Network Discovery Tool

Bestin Jose
Mahesh Kumar
Shyamsunder

Computer Science and Engineering
Indian Institue of Technology
Bombay

November 28, 2004

Problem Statement

To implement the algorithm which discovers the network topology information and give it to NetDisco tool.

Netdisco then uses this information to moniter and manage the network.

Problem Statement

To implement the algorithm which discovers the network topology information and give it to NetDisco tool.

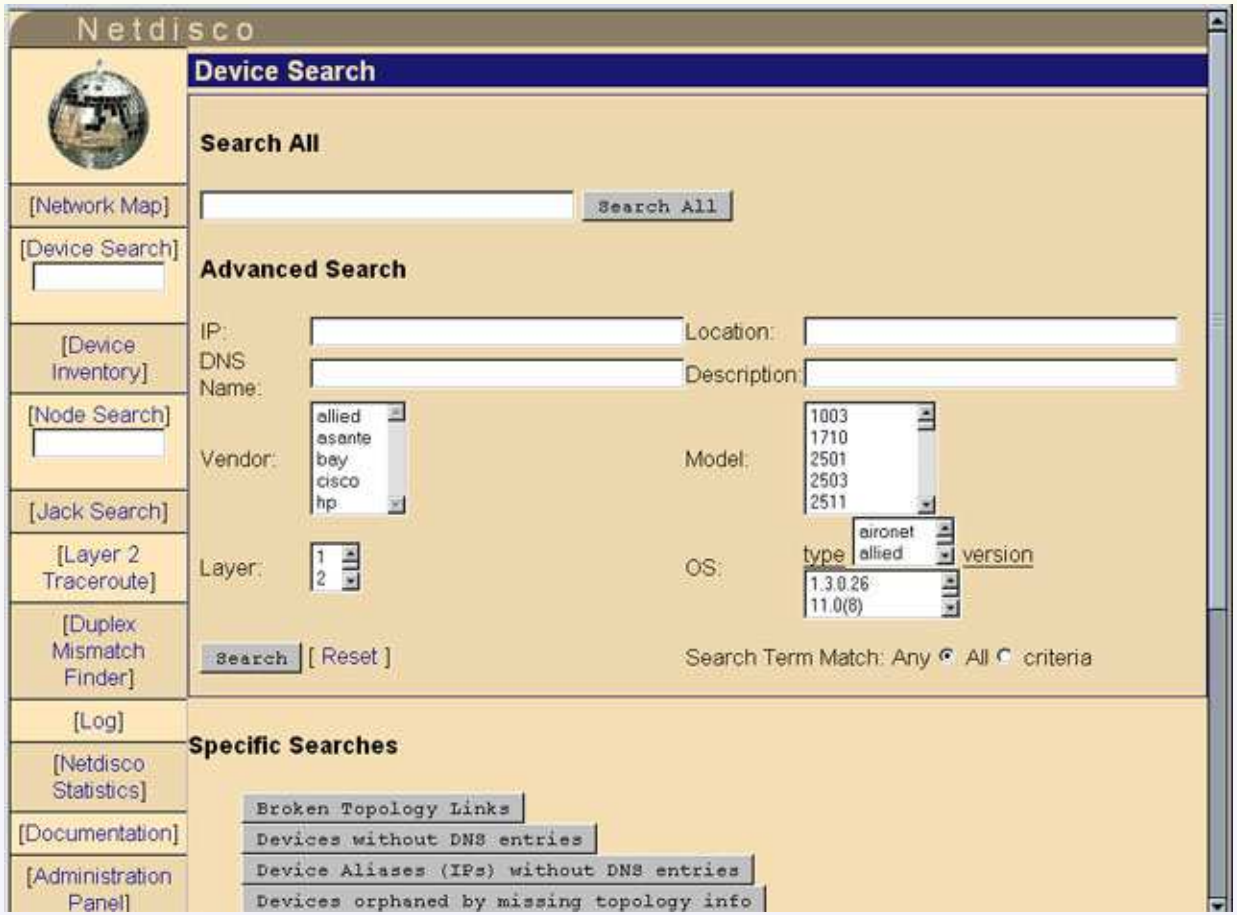
Netdisco then uses this information to moniter and manage the network.

What is NetDisco

- Netdisco is an Open Source web-based network management tool.
- Designed for moderate to large networks.
- Configuration information and connection data for network devices are retrieved using SNMP protocol.
- With Netdisco you can locate the switch port of an end-user system by IP or MAC address.

Screenshot of NetDisco

screenshot_03.jpg (JPEG Image, 640x473 pixels) http://netdisco.org/screenshot_03.jpg



Features of NetDisco
Switch Ports

- Central Location to disable/enable switch ports.
- MAC Address to switch port resolution
- IP Address to switch port resolution
- Find Switch Ports with multiple nodes attached
- Find nodes using multiple IP addresses

Features contd.

- **Easy Administration:**
  Controllable through Web Interface or Command Line Interface(CLI).
  Database store for scalability and speed.
  Easily extendible to new devices.
- **Network Administration and Security:**
  Automatic inventory and search of network hardware.
  Duplex Mismatch Finder.
  Layer Two Traceroute.

Features contd.

- **Easy Administration:**
  Controllable through Web Interface or Command Line Interface(CLI).
  Database store for scalability and speed.
  Easily extendible to new devices.
- **Network Administration and Security:**
  Automatic inventory and search of network hardware.
  Duplex Mismatch Finder.
  Layer Two Traceroute.

Features contd.

- **Reporting:**
  Graphing of network topology. Clickable image-map of devices. Link speed shown.
  Statistics for number of actual nodes connected to network.
- **Inventory of Network Devices:**
  By Operating System (IOS,CatOS,HP...)
  By Model, Vendor, OSI Layer, DNS Name
  Find device ports that are blocking (via Spanning Tree Protocol)
  Find devices using IP's w/out DNS entries

Features contd.

- **Reporting:**
  Graphing of network topology. Clickable image-map of devices. Link speed shown.
  Statistics for number of actual nodes connected to network.
- **Inventory of Network Devices:**
  By Operating System (IOS,CatOS,HP...)
  By Model, Vendor, OSI Layer, DNS Name
  Find device ports that are blocking (via Spanning Tree Protocol)
  Find devices using IP's w/out DNS entries

Proposed Work

- Netdisco autodiscovers devices which support CDP protocol.
- However, many networks have parts of the topology that are not covered by CDP.
- We need to fill the information of the devices which does not suppot CDP protocol in **netdisco-topology.txt**.

Our Work

To discover the network topology and give the topology information in the format required by Netdisco. For this we will use SNMP protocol.

Proposed Work

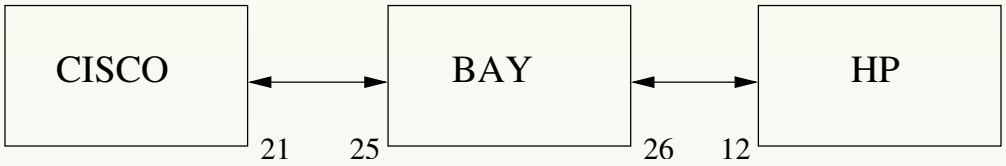
- Netdisco autodiscovers devices which support CDP protocol.
- However, many networks have parts of the topology that are not covered by CDP.
- We need to fill the information of the devices which does not suppot CDP protocol in **netdisco-topology.txt**.

Our Work

To discover the network topology and give the topology information in the format required by Netdisco. For this we will use SNMP protocol.

Example format of netdisco-topology.txt file

Let's say you have two CDP speaking devices with a non-CDP speaking device in between them.



topology file:

ciscoswitch.my.company
link:21,bayswitch.my.company,25
bayswitch.my.company
link:26,hpswitch.my.company,12

Snmp ptotocol

- SNMP is a protocol designed to give remote management access to a Network device.
- **Features:**
  - Enable/disable a port
  - Checks health and performance of the network.
  - Access control.
  - Error statistics etc...

Snmp ptotocol

- SNMP is a protocol designed to give remote management access to a Network device.
- **Features:**
  - Enable/disable a port
  - Checks health and performance of the network.
  - Access control.
  - Error statistics etc...

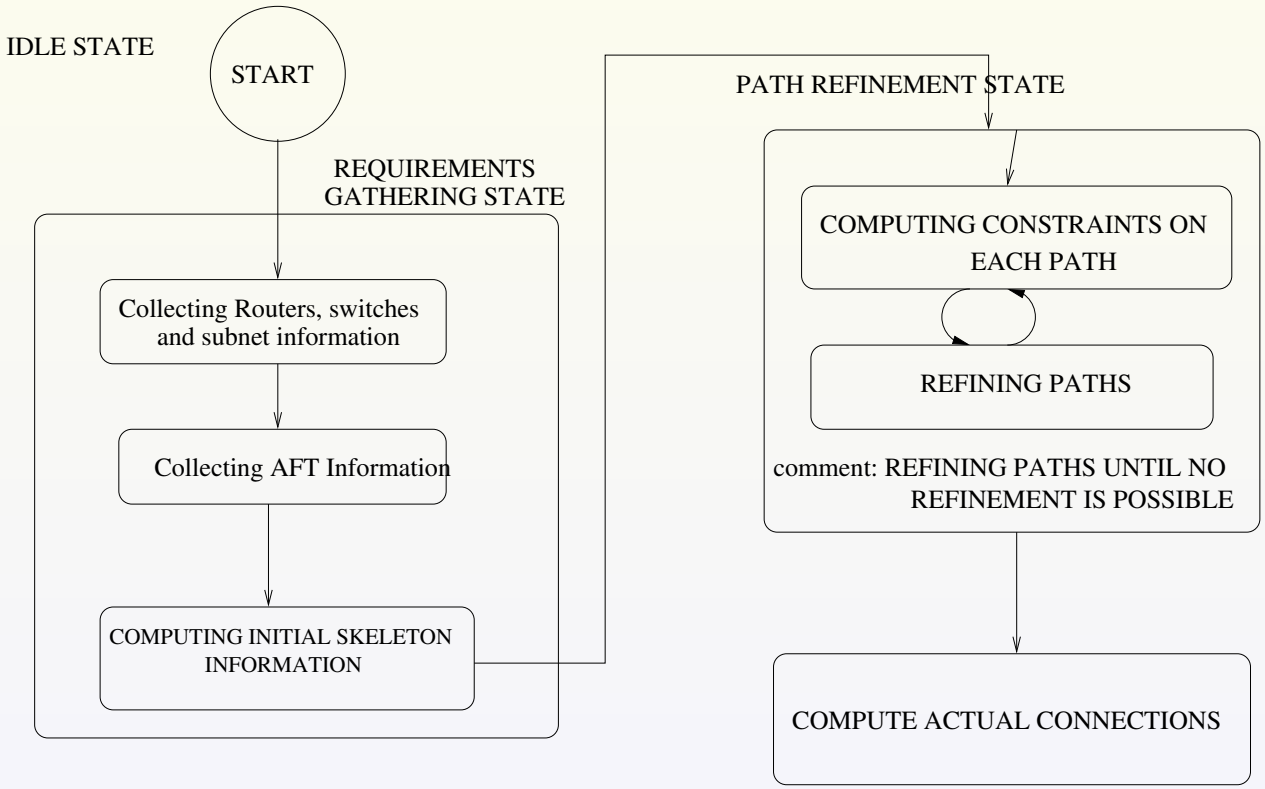
Idea of the Algorithm

1. Represents the network by a collection of skeleton paths, **Q**, between pairs of nodes belonging to the same subnet.
2. Iteratively refines **Q** to provide more accurate topology information for the network.

Idea of the Algorithm

1. Represents the network by a collection of skeleton paths, **Q**, between pairs of nodes belonging to the same subnet.
2. Iteratively refines **Q** to provide more accurate topology information for the network.

Flow diagram for the Algorithm



Inputs to the Algorithm

Router Information

- **Constraints:** You need to know atleast One Router IP address
- **Idea:** Repeatedly find the neighboring routers of the currently known routers until no new routers are discovered.
- **Implementation:** The neighboring routers of a router R are the set of routers that are next hops for some destination in the **ipRouteTable** in MIB-II in R.
- **Shell Command:** **snmpwalk -0s -c public -v 1 10.105.1.250 ipRouteTable**
- **Perl Module:** **Net::SNMP::Hostinfo module**

Inputs to the Algorithm

Router Information

- **Constraints:** You need to know atleast One Router IP address
- **Idea:** Repeatedly find the neighboring routers of the currently known routers until no new routers are discovered.
- **Implementation:** The neighboring routers of a router R are the set of routers that are next hops for some destination in the **ipRouteTable** in MIB-II in R.
- **Shell Command:** **snmpwalk -0s -c public -v 1 10.105.1.250 ipRouteTable**
- **Perl Module:** **Net::SNMP::Hostinfo module**

Inputs to the Algorithm

Router Information

- **Constraints:** You need to know atleast One Router IP address
- **Idea:** Repeatedly find the neighboring routers of the currently known routers until no new routers are discovered.
- **Implementation:** The neighboring routers of a router R are the set of routers that are next hops for some destination in the **ipRouteTable** in MIB-II in R.
- Shell Command: snmpwalk -0s -c public -v 1 10.105.1.250 ipRouteTable
- Perl Module: Net::SNMP::Hostinfo module

Inputs to the Algorithm

Router Information

- **Constraints:** You need to know atleast One Router IP address
- **Idea:** Repeatedly find the neighboring routers of the currently known routers until no new routers are discovered.
- **Implementation:** The neighboring routers of a router R are the set of routers that are next hops for some destination in the **ipRouteTable** in MIB-II in R.
- **Shell Command:** **snmpwalk -0s -c public -v 1 10.105.1.250 ipRouteTable**
- **Perl Module:** **Net::SNMP::Hostinfo module**

Inputs to the Algorithm

Router Information

- **Constraints:** You need to know atleast One Router IP address
- **Idea:** Repeatedly find the neighboring routers of the currently known routers until no new routers are discovered.
- **Implementation:** The neighboring routers of a router R are the set of routers that are next hops for some destination in the **ipRouteTable** in MIB-II in R.
- **Shell Command:** **snmpwalk -0s -c public -v 1 10.105.1.250 ipRouteTable**
- **Perl Module:** **Net::SNMP::Hostinfo module**

Inputs to the Algorithm contd..

Switch Information

- A interface of the router connects one subnet to the network.
- **Idea:** The IP addresses of the subnet can be determined by knowing the IP address of the interface.
- **Implementation:**
  - The IP address of the interface is obtained using **ipAddrTable** in MIB-II.
  - The subnet entities are computed by enumerating the ip addresses in the subnet corresponding to the IP address of the interface.
  - From the **ipNetToMediaTable** we can find subnet,mac address, system name and the number of ports.
  - We determine whether a particular ip address is a device by checking **ipForwarding** flag or **system.sysService** variables.
- **Perl Module: Net::SNMP::Hostinfo module**

Inputs to the Algorithm contd..

Switch Information

- A interface of the router connects one subnet to the network.
- **Idea:** The IP addresses of the subnet can be determined by knowing the IP address of the interface.
- **Implementation:**
  - The IP address of the interface is obtained using **ipAddrTable** in MIB-II.
  - The subnet entities are computed by enumerating the ip addresses in the subnet corresponding to the IP address of the interface.
  - From the **ipNetToMediaTable** we can find subnet,mac address, system name and the number of ports.
  - We determine whether a particular ip address is a device by checking **ipForwarding** flag or **system.sysService** variables.
- **Perl Module: Net::SNMP::Hostinfo module**

Inputs to the Algorithm contd..

Switch Information

- A interface of the router connects one subnet to the network.
- **Idea:** The IP addresses of the subnet can be determined by knowing the IP address of the interface.
- **Implementation:**
  - The IP address of the interface is obtained using **ipAddrTable** in MIB-II.
  - The subnet entities are computed by enumerating the ip addresses in the subnet corresponding to the IP address of the interface.
  - From the **ipNetToMediaTable** we can find subnet,mac address, system name and the number of ports.
  - We determine whether a particular ip address is a device by checking **ipForwarding** flag or **system.sysService** variables.
- Perl Module: Net::SNMP::Hostinfo module

Inputs to the Algorithm contd..

Switch Information

- A interface of the router connects one subnet to the network.
- **Idea:** The IP addresses of the subnet can be determined by knowing the IP address of the interface.
- **Implementation:**
  - The IP address of the interface is obtained using **ipAddrTable** in MIB-II.
  - The subnet entities are computed by enumerating the ip addresses in the subnet corresponding to the IP address of the interface.
  - From the **ipNetToMediaTable** we can find subnet,mac address, system name and the number of ports.
  - We determine whether a particular ip address is a device by checking **ipForwarding** flag or **system.sysService** variables.
- Perl Module: Net::SNMP::Hostinfo module

Inputs to the Algorithm contd..

Switch Information

- A interface of the router connects one subnet to the network.
- **Idea:** The IP addresses of the subnet can be determined by knowing the IP address of the interface.
- **Implementation:**
  - The IP address of the interface is obtained using **ipAddrTable** in MIB-II.
  - The subnet entities are computed by enumerating the ip addresses in the subnet corresponding to the IP address of the interface.
  - From the **ipNetToMediaTable** we can find subnet,mac address, system name and the number of ports.
  - We determine whether a particular ip address is a device by checking **ipForwarding** flag or **system.sysService** variables.
- **Perl Module: Net::SNMP::Hostinfo module**

Inputs to the Algorithm contd..

Address Forwarding Table(AFT) information

- Now we got all the MAC addresses of routers and switch in the system.
- Every Port of a switch or router has Address forwarding table.
- Definition: AFT for a port is the set of MAC addresses that have been seen as source addresses on frames received at that port.
- **Constraint:** AFT information should be complete.
- AFT info is complete if it contains MAC addresses of all switches and routers from which frames can be received at that particular port.
- **Implementation:** Perl Module SNMP::Info::Bridge.

Inputs to the Algorithm contd..

Address Forwarding Table(AFT) information

- Now we got all the MAC addresses of routers and switch in the system.
- Every Port of a switch or router has Address forwarding table.
- Definition: AFT for a port is the set of MAC addresses that have been seen as source addresses on frames received at that port.
- **Constraint:** AFT information should be complete.
- AFT info is complete if it contains MAC addresses of all switches and routers from which frames can be received at that particular port.
- **Implementation:** Perl Module SNMP::Info::Bridge.

Inputs to the Algorithm contd..

Address Forwarding Table(AFT) information

- Now we got all the MAC addresses of routers and switch in the system.
- Every Port of a switch or router has Address forwarding table.
- Definition: AFT for a port is the set of MAC addresses that have been seen as source addresses on frames received at that port.
- **Constraint:** AFT information should be complete.
- AFT info is complete if it contains MAC addresses of all switches and routers from which frames can be received at that particular port.
- **Implementation:** Perl Module SNMP::Info::Bridge.

Inputs to the Algorithm contd..

Address Forwarding Table(AFT) information

- Now we got all the MAC addresses of routers and switch in the system.
- Every Port of a switch or router has Address forwarding table.
- Definition: AFT for a port is the set of MAC addresses that have been seen as source addresses on frames received at that port.
- **Constraint:** AFT information should be complete.
- AFT info is complete if it contains MAC addresses of all switches and routers from which frames can be received at that particular port.
- **Implementation:** Perl Module SNMP::Info::Bridge.

Inputs to the Algorithm contd..

Address Forwarding Table(AFT) information

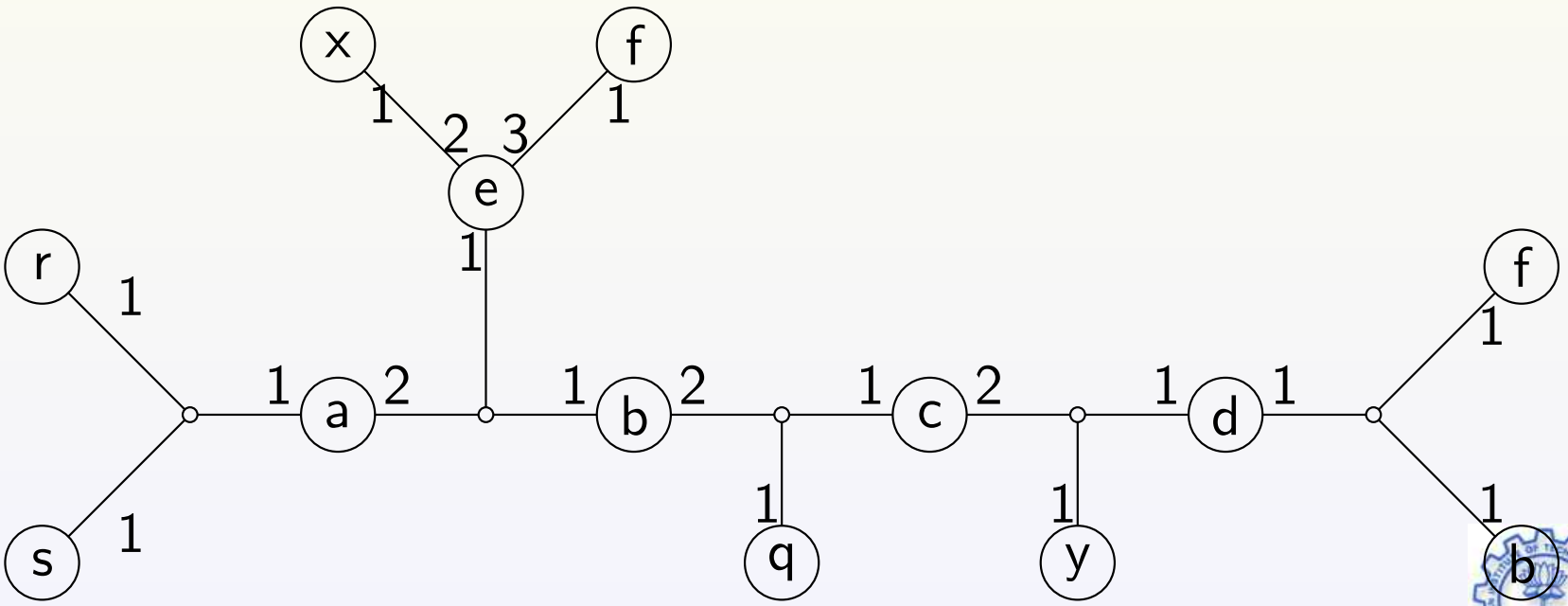
- Now we got all the MAC addresses of routers and switch in the system.
- Every Port of a switch or router has Address forwarding table.
- Definition: AFT for a port is the set of MAC addresses that have been seen as source addresses on frames received at that port.
- **Constraint:** AFT information should be complete.
- AFT info is complete if it contains MAC addresses of all switches and routers from which frames can be received at that particular port.
- **Implementation:** Perl Module SNMP::Info::Bridge.

Inputs to the Algorithm contd..

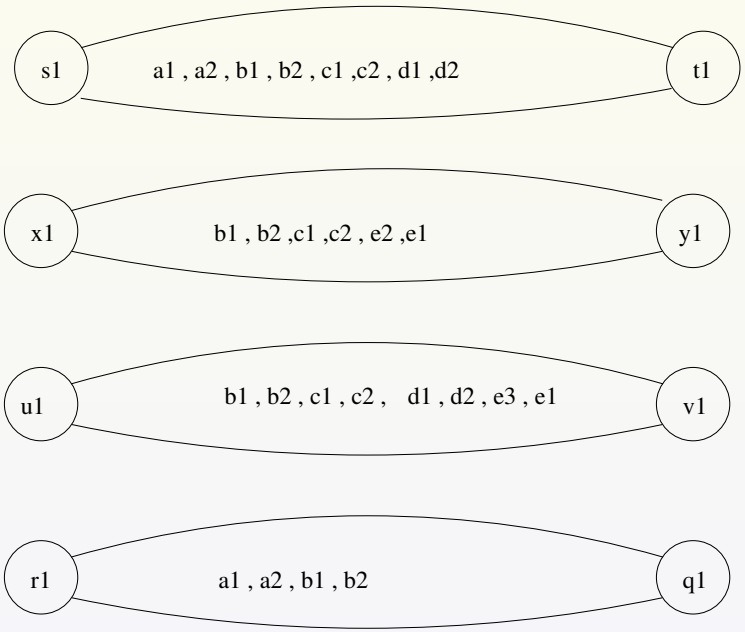
Address Forwarding Table(AFT) information

- Now we got all the MAC addresses of routers and switch in the system.
- Every Port of a switch or router has Address forwarding table.
- Definition: AFT for a port is the set of MAC addresses that have been seen as source addresses on frames received at that port.
- **Constraint:** AFT information should be complete.
- AFT info is complete if it contains MAC addresses of all switches and routers from which frames can be received at that particular port.
- **Implementation:** Perl Module SNMP::Info::Bridge.

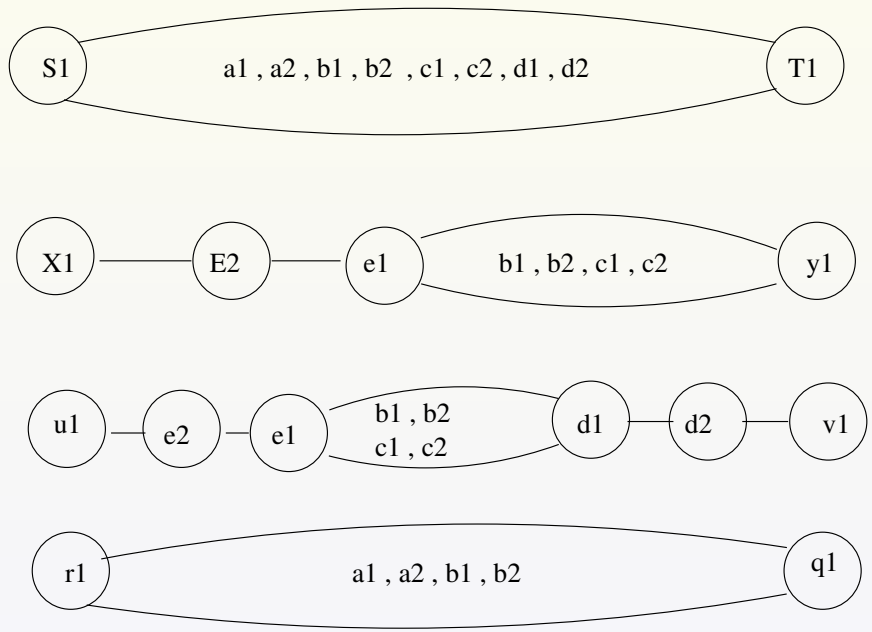
Example
Original Network Topology



Example contd.

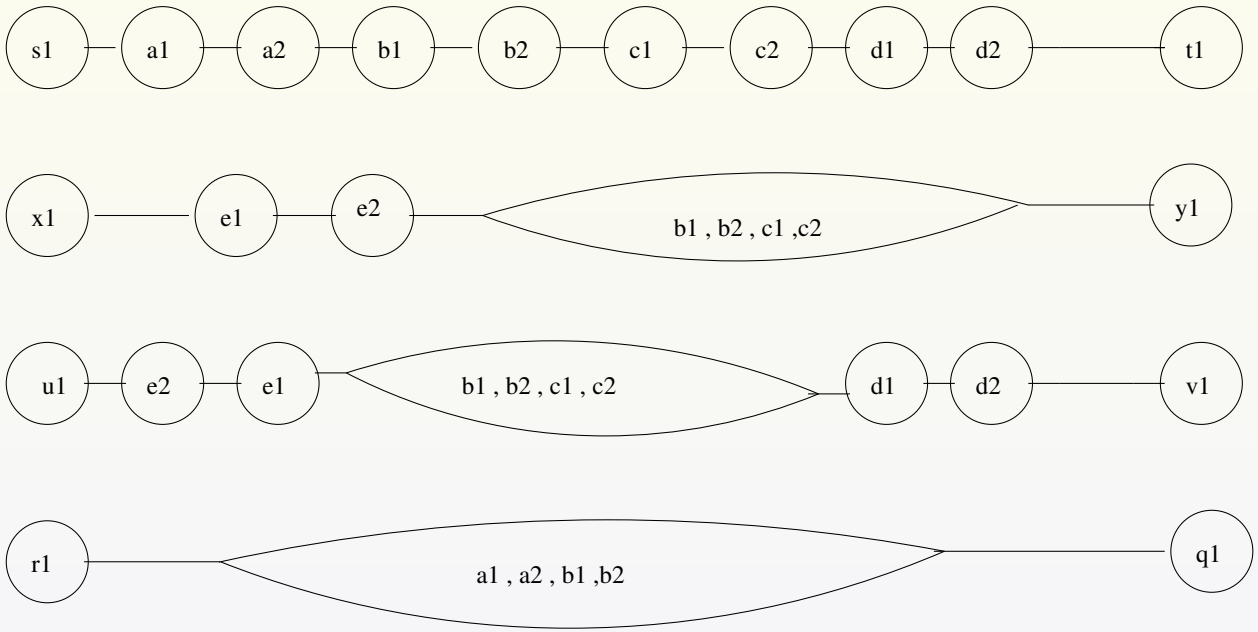


Skeleton Paths



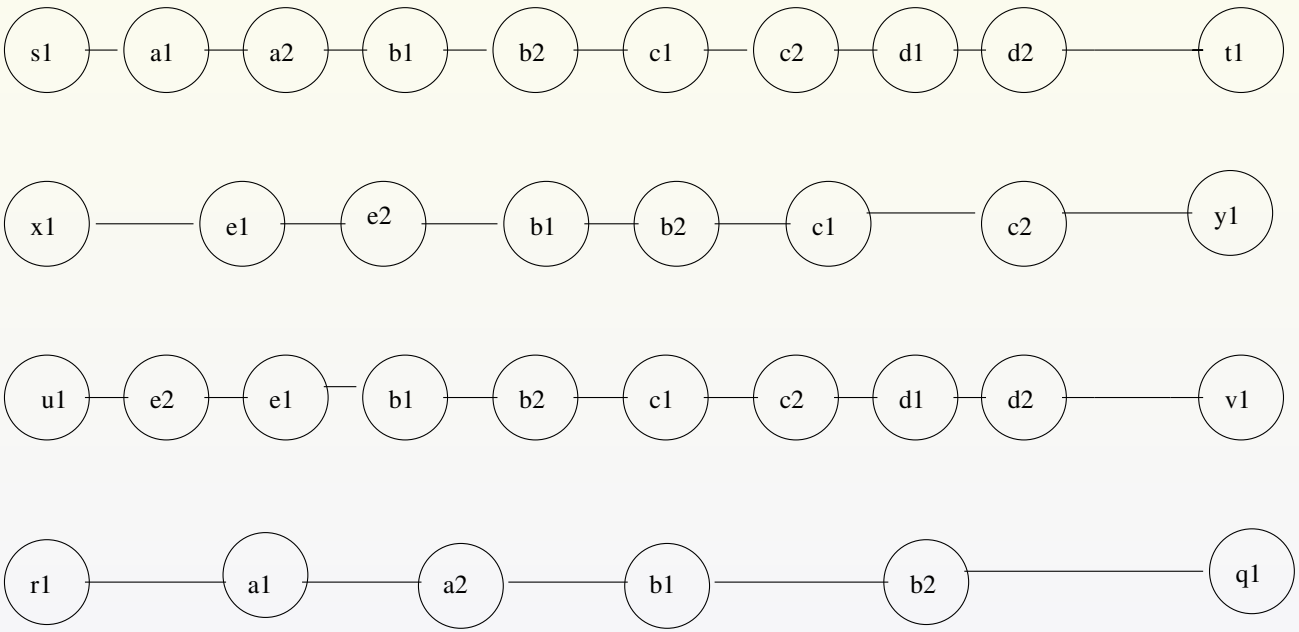
After first Iteration

Example contd.



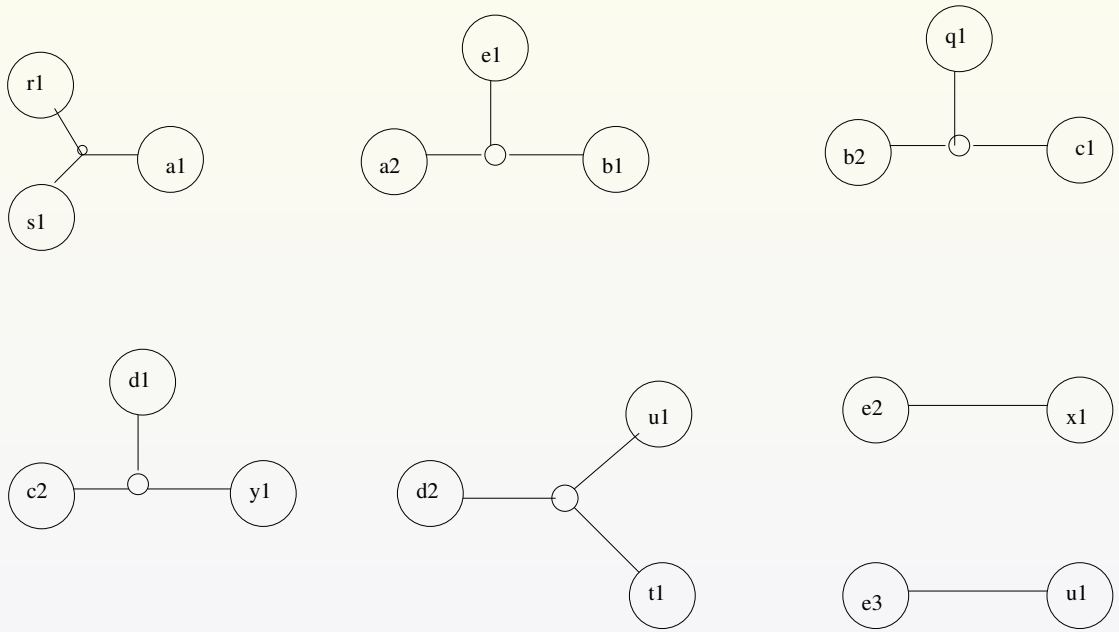
After second iteration

Example contd.



After third iteration

Example contd.



Resulting Connections

Plan of Implementation

We will be using perl language for implementation.

The perl modules which will be used are:

NET::SNMP

- Net::SNMP is a collection of various tools relating to the snmp including:
  - An SNMP library
  - Tools to request or set information from SNMP agents.
  - Tools to generate and handle SNMP traps etc..
- FUNCTIONS: snmpget, snmpset, snmpwalk, snmpgetnext, snmpstatus
  snmpnetstat, snmptable, snmptranslate etc...

Plan of Implementation contd.

SNMP::INFO

- Perl5 module to network devices through snmp.
- SNMP::INFO gives an object oriented interface to information obtained through SNMP.
- SUB-CLASSES:
  SNMP::INFO::BRIDGE, SNMP::INFO::CDP,
  SNMP::INFO::ETHERLIKE, SNMP::INFO::LAYER1
  SNMP::INFO::LAYER2, SNMP::INFO::LAYER3,
  SNMP::INFO::MAU
- METHODS:
  device_type(), uptime(), name(), ports(), interfaces() etc...

References

1. *Physical Topology Discovery for Large Multi-Subnet Networks.* Yigal Bejerano, Yuri Breitbart , Minos Garofalakis, Rajeev Rastogi. Bell Labs, Lucent Technologies
2. *Topology Discovery in Heterogeneous IP Networks.* Yuri Breitbart, Minos Garofalakis, Cliff Martin, Rajeev Rastogi, S. Seshadri, Avi Silberschatz. Information Sciences Research Center Bell Labs, Lucent Technologies.
3. *www.netdisco.org*
4. www.net-snmp.org
5. *http://snmp-info.sourceforge.net*
6. http://www.cpan.org/modules/by-module/SNMP/
7. *http://www.switch.ch/misc/leinen/snmp/perl*