Sequoia 2000 Network (S2Knet) Handbook

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Sequoia 2000 Network (S2Knet) Handbook

1. Introduction

The construction of the Sequoia 2000 network (S2Knet) is a joint effort involving people from the University of California campuses of Berkeley, Los Angeles, San Diego, and Santa Barbara, the UC Office of the President (UCOP), and the San Diego Supercomputer Center (SDSC). The purpose of this handbook is to serve as a reference, containing up-to-date information describing policy, topology, names, addresses, and routing. It also includes a list of contacts for network management.

1.1. Background Information

A lot of discussion has taken place during the design and construction of S2Knet at various meetings. Rather than including the minutes from these meetings in this document, the minutes have been copied to `postgres:~ftp/pub/sequoia/s2knet-meetings`. Additional minutes will be added to this directory after each S2Knet meeting.

2. Definitions

S2Knet: The Sequoia 2000 network, including the backbone and local networks fully or partially owned by the S2K project.

Site: Any of the major contributers of the S2K project connected to the S2Knet. Currently, these include UC Berkeley, UCLA, UC San Diego, UC Santa Barbara, and SDSC.

Backbone: Those parts of the S2Knet which connect the major S2K sites. Initially these are T1 links, but they will be upgraded to T3 links.

S2Knet Machine: Any machine which is fully or partially owned by the S2K project and is directly connected to the S2Knet.

S2Knet Manager: The person designated by the S2Knet Committee to manage the network. The S2Knet manager will be responsible for solving global problems, coordination of site managers to solve problems, and managing activities that are best done in a centralized manner (see section on job descriptions).

Site Manager: A person designated by each site to serve as primary contact for issues relating to local network management. An secondary site manager shall also be designated as an alternate to the site manager. Site managers are responsible for solving local problems, and carrying out requests from the S2Knet manager.

Decentralized: An item is said to be decentralized if it is maintained independentdly by the site manager. Most S2Knet management is decentralized.

Regional NSFNET Connectivity Point: The network providing connectivity between the NSFNET backbone and the various campus networks. Currently, UCSB and UCLA are connected by CerfNet, Berkeley is connected by BARRNET, and UCSD is connected to the CerfNet hub at SDSC as well as the NSFNET backbone.

3. Job Descriptions

The duties of the S2Knet manager and site managers are listed here. See the "Contact List" section for the names and addresses of all managers.

S2Knet Manager

The S2Knet manager has the following duties:

1. Coordinate site managers to implement design described in this handbook.

2. Serve as the primary contact for problems regarding the backbone or the network as a whole.

3. Monitor the S2Knet, and coordinate the site managers responding to problems.

4. Maintain the backbone, including allocation of names, addresses, and accounts of machines (e.g. routers) on the backbone.

5. Maintain the handbook so that it reflects the current state of the network. In particular, the topologies, machine and network names and addresses, routing tables, and contact list, shall be kept up-to-date.

6. Prepare weekly report which summarize weekly site manager reports on network status. Included should be descriptions of any modifications made to the network, e.g. addition of new machines, addition of subnetworks, renaming or readdressing, etc., and a record of any unusual events which may have occurred during the week. The typical length of this report is a page.

7. Coordinate reservations for time for experimental use of the S2Knet.

Site Manager

Each site manager has the following responsibilities:

1. Serve as the primary contact for problems regarding the site's local networks.

2. Monitor the site's local networks, and solve any problems which can be taken care of locally.

3. Maintain local networks: administer local names and addresses, and maintain routing tables. Any changes which affect the backbone or the S2Knet as a whole should be coordinated with the S2Knet manager.

4. Carry out requests by the S2Knet manager.

5. Prepare a weekly report on local network status. Included should be descriptions of any modifications made to local networks, e.g. addition of new machines, addition of subnetworks, renaming or readdressing, etc., and a record of any unusual events which may have occurred during the week. The typical length of this report is a paragraph.

4. Policies

This section describes high-level policies regarding the operation of the S2Knet.

Modes of Operation

The S2Knet backbone has two modes of operation: *normal* and *experimental*. In **normal mode**, all packets generated from or destined to S2Knet machines will attempt to be routed through the S2Knet backbone. In case the S2Knet backbone fails, packets will automatically be routed through an alternative network (e.g. the Internet).

In **experimental mode**, only a group of S2Knet experimenters shall be able to route packets over the backbone. To be a member of this group, one must obtain permission from the S2Knet committee by sending a request to the S2Knet manager. Other traffic presented to the backbone during experimental periods will be routed through an alternative network.

The S2Knet will usually operate in normal mode. A schedule identifying experimental mode periods will be distributed to the S2K project by the S2Knet manager. Time during experimental periods shall be reserved by making a request to the S2Knet manager.

Permissible Traffic (normal mode operation)

For inter-site traffic, packets transferred between S2Knet machines will be preferentially routed through the S2Knet backbone. Packets traveling between one S2Knet machine and one non-S2Knet machine might be routed across the backbone, although such routes are not guaranteed. Packets between two non-S2Knet machines will never be routed through the backbone.

Privacy

S2Knet experimenters may require statistical information on S2Knet utilization. Experimenters are free to collect packet information, such as generation or consumption rate, size distribution, etc. However, network experimenters must respect the privacy of S2Knet users. The contents of packet data shall not be used or distributed to other parties without explicit permission of the originator and the S2Knet manager.

5. Topologies

This section contains topological maps showing local network connectivity at each S2Knet site. Site managers should submit a picture indicating the physical network topology, as well as a table indicating additional information: names, interface devices/name, address assignment, netmasks, and broadcast addresses. Be sure to include enough detail to trace a path from your nearest Regional NSFNET Connectivity Point to your S2Knet local network.

5.1. S2Knet Backbone

[PICTURE GOES HERE]

S2Knet Backbone Router Configurations					
Router	Device	Interface-Name	Interface Addr	Netmask	Broadcast
UCB1	ln0	sock.cs.berkeley.edu	128.32.149.127	ffffff00	128.32.149.0
UCB1	fza0	gw.s2k.berkeley.edu	192.150.186.1	ffffff00	192.150.186.255
UCB1	ds0	ucb-ucsb.s2k.berkeley.edu	192.154.4.17	fffffff8	none[UCSB1 link]
UCSB1	ln0	s2k-gw1.ucsb.edu	128.111.253.60	ffffff00	128.111.253.255
UCSB1	fza0	breeze-fddi.s2k.ucsb.edu	192.150.216.24	ffffff00	192.150.216.0
UCSB1	ds0	ucsb-ucb.s2k.ucsb.edu	192.154.4.18	fffffff8	none[UCB1 link]
UCSB1	ds1	ucsb-sdsc.s2k.ucsb.edu	192.154.4.10	fffffff8	none[SDSC1 link]
UCSB2	ln0	s2k-gw2.ucsb.edu	128.111.253.70	ffffff00	128.111.253.255
UCSB2	fza0	wind-fddi.s2k.ucsb.edu	192.150.216.23	ffffff00	192.150.216.0
UCSB2	ds0	ucsb-ucla.s2k.ucsb.edu	192.154.4.26	fffffff8	none[UCLA1 link]
SDSC1	ln0	redwood.sdsc.edu	132.249.20.40	fffffc00	132.249.23.255
SDSC1	fza0	[none]	192.154.4.41	fffffff8	192.154.4.47
SDSC1	ds0	sdsc-ucsb.s2k.sdsc.edu	192.154.4.9	fffffff8	none[UCSB1 link]
UCLA1	ln0	s2k-gw1.atmos.ucla.edu	128.97.64.216	fffffc00	132.249.23.255
UCLA1	fza0	[not configured]			
UCLA1	ds0	ucla-ucsb.s2k.ucla.edu	192.154.4.25	fffffff8	none[UCSB2 link]

Table 1

5.2. Berkeley

5.3. Los Angeles

5.4. UC San Diego (incl. Scripps)

5.5. UCSD

UCSD/Computer Systems Lab Routing Topology					
Router	Device	Interface-Name	Interface Addr	Netmask	Broadcast
CSL1	ln0	sorrento.ucsd.edu	132.239.17.94	ffffffc0	132.239.17.12
CSL1	fza0	sorrento.s2k.ucsd.edu	192.154.1.201	ffffff00	192.154.1.255
CSL1	fza1	[none]	192.154.4.42	fffffff8	192.154.4.47

Table 2

5.6. Santa Barbara

6. Physical Connection

At the 1992 Sequoia retreat at Lake Tahoe, the S2Knet committee agreed the standard physical host connection to the S2Knet would be FDDI, with an optional (and expected) attachment to other local networks via Ethernet or another FDDI interface. Ordinary local services (e.g. NFS, mail, etc) are expected to be provided over the Ethernet.

Because the S2Knet backbone is expected to reach T3 rates (45Mb/s) by the fourth quarter 1992, using the Ethernet interface (10Mb/s) for S2Knet traffic would soon become a bottleneck.

Many vendor products support the coexistence of two distinct logical networks over the same physical medium. UCB and SDSC have voiced particular interest in this matter. [STILL NEEDS TO BE FILLED IN].

[PHYSICAL SECURITY ISSUES TO BE MENTIONED HERE]

[SHOULD SEQUOIA ROUTERS LIVE ON ANYONE's DMZ??]

7. Naming

Each interface on each router and host is named independently. Hosts and routers may be reached either via the S2Knet directly, or via NSFnet during periods of S2Knet backbone outages.

7.1. Host Naming

Interfaces on S2Knet hosts, as opposed to routers, are named according to the following convention:

- Since S2Knet hosts are assumed to be attached to both the S2Knet as well as a local Ethernet and/or FDDI, each host will have two names. A host named `foo` is referred to as `foo.HOSTSITE.edu` where `HOSTSITE` is one of: `atmos.ucla, cs.berkeley, ucsd, sdsc,` or `ucsb.` This name will refer to the Ethernet interface of the host.

- The S2Knet (FDDI) interface in the above example is referred to as `foo.s2k.S2KSITE.edu`, where `S2KSITE` is one of `ucla, berkeley, ucsd, sdsc,` or `ucsb.` Note the difference between `HOSTSITE` and `S2KSITE`. The latter never contains subdomain components that might come under the installations name. For example, at UCB `HOSTSITE` would be `cs.berkeley`, whereas `S2KSITE` would be only `berkeley`. Currently this distinction only exists at UCLA and UCB. At all other sites `HOSTSITE` and `S2KSITE` are identical.

The relationship between the naming convention and routing and address assignment will be discussed in subsequent sections.

Note that a new subdomain, namely `s2k.S2KSITE.edu` must be created at each site. Responsibility for creating and maintaining the new subdomain namespace is decentralized. See the section on Name Servers for more detail.

7.2. Router Naming

Routers are named in a fashion similar to hosts, with special attention paid to the point-to-point interfaces on the S2Knet backbone.

- Point-to-point interfaces are named in the following way: `local_endpoint-remote_endpoint.s2k.S2KSITE.edu`. For example, at UCSB, the UCSB to SDSC (currently T1) link is named `ucsb-sdsc.s2k.ucsb.edu`. At SDSC, the same link is called `sdsc-ucsb.s2k.sdsc.edu`.

- The Ethernet interface on a router is named `s2k-gwN.S2KSITE.edu`. The *N* is the number of the router, where the first router has the number one. Additional routers will be given successive numbers. Other names can be used as aliases for Ethernet interfaces.

- The FDDI interface on a router is named `gw.s2k.S2KSITE.edu`. From a S2Knet host, typing `telnet gw` will create a connection to the local router using the local S2Knet FDDI. The *N* convention as described above is used if names such as "gw1", etc. are required.

7.3. Name Servers

Establishing a new subdomain (`s2k.S2KSITE.edu`) requires the configuration of a name server to support the mapping of host names to addresses (see section on *addressing*). As site manager, you may either run your own authoritative name server responsible for maintaining the `s2k` mappings, or you may ask your campus' network nameserver maintainers to do this for you. The examples below show locations for files as they exist in the default Ultrix configuration. These locations may be different under SunOS or other operating systems.

A nameserver uses one table for resolving host name to network address queries, and another table of ''reverse'' mappings to resolve address-to-name queries. For reverse queries to operate correctly across the entire Internet, the NIC must be contacted to delegate authority to your site for the network in question.

7.3.1. Forward Mappings

The forward mappings are used by the nameserver to resolve name-to-address queries. At UCSD, the following table is used for the `s2k.ucsd.edu` subdomain: [/usr/var/dss/namedb/hosts.db]:

```
;
; Forward Mappings for S2k.ucsd.edu
;

@          IN     SOA   S2k.UCSD.EDU. kfall.ucsd.edu. (
                          92052118                 ; Serial
                        36000   ; Refresh - 10 hour
                        1800    ; Retry - 30 minutes
                        360000  ; Expire - 4.2 days (100 hrs)
                        86400 )                    ; Minimum TTL - 1 day

                          IN    NS    ucsd.edu.
                          IN    NS    network.ucsd.edu.
$ORIGIN                   S2k.ucsd.edu.
rossano                   IN                   A            192.154.1.193
calabria                  IN                   A            192.154.1.194
capri                     IN                   A            192.154.1.195
crotone                   IN                   A            192.154.1.196
paola                     IN                   A            192.154.1.197
positano                  IN                   A            192.154.1.198
salerno                   IN                   A            192.154.1.199
scalea                    IN                   A            192.154.1.200
sorrento                  IN                   A            192.154.1.201
spezzano                  IN                   A            192.154.1.202
strongoli                 IN                   A            192.154.1.203
```

This table represents an authority record for the `s2k.ucsd.edu` naming subdomain. Currently, the name of the host providing this information is `ucsd.edu`. The nameserver initialization file (usually `/usr/var/dss/namedb/named.boot`) file on `ucsd.edu` contains a line of the form:

```
primary  S2k.UCSD.EDU /usr/var/dss/namedb/hosts.db
```

which causes primary responsibility for this naming subdomain to be retrieved from the file `/usr/var/dss/namedb/hosts.db`.

7.3.2. Reverse Mappings

The nameserver reverse mapping tables provide the nameserver with information necessary to resolve an address-to-hostname query. For S2k at UCSD, the following table is used [/usr/var/dss/namedb/hosts.rev]:

```
; -------------------------------------------------------------------
; Reverse Mappings for S2k.ucsd.edu
; -------------------------------------------------------------------

@          IN     SOA   ucsd.edu. kfall.ucsd.edu. (
                          92052118                 ; Serial
                        36000   ; Refresh - 10 hours
                        1800    ; Retry - 30 minutes
                        360000  ; Expire - 4.2 days (100 hrs)
                        86400 )                    ; Minimum TTL - 1 day

                          IN                       NS          ucsd.edu.
                          IN                       NS          network.ucsd.edu.

193     IN            PTR                          rossano.s2k.ucsd.edu.
194     IN            PTR                          calabria.s2k.ucsd.edu.
195     IN            PTR                          capri.s2k.ucsd.edu.
196     IN            PTR                          crotone.s2k.ucsd.edu.
197     IN            PTR                          paola.s2k.ucsd.edu.
198     IN            PTR                          positano.s2k.ucsd.edu.
199     IN            PTR                          salerno.s2k.ucsd.edu.
200     IN            PTR                          scalea.s2k.ucsd.edu.
201     IN            PTR                          sorrento.s2k.ucsd.edu.
202     IN            PTR                          spezzano.s2k.ucsd.edu.
203     IN            PTR                          strongoli.s2k.ucsd.edu.
```

To enable the reverse mappings, the `/usr/var/dss/namedb/named.boot` file contains a line as follows:

```
primary  1.154.192.IN-ADDR.ARPA /usr/var/dss/namedb/hosts.rev
```

An important difference between the administration of forward and reverse mappings is the need to contact the NIC when establishing an authoritative table of reverse mappings. Machines requesting reverse name lookups for S2KNet machines will typically query a local nameserver for reverse entries, and upon failure revert back to a query to a root nameserver (e.g. at the NIC). If the NIC is not informed (i.e. by a human) of your desire to take over responsibility for a particular set of reverse mapping, the request will fail when it reaches the root nameserver which will be unable to resolve the reverse mapping request. To inform the NIC of your intent on establishing an authoritative nameserver for reverse mapping, obtain the file `nic.ddn.mil:netinfo/in-addr-template.txt` by public ftp, fill it out, and send it to `hostmaster@nic.ddn.mil`.

8. Addressing

Each interface on each host and router in the S2Knet receives its own network address. S2Knet has obtained a number of class C network numbers from the NIC and has allocated them as follows: [Note UCLA has a second network but not a first, and UCSD has no second]

Sequoia 2000 Address Assignments		
Network Name	Campus	Address Range
NET-SEQUOIA1	All	192.154.4.0
NET-SEQUOIA2	All	192.154.5.0
NET-SEQUOIA3	All	192.154.6.0
UCB-SEQUOIA1	Berkeley	192.150.186.0
UCB-SEQUOIA2	Berkeley	192.150.187.0
UCLA-SEQUOIA2	UCLA	192.154.2.0
UCSB-SEQUOIA1	UCSB	192.150.216.0
UCSB-SEQUOIA2	UCSB	192.150.217.0
UCSD-SEQUOIA1	UCSD	192.154.1.0

Table 3

8.1. Subnets and Broadcast Addresses

The subnet structure and choice of subnet mask at each campus is decentralized. The default subnet mask of `0xffffff00` allows one network of 255 hosts. Broadcast addresses will be assigned with all 1's in the host field, except where local practice requires all 0's.

8.2. Interface Addresses

FDDI interfaces are assigned addresses from the campus-allocated class C S2Knet address space listed in Table 2. Ethernet interfaces are assigned addresses from the already-existing subnet structures at each site. For example, the Ethernet interfaces on S2Knet machines at Berkeley would use addresses from the 128.32 class B address space, and at UCSD would use addresses from the 132.239 class B network.

9. Routing

Routing table information is exchanged between the S2Knet routers via the RIP protocol. Each router runs the *gated* program as a routing daemon to control routing information exchange. Gated provides a much finer granularity of control over routing information exchange than most vendor-supplied programs (e.g. *routed*). Gated version 2.1 also provides support for several routing protocols, including HELLO, RIP, EGP, and BGP Version 1. The *gated* program may be obtained via public FTP at `gated.cornell.edu:/pub/gated/gated-2.1.tar.Z` You should also acquire and apply the two patches `gated-2.1.patch1.shar` and `gated-2.1.patch2.shar` also stored in the same directory. The README file in the directory explains additional information. Note there is also another version of *gated* called *gated-alpha* which ostensibly supports OSPF as well.

In an effort to maintain fallback routing to S2Knet machines during periods of S2Knet backbone outages, S2Knet Class C networks will be advertised to the NSFNET Regionals via [XX- WHATEVER ROUTING PROTOCOL IS APPROPRIATE-XX]. Metrics are chosen in such as way that S2Knet hosts will preferentially choose routing via the S2Knet backbone to communicate with remote S2Knet hosts. During S2Knet backbone outages, routing will change in such a way as to prefer NSFNET routing. At no time are routes *through* the S2Knet backbone to be advertised to the NSFNET Regionals.

Here is a sample /etc/gated.conf file for one of the S2Knet routers:

```
#
# Gated configuration file for UCSB Router (links to UCB and SDSC)
#
# BREEZE.UCSB.EDU
#
# Kevin Fall
# June, 1992
```

```
# kfall@ucsd.edu
#

tracefile           "/usr/tmp/gated.trace"          replace;
traceoptions        mark nostamp;
interface           all          passive;
#autonomoussystem xxx

#
# Global protocol descriptions
#                   Supported Routing Protocols
#                   For now, using only RIP, and not advertising on ln0
#

hello off;
bgp off;
egp off;
redirect off;

rip yes {
                    preference   35;
                    defaultmetric                  1;
                    interface    ln0               noripout;
};

#
# Static Routes
#

# default gateway
static {
                    default      gateway           olive-fddi.s2k.ucsb.edupreference70;
};

#
# Route Acceptances
#

accept proto rip {
                    nolisten     default;
                    listen                         all;
};

#
# Route Advertisements
#

# Announcements on the UCSB s2k net
propagate proto rip interface fza0 {
                    proto rip {
                                 announce          ucb-s2k1;
                                 announce          ucb-s2k2;
                                 announce          ucsd-s2k1;
                                 announce          sequoia1 mask 255.255.255.0 ;
                    };

                    proto direct {
```

```
                    announce    ucb-s2k1;
                                announce        ucb-s2k2;
                                announce        ucsd-s2k1;
                                announce        sequoia1 mask 255.255.255.0 ;
                    };
};

# Announcements on the UCSB<->UCB link
propagate proto rip interface ds0 {
                    proto rip {
                                announce        ucsb-s2k1;
                                announce        ucsb-s2k2;
                                announce        ucsd-s2k1;
                                announce        ucla-s2k2;
                                announce        sequoia1 mask 255.255.255.0 ;
                    };

                    proto direct {
                                announce        ucsb-s2k1;
                                announce        ucsb-s2k2;
                                announce        ucsd-s2k1;
                                announce        ucla-s2k2;
                                announce        sequoia1 mask 255.255.255.0 ;
                    };
};

# Announcements on the UCSB<->SDSC link
propagate proto rip interface ds1 {
                    proto rip {
                                announce        ucb-s2k1;
                                announce        ucb-s2k2;
                                announce        ucsb-s2k1;
                                announce        ucsb-s2k2;
                                announce        ucla-s2k2;
                                announce        sequoia1 mask 255.255.255.0 ;
                    };

                    proto direct {
                                announce        ucb-s2k1;
                                announce        ucb-s2k2;
                                announce        ucsb-s2k1;
                                announce        ucsb-s2k2;
                                announce        ucla-s2k2;
                                announce        sequoia1 mask 255.255.255.0 ;
                    };
};
```

10. Contacts

This section lists human contacts for the S2Knet. Everyone associated with the S2Knet should be listed here. Name, postal address, email address, phone number, fax number, and relationship/responsibility to the S2Knet.

10.1. S2Knet Manager

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10.9. Full Contact List

[NEEDS TO BE FILLED IN WITH CONTACT INFO FOR EVERYONE LISTED ON FRONT PAGE]

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