1.4.1 INTERNET Meeting Notes
15 August 1977

Editors Remarks

  Here are some notes from the Internet meeting held at ISI on 15 August
  1977. The notes are incomplete, and remarks attributed to individuals
  may be in error.

Agenda

  Opening Remarks - Danny Cohen
  Meeting Objectives - Vint Cerf
  Current Internet Plans - Vint Cerf
  Issues in Internetting - Andrew Hinchley & Chris Bennett
  Gateway Monitoring - Bob Bressler
  International Standards - Vint Cerf
  X.25 Gateway Interface Experiment - Peter Kirstein
  Type of Service Issues - Danny Cohen
  Internet Mail Service - Steve Crocker
  Wrap Up - Vint Cerf
  Future Meetings - Vint Cerf

Opening Remarks - Danny Cohen

  Cohen discussed the agenda and the rules of the meeting, Danny is
  moderator and can recognize people to speak or cut people off if
  necessary.

Meeting Objectives - Vint Cerf

  Cerf presented the following meeting objectives:

    Review the current internet plans
    Raise and discuss internet research issues
    Compose a list of objectives of internet research
    Prepare a prioritized list of internet tasks
    Prepare a prioritized list of internet experiments

Current Internet Plans - Vint Cerf

  Cerf reviewed the current (FY 78) Internet Plan:

    TCP Development

      UCLA - 360/91
      MIT - Multics
      BBN - Tenex, Tops 20, Unix
      SRI - LSI-11
      NDRE - NORD-10

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        UCL   - PDP-9 (?)

     Network Development

        BBN      - ARPANET (gateway routing, flow control, broadcasting)
        MIT/LCS - LCSNET, CHAOSNET
        Collins & BBN - Packet Radio Network Broadcasting
        MIT/EE  - Theory (spanning trees...)

     Gateways

        BBN      - Packet Radio / ARPANET
        BBN      - Packet Satellite / ARPANET
        BBN      - ARPANET / RCCNET
        BBN      - Gateway Control Center
        XEROX   - Packet Radio / Ethernet
        MIT      - ARPANET / LCSNET(s)
        UCL      - EPSS / ARPANET
        UCL      - EPSS / Packet Satellite
        UCL      - X.25 Net Issues
        BBN      - Gateway flow control, routing, reporting, checks and
        balances, etc.
        UCLA     - Internet performance modelling and analysis, gateway flow
        and congestion control
        MIT/EE - Relibility of internetworking, alternate routing
        ISI      - Fast network deployment, addressing, authentication
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     Internet Performance Measurement

        UCLA - Internet Measurement Center
        UCL  - Internet Gateway traffic generation and performance
        measurement

     Internet Services

        ISI - Internet Mail

     Protocol Development

        ISI - Internet Types of Service (TOS)
        ISI - Conferencing, multi-connection synchronization
        LL  - Packet Satellite / internet speech [NDRE, UCL, LL, BBN,
        LPCMs]
        SRI - Impact of TOS on Packet Radio
        ISI - Protocol Modelling and Testing/Evaluation System
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  Cerf: We need a specification for a gateway so that other
  inplementations will come out the same.

  Cerf reviews related working groups:

    TCP working group (V. Cerf - ARPA) focuses on TCP as an end to end
    protocol in an internet environment, technical orentation.

    Packet Radio working group (D. Neilson - SRI)

    Packet Satellite working group (I. Jacobs - Linkabit)

Internet working group (D. Cohen - ISI) focuses on network
interconnection problems and plans internetwork experiments.

  Cerf reviews the "number czars" for various note series etc:

    PSPWNs - Lin-Nan Lee (Linkabit) [JACOBS@ISIE]
    PRTNs - Ron Kunzelman (SRI) [PRSETD@ISIC]
    IENs   - Jon Postel (ISI) [POSTEL@ISIB]
    Network Identifiers - Jon Postel (ISI) [POSTEL@ISIB]
    Internet Messages Types - Jon Postel (ISI) [POSTEL@ISIB]

  Cerf reviews the forecast of events in interneting:

    TCP Development

      Sep 77 - Experimental small-machine Top20 TCP
      Oct 77 - Unix TCP
      Nov 77 - Operational small-machine Tops20 TCP
      Dec 77 - Nord 10 TCP
      Jan 78 - Tenex TCP
      May 78 - large-machine Tops20 TCP
      Jul 78 - 360/91 TCP

    Network Development

      Sep 77 - 2 node PR test cell in Boston
      Jan 78 - LCS Net
      Jun 78 - PR Net Broadcast
      Dec 78 - ARPANET Broadcast

    Gateways

      Oct 77 - Ethernet/PR net
      Dec 77 - Gateway monitoring center
      Jan 78 - LCSNet/ARPANET
      Jan 78 - X.25 Epss interface / SATNET
      Apr 78 - Gateway flowcontrol, routing etc specification
      Oct 78 - Gateway flow control, routing, etc. Pass 1 implemented
      Jan 79 - PR Net in Army C2 test bed

Performance Measurements

    May 78 - SATNET/ARPANET/EPSS/PRNET performance tests (UCL)
    Oct 78 - Internet Measurement Center (UCLA)
    Jan 79 - Internet performance tests
    Mar 79 - Rapid deployment tests

  Protocol Development

    Sep 77 - TCP 2.5 specification
    Jan 78 - Unix telnet
    Mar 78 - Tenex & Tops20 Telnet
    Apr 78 - Draft TOS Specification
    May 78 - Prototype FAX specification from UCL
    Jul 78 - Prototype internet mail service
    Aug 78 - Tenex & Tops20 FTP
    Sep 78 - Internet speech conferencing specification
    Oct 78 - 360/91 telnet & ftp
    Mar 79 - Internet speech conferencing tests
    Jun 79 - Speech & Video conferencing specification

  Demos

    Sep 77 - Point to point raw internet speech demo
    May 79 - Internet services demo

Cerf: We need a specification of how a gateway should behave to
cooperate with a gateway control center.

Kirstein: EPSS and SATNET will have X.25 interfaces but there is no
plan for an X.25 interface to the ARPANET.

Cerf: The issue of secure internetting is postponed.

Cerf: There is consideration of an effort to develop a new ftp, but
there is no plan as yet.

Kirstein: FAX might be worked into the speech and video conferencing
system.

Kirstein: Are LLL or Commercial nets to be involved in internet
experiments?

Cerf: LLL is interested in TCP for the local to Livermore Octopus net
not the CTR net.

Cerf: No current plans to get commerical nets involved.

Kirstein: What is happening about AUTODIN II and ARPANET as described
at TCP Meeting?

Cerf: That plan is no longer active, and it is not expected that there
will be any move to get people off the ARPANET until 1980, after that
AUTODIN II service may be offered instead of ARPANET on a customer by
customer basis.

Kirstein: It seems more likely that university type users will have to
go to a commerical net than get on AUTODIN II, so shouldn't we be
exploring internetting with commercial nets now?

Issues in Internetting - Andrew Hinchley & Chris Bennett

Hinchley & Bennett discussed the paper (PSPWN 76, INDRA 637) "Issues in the Interconnection of Datagram Networks" that was distributed prior to the meeting.

Hinchley: there are three catagories of interconnections:

1) ARPA like datagram networks,

2) PTTs X.25 networks, note that the PTTs are moving very fast with a model of an internetwork system composed of a small number of very large national networks,

3) Interconnection of private networks via public X.25 networks.

The SATNET experience is the basis for these (PSPWN 76) comments.

Cerf: Is a gateway a piece of hardware physically connected to two or

more networks, or is it pair(s) of software modules connected by physically complicated networks ?

Kirstein: We should be more aware of what is going to be possible with PTT provided "virtual call networks".

Bennett: Addressing is a topic discussed in the memo.

Cerf: Up to now we have not had names for gateways, but now we may need names if gateway control centers are to communicate directly with gateways.

Cerf and Crocker discuss gateway models, one point was that one should try a model with a three or more connected gateways since sometimes a two connected model may make things seem simpler than they really are, another point is that a gateway is a kind of a forwarder, and Crocker argues that the forwarder is logically a network.

Postel: An address is just a string of bits, with each address parser consuming part of the string, to give a gateway an address reserve one value of the set of values representable in the bits the gateway parses, that reserved value means "here".

Kirstein expressed concern about the address space in the individual networks. Also concerned about translations necessary when going between datagram and virtual call networks.

Cerf: Does the way a thing is named specify the way one gets to it? Especially if a thing is multi-hommed?

Shoch: One way is all gates are in the same net and have exactly one address. Another way is that a gateway has distinct host address on each net it is connected to.

Cerf: If the gateway control center has to talk to the gateway and the gateway has two names, which name does the control center use?

Shoch: Someone has to take responsibility for choosing.

Jacobs: Where do the global unique names come from?

   Postel: They are external. We always have a unique description,
   usually by location, for objects. The gateway control center will have
   to have for each gateway a unique (external) name, and associated with
   that a list of internal addresses.

   Cerf designates that there be a committee to study addressing and
   naming of gateways to (1) figure out what things there are, and (2)
   figure out how to address them. Crocker is chairman.

   Bennett: Routing in the Internet is discussed in PSPWN 76. The main
   ideas are that adaptive routing in internet is not likely to be much
   good due to the larger delays in information propagation. Fixed
   routing with a number of alternatives (this is also called "Explicit
   Path Routing") might be useful. [Naylor says this is explored by IBM
   Zurich.] Could use alternate routing in a event driven form to recover
   from service outages. One issue is what to base the adaptation on.

   Postel: Most of the things normally used could get washed out by local
   traffic.

   Crocker: Perhaps there are some things...

   Postel: for example queue lengths in the gateways.

   Cerf: Adaptive routing is not a substitute for congestion control.

   Jacobs: The information available to a gateway includs both facts
   about its directly attached networks and information received from
   other gateways.

   Cerf: Gatways may have to exchange information about what paths are
   viable. If one packet from a gateway to a host in the ARPANET results
   in a "host dead" error what does the gateway do about other packets to
   the ARPANET? We should avoid having a lot of state information in the
   gateways.

   Postel: What happens when the ARPANET says to a gateway "host dead"?

   Jacobs: Nothing.

   Cerf: Try to pass an error message back to source TCP. We have no
   conventions for this as yet.

   Mathis: Out thinking has been: Gateways do routing; TCPs do not do
   routing.

   Cohen: Routing algorithms need to be smarter.

Hinchley: Flow Control Possibilities

   1) No control at gateway level (expect end-to-end control to take
   care of any problems)

   2) Gatway to Gateway control

   3) Terminating Gateway Control (source - desination gateways
   control flow)

   4) X7X virtual circuit control

   This is a range of possibilities.

Postel favors a hop by hop (that is gate by gate) flow control.

Cohen: Why should there be a single type of flow control? The type of
service (drops, streams, floods) should get different kinds of flow
control.

Jacobs: In SATNET there are a whole rage of stratagies from try once
to try very hard to get a message through.

There occured at this point a discussion of the cost of hop by hop
acknowledgements.

Jacobs: This should all be in terms of bump to bump, that is a
gateway consist of a bump for each connected network and a core, any
network is between a pair of bumps, and the bumps should decide how
much error control etc is needed across that network.

There was a discussion of status information, particularly error

   reports. If a gateway has a problem then it is an internet error and
   "the internet" ought to tell the source about it. If a destination
   host has a problem then a service center could know the problem and a
   query to the services center could tell the source what is happening.

   Hinchley: Gateway Control, Once gateways get above a certain level of
   complexity there needs to be a control function, that suggest that the
   reshould be a gateway control language which is standard throught the
   internet.

Gateway Monitoring - Bob Bressler

   Bressler described the current gateway monitoring center as a fairly
   simple program that summarized reports from the SIMP and some other
   gateway. The information reported was:

      number of messages sent and received on each port of each gateway
      and the number of messages dropped by the gateway

   The gateways spontaneously generate the reports to the control center,
   the control center curently sends no messages to the gateways. There
   are data generators and data sinks in the gateways now controled by
   XNET a ddt like cross net debugger.

   Kirstein: One of the simplest services one could provide is reliable
   delivery but allow duplicates to be delivered as well.

Hinchley: What common functions can be listed?

    restart
    reload
    run a diagnostic
    update routing information

Shoch: Gateways exchange routing tables perodically gratuitously. Many processes in a gateway for example time server, name lookup server, boot loaders, measurement process, echo server, source, sink, trace.

Shoch: There is a distinction between Routing, Addressing, and Naming.

Kirstein: There will need to be several monitoring centers. There may be a central control center that forwards suggestion for control to national control centers.

Burchfiel: No gateway in the ARPANET currently does fragmentation.

International Standards - Vint Cerf

  Cerf reviews international standards organizations:

    ITU - International Telecommunications Union (established by treaty)
      CCIR - International Radio Consultative Committee (issues
      recommendations on the use of electromagnetic spectrum)
      CCITT - International Telegraph and Telephone Consultative
      Committee (issues recommendations on telephone and telegraph
      communication)
        PTTs - Government operated Post, Telephone & Telegraph Systems
        ATT - American Telephone and Telegraph Corporation
        IFIP - International Federation for Information Processing
        ANSI - American National Standards Institute
          cats & dogs
          common carriers
          manufacturers
          EIA - Electronic Industry Association
          government
            NBS - National Bureau of Standards
            DCA - Defense Communications Agency
    ISO - International Standards Organization
      ANSI
      PTTs
      manufacturers
      IFIP
    CEPT -
      UK
      France
      DBP

ECMA - European Computer Manufacturers Association
               CII
               HB
               Phillips
               ICL

         Cerf reviews relevent standards activity:

            Analog

               V.24 (CCITT recomendation) = RS232C (EIA)

            Digital

               X.21 <-> RS232C

               HDLC (ISO) <-> [SDLC (IBM), UDLC (Univac), ADCCP (ANSI)]

               X.25 packet network interface, virtual call, asymetric

               X.C PAD control

               X.7X packet net / packet net interface (virtual circuit)

X.25 Gateway Interface Experiment - Peter Kirstein

   Kirstein discussed the work UCL is going to be doing with EPSS and
   X.25 interfaces.

Type of Service Issues - Danny Cohen

   Cohen discussed Type of Service issues. He suggests the following
   dimensions to service selection:

      priority
      relibility/cost
      delay/cost
      Floods / Streams / Drops
      Message/Wire
      Sort Messages
      Acknowledgement / Negative acknowledgement/ No acknowledgement
      Security
      Synchronization
      Multidestination addressing
      End of Letter

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      Buffer Runout
      Receiver Wakeup

   Cohen: Whether ACK or NACK or both or neither are used should depend
   on statistics.

   Jacobs: The Host-SIMP protocol paper may be relevant.

   Hoversten: Is the user helping the network by telling it what type of
   demands the user is going to make?

Internet Mail Service - Steve Crocker

   Crocker discussed a model of how to make mail services available in
   the internet system in a straightforward way.  Also of interest is
   possibility for authentication and privacy.
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Wrap Up - Vint Cerf

   Binders for an Internet Notebook were distributed, and Cerf explaind
   the intention to use it to collect the current information for
   internet experements.  Jon Postel is the Notebook coordinator.

   Cerf summarized as follows:

     Addressing alternatives need to be written down - assigned Steve
     Crocker to coordinate. Please supply him with your thoughts.  What
     objects exist and what names should they have.  John Shoch will
     provide a one page note on nomenclature.  A Gateway Specification is
     to be prepared by Bob Bressler.  Cerf will distribute a current
     version of the X.25 specification.  Kirstein will distribute a
     document on the UCL X.25 experiments.

Future Meetings - Vint Cerf

   Cerf reviewed the plans for future meetings:

        15 Aug 77 - Internet meeting at ISI
     17-19 Aug 77 - PSPWG    meeting at Linkabit
     13-14 Oct 77 - TCP      meeting at SRI
     31Oct-2Nov77 - PSPWG    meeting at BBN
         3 Nov 77 - Internet meeting at BBN
     30-31 Jan 78 - TCP      meeting at ISI
      1- 2 Feb 78 - PSPWG    meeting at UCLA
         3 Feb 78 - Internet meeting at UCLA
     20-21 Apr 78 - TCP      meeting at BBN
      1- 2 May 78 - Internet meeting at UCL
      3- 5 May 78 - PSPWG    meeting at UCL
     13-14 Jul 78 - TCP      meeting at PARC
      2- 3 Aug 78 - Internet meeting at LL
         4 Aug 78 - PSPWG    meeting at LL
     12-13 Oct 78 - TCP      meeting at LCS
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Section 1.4.1   [page 14]

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Section 1.4.1   [page 15]