The New Internet

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Why me?

- ◆ ex-member USENET cabal
- ◆ ran a USENET/BITNET/ARPANET gateway
- ◆ cofounder of NEARNET
- ◆ member of NEARNET TC & SC
- ◆ chair of CoREN TC
- ◆ co-chair of MCI JTC

Old History - Building the Internet

- ◆ common story - the ARPANET begat the Internet
- ◆ other nets were also involved
  - the global UUCP network and USENET
  - HEPNET, SPAN, BITNET (I and II)
  - the pre-1987 supercomputer networks
  - MFENET, CSNET
  - JANET, EUNET, CA*NET
  - NSFNET, the CIX

Recent History

- ◆ U.S. National Science Foundation provides the Internet backbone (NSFNET)
- ◆ Canada talks to Brazil through the NSFNET
- ◆ ANS provides NSFnet under contract with NSF
  - NSFnet is a service over ANSnet
- ◆ NSF AUP restricts use of NSFNET

Myth Note

- ◆ Internet is not free good
- ◆ NSF spends ~ $330K for NEARNET <-> NSFnet connection
- ◆ would be a small part (2%) of NEARNET budget
- ◆ overall, in U.S. NSF pays < 15% of inter-organizational costs
- ◆ users' organizations pay for most of the Internet
  - end user often not charged
  - just like light & heat

Commercial Connectivity

- ◆ NSFnet has a restricted usage policy (AUP)
- ◆ no commercial traffic permitted
  - only Research and Educational (R&E) traffic
- ◆ midlevels get commercial connectivity via CIX
  - some connect to CIX via ANSnet
  - some use other providers (Sprint, MCI...)

NSFNET Map
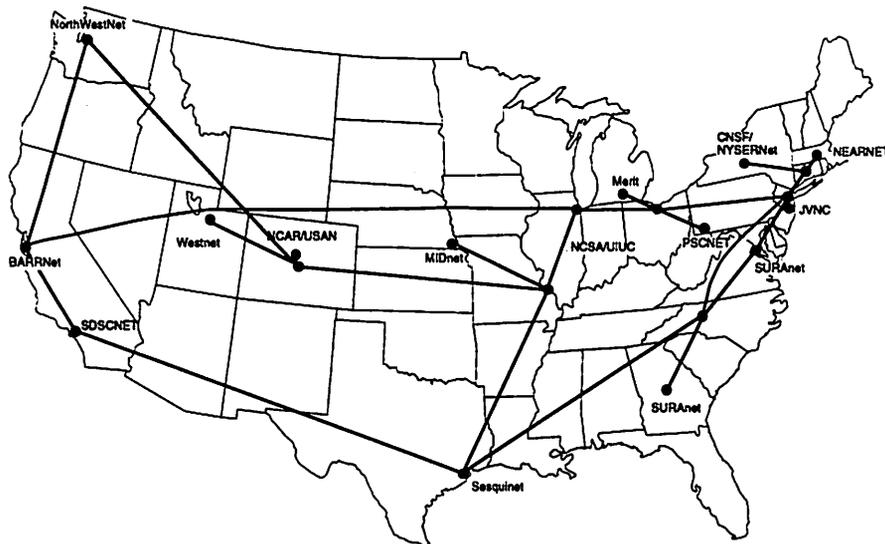
Near Future

- NSF is getting out of backbone biz
- NSF trying to ensure continuity
  - providing funding to regionals for connection
  - regional purchases connection from vendor
    - » Network Service Provider (NSP)
- NSF imposes constraints on NSP service requirements

NSF Requirements

- NSF only pays for R&E traffic
- NSP must attach to 3 prime NAPs
  - more on NAPs later
- regional must ensure NSF of R&E connectivity
- decreasing funding over 4 years

Perspective Note

◆ Internet is a government success story

◆ small targeted funding facilitated infrastructure

◆ protocol - fund Berkeley to port BBN TCP/IP to UNIX

◆ start up funding for many regionals
  – (not NEARNET)

◆ proof of concept for backbone

◆ migrate to commercial providers

NSF Assumptions

◆ new world will have many backbones

◆ must interconnect to continue *Internet*

◆ will require unified routing information

◆ must be self supporting

Existing Internet features

- ◆ Commercial Internet Exchange (CIX)
  - – router in San Francisco area
  - – ~90 members, direct & indirect
  - – exchange point for traffic
  - – T1 & T3 connections

Existing Internet features, contd.

- ◆ Metropolitan Area Ethernet - East (MAE-east)
  - – Ethernet & FDDI MANs in Washington DC area
  - – exchange point for traffic
  - – big providers
  - – international links
- ◆ MAE-west under construction

Existing Internet features, contd.

◆ Federal Information Exchanges (FIXs)
- Ethernet LANs near DC & near San Francisco
- U.S. federal network interconnect
    » NASA, energy etc.
- some regionals also connect

NSF Plans: Funding

◆ provide bridge funding to regionals
- Inter-Regional Connectivity (IRC)
- 100% of R&E cost 1st year
- 75%   2nd year
- 50%   3rd year
- 25%   4th year
◆ regional to purchase connectivity from an NSP

NSF Plans:
Network Access Points (NAPs)

- ◆ designated exchange points
  - – primary - NYC area, Chicago area, San Francisco area
  - – secondary - Washington DC area
- ◆ NSPs must connect to 3 primary NAPs to get funds
- ◆ connections not restricted to NSF NAPs
- ◆ NSP assumed additional "NAPs"
  - – in U.S. and elsewhere

NSF Plans: Routing Arbiter (RA)

- ◆ awarded two agreements
  - – development - Postel & Co.
  - – operation - MERIT
- ◆ maintains database of networks & policies
- ◆ RA boxes at each NAP
- ◆ font of routing information for NAP attaches
- ◆ maintains multiple "views" of routing information
- ◆ routing information exported to NSPs

NSF Plans: vBNS

◆ inter supercomputer traffic on separate network
◆ very high speed Backbone Network Service
  – ≥ 155Mbps
◆ connects to NAPs
◆ severe AUP - i.e., not you & me

NSF Plans - Picture
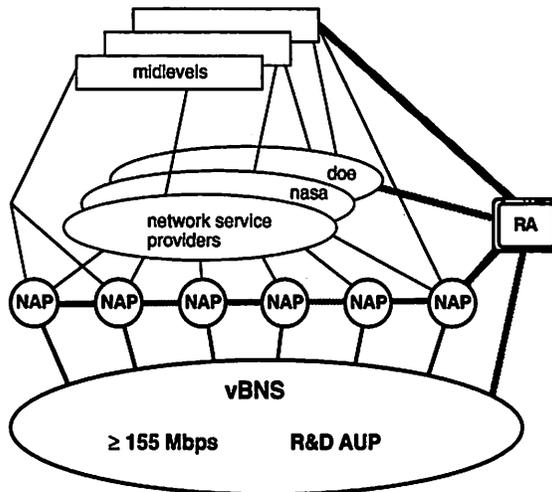
CoREN

- ◆ Corporation for Regional and Enterprise Networking
- ◆ 8 regional networks organized to control their own future
- ◆ CoREN started out to build its own backbone
  - – made announcement May 1993
- ◆ later decided to purchase service
  - – market now mature enough
- ◆ CoREN is now a buying club

RFP

- ◆ CoREN issued RFP for inter-regional connectivity
- ◆ sent to all major networking players (even if no announced service)
- ◆ received multiple responses
- ◆ chose MCI after careful evaluation of responses

JTC

◆ MCI offer included a Joint Technical Committee
◆ MCI representatives plus representatives from network customers
  – one from each regional
  – plus Michnet and CA*NET
◆ reviews MCI proposals for network architecture
  – network testing
  – trouble procedures

MCI Infrastructure

◆ national clear channel T3 point to point network
  – dual coast to coast paths
  – three north-south paths
◆ T3 tail circuits to most regionals
  – Sesquinet 10Mbps, CA*NET 6 T1s
◆ T3 connections to NAPs, CIX, MAE-east, MAE-west, FIXes

Plans

- ◆ phased migration from NSFnet (ANSnet) to MCI
- ◆ then other MCI customer traffic
- ◆ then other NSP customers
  - through exchange points
  - including unmigrated part of NSFnet
- ◆ by mid January
- ◆ SURANet & CA*NET already moved

Pending

- ◆ Routing Arbiter
  - operation 'soon'
- ◆ reliability of ATM-based NAPs
  - some worries
- ◆ load on exchange points
  - CIX and MAE-East & West as fallbacks

Unknowns

◆ transit traffic no longer 'free'

◆ how does Japan talk to France?

◆ many providers must interact with each other

◆ problem resolution

◆ settlements?

◆ non-U.S. NAPs?

Current Internet

◆ small governmental support

◆ 3-4 million computers

◆ run by commercial service providers

◆ growing faster outside of U.S. than inside

◆ no security

◆ no service guarantees

◆ dumb inefficient protocols

◆ driven by a hunt for dirty pictures

Future Internet

◆ many different views on Internet future
- 500 channels of 'nothing on'
- video on demand
- stock quotes
- news wires
- home shopping with virtual reality

What is Wanted?

◆ hard to project demand for a new paradigm
◆ remember Xerox and supercomputer projections
◆ people project with today's eyes assuming only today's applications
◆ how can one know applications that will be important in the future

How Predict Future Applications

- ◆ before you know you have a precursor
  - − need to know the shape of the final beast
- ◆ before you know the shape of the final beast
  - − need to know what services that will be offered
- ◆ before you can guess the services
  - − need to know elsewhen
- ◆ "Any significantly advanced science is indistinguishable from magic."

Speculation

- ◆ the Internet is a prototype of the future data infrastructure
- ◆ video on demand will not be a major player
- ◆ few non-telco (PTT) connection providers
- ◆ usage-based billing will become common
- ◆ security problems will be solved
- ◆ unsolicited advertising will be a major issue
- ◆ differing mores will become a major issue

Problem & Promise

"There will be no 'there' 'there',
it will all be 'here'.