPF.
- Not posting your e-mail, intentionally mixing up your e-mail so address harvesters have trouble getting it. Downside? Things like + in e-mail address?
- Challenge/response. Need to ACK before e-mail goes



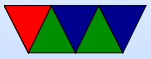
through. No one likes this.

- DNS black lists, lists of known spamming sources
  Some people block whole countries or all cable-modem connections
- Strict SMTP implementations. Spammers don't always implement their mail senders well.
- Greylisting – delay delivery of the mail by a few minutes (with a 400 response). Most legitimate servers will retry, a lot of spam software doesn't bother.
- Filtering, blocking keywords/all-caps
  False positives?



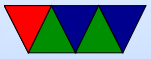
e-mails with chunks of books in them, crazy characters

- Bayesian filtering – auto learning. Sometimes can see this in headers



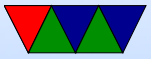
Other e-mail topics

- Vacation Messages
- Mailing lists
- procmail sorting



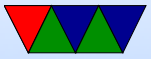
e-mail privacy

- SSL encrypted connection to SMTP server (usually plain text) SSMTP
- SMTP end to end still unencrypted
- Can use PGP (pretty good privacy) to encrypt e-mails, practically no one does this



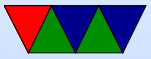
Can you run your own e-mail server

- Used to be possible/common
- Common e-mail servers: configuring them, specifically SendMail



e-mail issues

- Reply-all storms (look up microsoft one)

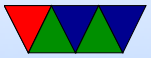


e-mail netiquette

- Signature, 4 lines 76(?) chars (why?)
- No top-posting!
- Quoting
- Linux kernel rules. Text only. No attachments. No MIME. no line-wrapping. Include patch as text.
- Eternal September / September that never ended!

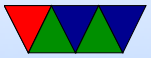
  sdate

  `Mon Sep 11115 12:19:44 PM EST 1993`

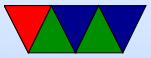


Other common protocols we won't cover

- Legacy (inetd): echo, chargen, discard, time, finger (.profile, .plan), qotd, systat, write, talk
  why no longer supported? security? lack of interest?
- Messaging:
  - IRC – internet relay chat
  - AIM/ICQ/MSN etc
  - unix talk/write
  - MUDs, talkers
- IPP – printer protocol (CUPS, lpd, jetdirect)



- backup software
- syslog
- telephony
  - skype
  - facetime
  - Zoom
  - VOIP
  - ASTERISK
- ntp – network time protocol
- LDAP/Authentication
- Network Attached Storage/Fileservers



  - NFS
  - Samba/CIFS
  - andrewfs (afs)
- Databases: mysql
- Distributed/Torrent sites
- Distributed computing (SETI@Home)