Asynchronous Transfer Mode Switching Topology Design and Implementation: An Information Networking and Telecommunications Capstone Project

Completed for
Nex-Tech, Inc.
By
Intelligent Solutions Consulting

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Table Of Contents

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Intelligent Solutions Consulting was awarded a contract to provide technological consulting services to organize, design and implement a network topology change for Nex-Tech, Inc. This project completed the transition from a Frame Relay switched network topology to an Asynchronous Transfer Mode (ATM) switching method in the backbone of Nex-Tech's network. Nex-Tech needed the flexibility and functionality of a redundant ATM backbone that could carry a massive amount of data throughout their service area.

Intelligent Solutions Consulting is pleased to announce the completion of this project, and is happy to report success in the endeavor. The following will be a report explaining Asynchronous Transfer Mode technologies, the specifics of the Nex-Tech migration process, thus showing the skills acquired by members of Intelligent Solutions Consulting by the completion of this project.

Asynchronous Transfer Mode (ATM) Technologies

Asynchronous Transfer Mode is a switching technology that transfers data digitally in fixed 53-byte cell units. ATM uses circuit switching – where a direct connection is made end-to-end during transfer of data – and can be multiplexed over the set transmission path. All these characteristics allow ATM be a fast and reliable technology that is scalable for future growth.

ATM allows effective use of its bandwidth by allowing multiple different signals to be multiplexed over the same physical link. This makes ATM the perfect choice for multi-media networks that host a number of different services.

The fixed size of the ATM cells allows bandwidth heavy and bandwidth light data to be transferred together without the bandwidth intensive signal monopolizing capacity and speed of the transmission medium. For instance, a telephone conversation needs only 8 kilobytes per second of bandwidth, while a digital subscriber line (DSL) Internet line can run up to 1.544 megabits of information a second. Under frame relay, there is no fixed size to each cell / frame / data packet. The DSL Internet data has inherently bigger packets and are sent at a faster rate. Those huge and fast cells do not allow the smaller and slower telephone packets to have the same access to the bandwidth of the backbone. Since ATM splits up these frames into fixed 53 byte cells, the telephone signal is given equal access to the medium, but still not degrading the quality of the DSL Internet speed.

ATM is able to process and switch data quickly because it uses hardware – and not software – to be implemented. ATM's scalability is attributed to standardization of the bit rates of 155.520 and 622.080, which are the same as the standards made for Synchronous Optical Networks (SONET). ATM can be used on any optical carrier line up to the technological limit of the time.

ATM also has four different classes of service that allow network operators the ability to give certain applications varying throughput and latency metrics to meet the requirements of each particular service through ATM Abstraction Layers.

Bandwidth demands are the limiting factor in most companies that provide telephony and Internet services to consumer populations. New services and state-of-the-art technologies that are becoming ubiquitous require an ever-present increase in bandwidth on the network's backbone. Along with the shear amount of bandwidth required, it is requisite that the available bandwidth is used most efficiently. This is done in avoidance of potential bottlenecks, using equipment in the company that is best suited for a particular job, and using the scarce public IP addresses an organization has effectively.

ATM switching has become a popular switching protocol for carriers since it offers not only high speed transportation of data and voice but also can guarantee a high quality of service which is critical in today's bandwidth intensive environment. With over eighty percent of carriers now using ATM in their backbones, it is becoming the choice for core network backbones. ATM is also bandwidth flexible. Digital lines up to an OC-48 can be used in ATM networks, but also standard T-1 lines can be used. This allows an ATM topology to grow with the network's growth of services handed by the core network (atmforum.com, 2001). Along with being robust, ATM is efficient, simple, and manageable, since ATM can use existing technologies that are ubiquitous in the current network and allow integration of different types of signals and modulations (Subramanyan, 1995).

The Nex-Tech Migration Project -- Background

Even though Intelligent Solutions Consulting had no direct input on the makeup of the ATM backbone and equipment – as it was completed before the group acquired this project – it is still crucial to look at the specific reasons Nex-Tech decided an upgrade path to an ATM backbone was beneficial for their company.

Nex-Tech became interested in having an ATM backbone when they saw all the potential upsides involved in ATM switching as discussed above. This was magnified when they looked at some of their current, implemented technologies in the network's present design. They saw the possibility for future bottlenecks caused by increases in users and services. An ATM upgrade enhanced the quality of the network backbone in a couple ways. First, it allowed scaleable capacity upgrading in the network for future needs. The Marconi ATM products Nex-Tech purchased allowed them the ability to use up to OC-786 digital lines with the same equipment. Although the present backbone runs on an OC-3 line, the future of communications that is geared to streaming, multimedia information on demand, will require an ever-increasing demand for increased capacity so Nex-Tech can adapt to the changes in the market. This backbone upgrade allowed Nex-Tech to move away from frame relay in the backbone, as some of the equipment was limited to a line speed of a T-1, and was a bottleneck in the network.

Also, this new backbone gives Nex-Tech added reliability of service. The ATM backbone is fully redundant using the Public Network to Network Interface (PNNI) specifications. Basically, there is redundancy in the backbone because it is a looped system – each switch has two interfaces going out of it. If one interface on a switch goes down, the switch will automatically adjust to the interface being down and will switch to the second interface. This reliability is critical in Nex-Tech's business as an Internet and content provider for western Kansas.

The Nex-Tech Migration Project – Skill Upgrades

By far the most critical thing that Intelligent Solutions Consulting obtained for successful completion of this project was an in-depth understanding of ATM technologies and standards.

Our group members took this opportunity to learn and relished in it. Our group members have a basic understanding of ATM that the Information Networking and Telecommunications department's curriculum provided for us, but none of us had the extensive knowledge that was requisite for this project. Group members researched and gained understanding of the basic concepts of ATM switching and the processes and standards that surround this technology.

Research also took place on each piece of equipment that Nex-Tech has in the ATM backbone. This again gave group members the opportunity to find out information on something that, for the most part, is outside the standard syllabus of INT students. The fact that Nex-Tech is not solely dependent on Cisco Systems equipment made this project an adventure and also a time to see other options for networking equipment.

Understanding of the Nex-Tech network was also an essential part of the information discovery process. The reasons for the current topology and networking design and the different services that ran on the Nex-Tech network all had to be looked at and understood by group members. For instance, the Palco 5200 Router #2 that was the focus of our project runs a pool of IP addresses for dial up Internet customers in Palco, also it directs traffic to a private IP network that is comprised of the Palco High School and a few business's in Palco. Determining these services and how they will interact with the migration process forced us to look at all the different skills that our group has learned in the INT department curriculum. It was truly a project that tested the knowledge accumulated in our years of study in INT, but also required the accruing of new obligatory skills in order for successful completion of this venture.

The Nex-Tech Migration Project – Processes and Procedures

Intelligent Solutions Consulting developed a three-step plan for completion of this ATM migration project. We feel that each step was a success, but nonetheless, each had issues surrounding it that did not go exactly as to plan.

The first step was for information gathering and skill building. As alluded to in the past section, the information discovery was by far the most time consuming part of the assignment. In this step group members worked closely with Nex-Tech personnel to obtain technical information about the network topology, performance monitors, router and switch configurations, and Nex-Tech's exact expectations of Intelligent Solutions Consulting. Even though group members occasionally had to traverse through some different people to get information, we managed to get all of this information and stay on track on our timeline. The second part of this first step was to gain as much knowledge on ATM technologies and the specific equipment that was being used in this project. Although information is not as ubiquitous on Marconi equipment – compared to Cisco Systems equipment -- and said information is often esoteric, group members where able to gain a considerable amount of erudition from these materials.

The second step in this migration project was to develop a new physical topology and reconfigure the routers, switches, and media converters effected by this change over to ATM. This step allowed group members to use what they have learned in the information discovery process. The topology change was rather small; all we needed to do was to move a router from a frame relay switch to an ATM media converter. As can be seen on the attached before and after topology documentation. However, the simplicity of the topology design was more than compensated in the complexities of device configuration between the Palco 5200 Router #2 and the core Internet routers. A total of five devices needed to have some configuration changes done to them. They are as follows (listed core to edge):

1) Sprint Internet Router
2) Cable and Wireless Internet Router
3) Redback
4) Marconi 3810
5) Palco AS 5200 Router

Nex-Tech added a couple of additional expectations to us during this stage of the project. The first was that they wanted to remove the termination of the Palco Router services from the Cable and Wireless Internet Router and move them to the Sprint Internet Router. They wanted this to happen because they are working on balancing the load on both of these core routers, and they felt that the Sprint Router did not have as many connections being terminated on it. This was not a huge change, but required us to look at both of these core routers and added a little more complexity to the project. Also, while we where going to be working on the Palco router, Nex-Tech wanted to do an IOS upgrade. We had no problems accommodating that request, and found the needed files to do that flash upgrade.

In the concluding steps of this second stage, group members developed the actual working configuration files that would be used in the completed migration. These files are attached with one caveat: the IP addresses and other sensitive information included in the configurations have been deleted and sometimes changed. This is to ensure the integrity of the Nex-Tech network so it does not comprise their network to malaise attacks. The specifics of these changes will be developed in the coming section.

The final step was to actually take our working configurations and topology and implement them into the Nex-Tech environment. On a Wednesday morning, during a slow traffic period, Intelligent Solutions Consulting went to Palco, Kansas and performed the network migration. The Palco router was taken offline and the following steps where done.

The configurations were changed starting with the core and then working our way to the Palco portion of the network. The NewBridge frame relay traffic from the Palco Router #2 originally flowed through the Cable and Wireless Core Internet Router via IP route statements. Since Nex-Tech was wanting to balance the load between the two core routers (Cable & Wireless and Sprint) because the Cable and Wireless router had more traffic flowing through it than the Sprint router, we took out the existing IP route statements and moved them to the Sprint core router. The IP route statements placed in the Sprint router forwards traffic bound for portions of the Palco network. The first route statement we added was for the Palco High School IP NAT addressing pool. The second route was for the Async Pool on the Palco 5200 #2 router. The final IP route statement added was for a small business network. All IP route statements are directed to the next hop address of the Redback. Since the configuration of the ATM backbone is done with permanent virtual circuits (PVCs) there is no need to have a specific route statement for each of the ATM switches in between the Palco 5200 #2 router and the Redback.

Once in the Redback, additional IP route statements and IP addresses had to be added to the Occam/Palco interface (designating the Palco section of the network). At this time we added 3 IP addresses; one IP address for the small business network, one for the Palco HS, and one for the Palco 5200 #2 router. Next, we added IP route statements. The first IP route statement directed traffic bound for the Palco High School IP NAT Pool to the next hop address of the Palco High School Router. The second IP route statement directed traffic bound for the Async pool to the next hop address of the Ethernet 0 interface on the Palco 5200 #2 router. No additional IP route statements were added for the small business network because the small business network has not been converted to PPPoE and is running off an Ethernet link on the

Marconi 3810 out to a Pairgain DSL Shelf. The Redback system however has an IP address on the Occam/Palco interface for this network. This IP address allows Redback to bridge traffic to this network directly. The Palco High School has also not been converted to PPPoE and is running off the Pairgain DSL shelf and its IP address on the Occam/Palco interface in Redback allows for a route from Redback directly to their network.

After these configuration changes were complete we moved to the Palco router specifically. Before starting any of the changes to any device all dial-up Internet users were disconnected from the modem via the command clear modem all. We also had to issue a shutdown command on the conters T1 interfaces via the interface config and typing "shutdown". Next to change the configuration of the router from Frame Relay we used the shutdown command on the Frame Relay configured serial interfaces. We also removed the loopback interface configured on the router by using the no interface loopback 0 command. The configuration of the Async interface from IP unnumbered loopback 0 to IP unnumbered Ethernet 0 was also changed. The IP address pool for the Async interface stayed the same. At this point we then changed the IP address of the Ethernet interface and also changed the IP route statement. The IP route statement now sends all information it doesn't know a specific the path for to the newly configured IP address on the Occam/Palco interface on the Redback. From here Redback can route -- through its routing statements -- the traffic appropriately.

Here is an itemized list and description of each of the changes made to the routers, switches, and media converters.

Sprint Internet Router:

ip route 10.2.3.2 255.255.255.0 10.2.6.1

- This routing statement routes information going to the IP Nat Pool in Palco High School to the next hop address of Redback. The route terminates in a router at Palco High School, and runs through a Paragain DSLAM.

ip route 10.2.4.2 255.255.255.0 10.2.6.1

- This routing statement routes information going to Async Pool on the Palco 5200 #2 router to the next hop address of Redback.
-

ip route 10.2.2.1 255.255.255.0 10.2.6.1

- This routing statement routes information going to the small business network in Palco to the next hop address of Redback. The route terminates in a router we did not work with, and runs through a Paragain DSLAM.

Cable and Wireless Internet Router:

no ip route 10.2.3.2 255.255.255.0 10.2.6.1
no ip route 10.2.4.2 255.255.255.0 10.2.6.1
no ip route 10.2.2.1 255.255.255.0 10.2.6.1

- All these routers where taken out of this router, and added to the Sprint Internet Router as seen above.

Redback:

ip address 10.2.2.2 255.255.255.0 secondary

- This IP address is for the small business network in Palco.

ip address 10.1.2.1 255.255.255.0 secondary

- This IP address supports a route to the Palco HS.

ip address 10.1.1.1 255.255.255.0 secondary

- This IP address is for the Palco 5200 #2 Router. The IP route statement (default gateway) on the Palco 5200 #2 Router points to this Occam Palco interface IP.

Marconi 3810

- Since the Palco 5200 #1 Router was already connected to this switch through a VLAN we only needed to find an open port assigned to the same VLAN. We used the menu-driven interface of the Marconi and found the VLAN the Palco 5200 #1 Router was attached to and found that it had an open port statically assigned to the VLAN. Thus no configuration changes were needed.

Palco 5200 Series Router #2:

Loopback 0

- Since this interface was no longer going to be used we removed it by issuing the following command: no interface loopback 0.

Ethernet 0

- This interface had existing IP addresses, one of which was a secondary address and both were on the Frame Relay network. To remove these addresses we used the no form of the IP address command: no ip address *ip-address subnet-mask.*
- Next we added a different IP address to this interface using the following command: ip address 10.1.1.2 255.255.255.0

Serial 0

- Since these interfaces where used for Frame Relay and were not going to be a part of the ATM Network we shutdown these interfaces using the shutdown command. By issuing this command on interface Serial 0 it removed the point-to-point subinterfaces of Serial 0.

Group-Async 1

- Since we removed the loopback 0 interface we had to change the IP unnumbered statements under the Group-Async 1 interface. To do this we issued the following command to remove the original IP unnumbered statement: no ip unnumbered loopback 0.
- Next we needed to change the IP unnumbered statement to use Ethernet 0. To do so we used the following command: ip unnumbered Ethernet 0.

IP Route Statements

- Since the original IP route statements were no longer valid we removed them through the following command: no ip route *ip-address subnet-mask next-hop-ip-address*.
- We then added the following IP route statement to forward all information the router did not know what to do with to the Occam/Palco interface on the Redback. From there the Redback could look through its statements to send the information on accordingly. The command was as follows: ip route 0.0.0.0 0.0.0.0 10.1.1.1

Again, this material is rather broad – and the specific IP addresses are not given -- because of security issues. Each of these modified configurations files are attached fully to the end of this report.

Notwithstanding these unexpected circumstances, each step along the way was a success.

Post Performance and Capacity Issues

This project's goals were geared from the start as an upgrade looking to the future. The current traffic coming from the Palco routers did not reach the limited capacity of the T-1 line they currently were connected to the frame relay network by, but future considerations on possible traffic, gave justification for the ATM migration. From performance monitors attached to this report, it can be deduced that traffic on the Palco router that was moved was not affected in any way. Having no noticeable spike or trough in network utilization shows Intelligent Solutions Consulting that the migration was a success and that the Palco router is a functional component on the ATM backbone of Nex-Tech.

As mentioned earlier, there was an immediate capacity increase on the line from the Palco router to the backbone. Before the router was connected to the backbone via the Newbridge 36170 frame relay switch by a T-1 line (the maximum line the ports on that switch can handle). After the migration, the router is connected to the backbone via a Marconi 3810 by a DS-3 line. This 24-fold increase in capacity will make this link viable for years to come under Nex-Tech's current growth strategies.

Successes and Failures

In generic terms, the project was a total success. There might have been bumps along the road in the case of extra requirements, learning curves, and scheduling issues; but our group was able to come together and get this project completed fully. The skills that members of this group are going to take out of this project are impressive; the amount of information we now have acquired about ATM is only part of what we have gained. Our group got the chance to see what an upgrade in an enterprise environment really requires, from planning, double-checking, documenting, and implementing.

As in any project communication was a concern. An e-mail list serve was set up for members of the group to communicate effectively by never leaving a group member of the loop. This was helpful to communicate, but has some problems. Some members where not by a computer as much as others to check list serve e-mails and this caused access and some communication problems. Also, the list-serve concept leads to some impersonal communications as rarely where things discussed one-to-one. Still overall, this communication process was better than others, and taking into account the diverse schedule of team members, it was as much of a success as one could possibly expect.

Using the different skills of the group members also was a success of the group. Marie Jones and Laurie Rollins used their advance knowledge of routing and protocols to do the bulk of the designing of the configurations files. Justin Tuttle and Preston Trilk used their skills in research and design to come up research and information that would help the group in the knowledge management stage of the project and also to develop the website for the project. Bryan Dreiling used his background in writing, leadership and presentation to make the group a cohesive unit while maintaining the autonomy of the group members and allowing them to use their diverse talents for the best interest of the group.

Intelligent Solutions Consulting did hit some bumps along the road to completion of this project, but nothing that the group members could not have recovered and learnt from; and nothing that was a detriment to the group as a whole.

Thank You's

Intelligent Solutions Consulting would like to thank Nex-Tech generically, and Justin McClung, Chris Robben, and Jason Jenisch specifically, for there willingness to work with us during this process. We wholeheartedly thank you for this opportunity to help your company.

Intelligent Solutions Consulting would also like to thank the facility and staff of the Information Networking and Telecommunications program at Fort Hays State University. Each member of the facility and staff has impacted us in some way. Thank you for your dedication to our pedagogical endeavors.

Sprint Internet Core Router – Before Migration

```
Sprint#sh run
Building configuration...

Current configuration:
!
version 12.0
no service pad
service tcp-keepalives-in
service tcp-keepalives-out
service timestamps debug datetime msec localtime show-timezone
service timestamps log uptime
service password-encryption
service linenumber
!
hostname Sprint
!
boot system flash slot0:c7200-p-mz.120-17.S.bin
no logging console
enable secret
!
ip subnet-zero
ip cef
no ip finger
ip tcp window-size 32000
ip tcp path-mtu-discovery
ip host cw ip-address
ip host rb ip-address
ip name-server ip-address
!
no ip bootp server
!
!
!
!
interface FastEthernet0/0
 ip address ip-address subnet-mask secondary
 ip address ip-address subnet-mask
 no ip redirects
 no ip directed-broadcast
 no ip proxy-arp
 media-type MII
 full-duplex
 no cdp enable
!


interface Serial1/0
 ip address ip-address subnet-mask
 no ip redirects
```

```
 no ip directed-broadcast
 scramble
 framing c-bit
 cablelength 10
 dsu bandwidth 12000
 no cdp enable
!
interface ATM6/0
 no ip address
 no ip directed-broadcast
 no atm clock INTERNAL
 atm scrambling cell-payload
 atm framing cbitplcp
 atm uni-version 3.0
 atm pvc vcd vpi vci aal-encap
 atm pvc vcd vpi vci aal-encap
 no atm ilmi-keepalive
!
interface ATM6/0.1 multipoint
 ip address ip-address subnet-mask
 no ip directed-broadcast
 lane client ethernet
 no cdp enable
!
interface ATM6/0.35 point-to-point
 ip address ip-address subnet-mask
 no ip directed-broadcast
 atm pvc vcd vpi vci aal5snap cir burst
!
interface ATM6/0.36 point-to-point
 ip address ip-address subnet-mask
 no ip directed-broadcast
 atm pvc vcd vpi vci aal5snap cir burst
!
interface ATM6/0.43 point-to-point
 ip address ip-address subnet-mask
 no ip directed-broadcast
 atm pvc vcd vpi vci aal5snap cir burst
!
interface ATM6/0.45 point-to-point
 ip address ip-address subnet-mask
 no ip directed-broadcast
 atm pvc vcd vpi vci aal5snap cir burst
!
interface ATM6/0.55 point-to-point
 ip address ip-address subnet-mask
 no ip directed-broadcast
 atm pvc vcd vpi vci aal5snap cir burst
!
interface ATM6/0.56 point-to-point
 ip address ip-address subnet-mask
```

```
 no ip directed-broadcast
 atm pvc vcd vpi vci aal5snap cir burst
!
interface CBR6/0
 no ip address
 no ip directed-broadcast
!
interface CBR6/1
 no ip address
 no ip directed-broadcast
!
interface CBR6/2
 no ip address
 no ip directed-broadcast
!
interface CBR6/3
 no ip address
 no ip directed-broadcast
!
router ospf 1000
 redistribute connected
 redistribute static subnets
 passive-interface Serial1/0
 passive-interface ATM6/0
 network network-number subnet-mask area area
 default-information originate always metric 200
!
router bgp 14155
 no synchronization
 network ip-address mask subnet-mask route-map route-map-name
 network ip-address mask subnet-mask route-map route-map-name
 neighbor internal peer-group
 neighbor internal remote-as as-number
 neighbor internal version 4
 neighbor internal send-community
 neighbor ip-address peer-group internal
 neighbor ip-address remote-as as-number
 neighbor ip-address version 4
 neighbor ip-address route-map route-map-name in
 neighbor ip-address route-map route-map-name out
!
ip classless
ip route destination-prefix destination-prefix-mask next-hop-ip-address
interface interface-number
ip route destination-prefix destination-prefix-mask next-hop-ip-address
ip route destination-prefix destination-prefix-mask next-hop-ip-address
ip route destination-prefix destination-prefix-mask next-hop-ip-address
ip route destination-prefix destination-prefix-mask next-hop-ip-address
ip route destination-prefix destination-prefix-mask next-hop-ip-address
ip route destination-prefix destination-prefix-mask next-hop-ip-address
ip route destination-prefix destination-prefix-mask next-hop-ip-address
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ip route *destination-prefix destination-prefix-mask next-hop-ip-address*
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ip route *destination-prefix destination-prefix-mask next-hop-ip-address*
ip route *destination-prefix destination-prefix-mask next-hop-ip-address*
ip route *destination-prefix destination-prefix-mask next-hop-ip-address*
ip route *destination-prefix destination-prefix-mask next-hop-ip-address*
ip route *destination-prefix destination-prefix-mask next-hop-ip-address*
ip route *destination-prefix destination-prefix-mask next-hop-ip-address*
ip route *destination-prefix destination-prefix-mask next-hop-ip-address*
ip route *destination-prefix destination-prefix-mask next-hop-ip-address*
ip route *destination-prefix destination-prefix-mask next-hop-ip-address*
ip route *destination-prefix destination-prefix-mask next-hop-ip-address*
ip route *destination-prefix destination-prefix-mask next-hop-ip-address*
ip route *destination-prefix destination-prefix-mask next-hop-ip-address*
ip route *destination-prefix destination-prefix-mask next-hop-ip-address*
ip route *destination-prefix destination-prefix-mask next-hop-ip-address*
ip route *destination-prefix destination-prefix-mask next-hop-ip-address*
ip route *destination-prefix destination-prefix-mask next-hop-ip-address*
ip route *destination-prefix destination-prefix-mask next-hop-ip-address*
ip route *destination-prefix destination-prefix-mask next-hop-ip-address*
ip route *destination-prefix destination-prefix-mask next-hop-ip-address*
ip route *destination-prefix destination-prefix-mask next-hop-ip-address*
ip route *destination-prefix destination-prefix-mask next-hop-ip-address*
ip route *destination-prefix destination-prefix-mask next-hop-ip-address*

```
ip route destination-prefix destination-prefix-mask next-hop-ip-address
ip route destination-prefix destination-prefix-mask next-hop-ip-address
ip route destination-prefix destination-prefix-mask next-hop-ip-address
ip route destination-prefix destination-prefix-mask next-hop-ip-address
ip route destination-prefix destination-prefix-mask next-hop-ip-address
ip route destination-prefix destination-prefix-mask next-hop-ip-address
ip route destination-prefix destination-prefix-mask next-hop-ip-address
ip route destination-prefix destination-prefix-mask next-hop-ip-address
ip route destination-prefix destination-prefix-mask next-hop-ip-address
ip route destination-prefix destination-prefix-mask next-hop-ip-address
ip route destination-prefix destination-prefix-mask next-hop-ip-address
ip route destination-prefix destination-prefix-mask next-hop-ip-address
ip route destination-prefix destination-prefix-mask next-hop-ip-address
ip route destination-prefix destination-prefix-mask next-hop-ip-address
ip route destination-prefix destination-prefix-mask next-hop-ip-address
ip route destination-prefix destination-prefix-mask next-hop-ip-address
ip route destination-prefix destination-prefix-mask next-hop-ip-address
ip route destination-prefix destination-prefix-mask next-hop-ip-address
ip route destination-prefix destination-prefix-mask next-hop-ip-address
no ip http server
ip bgp-community new-format
ip community-list 1 permit 14155:100
ip as-path access-list 70 permit ^1239$
ip as-path access-list 70 permit _701_
ip as-path access-list 70 permit _3549_
ip as-path access-list 70 permit _10310_
ip as-path access-list 70 permit ^(1239_)+([0-9]+_)$
ip as-path access-list 71 permit _3561_
ip as-path access-list 72 permit _701_
ip as-path access-list 72 permit _3549_
ip as-path access-list 72 permit _12076_
ip as-path access-list 72 permit _1_
ip as-path access-list 72 permit _7018_
ip as-path access-list 72 permit _8070_
ip as-path access-list 72 permit _8069_
ip as-path access-list 72 permit _13694_
ip as-path access-list 72 permit _174_
ip as-path access-list 72 permit _1668_
ip as-path access-list 72 permit _6461_
ip as-path access-list 72 permit _6172_
ip as-path access-list 72 permit _6503_
ip as-path access-list 72 permit _209_
ip as-path access-list 72 permit _2914_
ip as-path access-list 72 permit _577_
ip as-path access-list 72 permit _6327_
ip as-path access-list 72 permit _4755_
ip as-path access-list 72 permit _10029_
ip as-path access-list 72 permit _11060_
ip as-path access-list 73 permit _3561_
ip as-path access-list 95 permit ^$
ip as-path access-list 96 permit .*
```

```
!
logging ip-address
access-list 101 permit ip any any log-input
no cdp run
route-map transit-out permit 10
 match as-path 95
 match community 1
!
route-map sprint-in permit 5
 match as-path 73
 set local-preference 90
 set community 14155:73
!
route-map sprint-in permit 20
 match as-path 70
 set metric 0
 set local-preference 115
 set community 14155:70
!
route-map sprint-in permit 30
 match as-path 72
 set metric 0
 set local-preference 112
 set community 14155:72
!
route-map sprint-in permit 40
 match as-path 96
 set local-preference 100
 set community 14155:96
!
route-map ruraltelco-out permit 10
 set community 14155:100
!
snmp-server engineID local 0000000902000030969D0800
snmp-server view cutdown internet included
snmp-server view cutdown at excluded
snmp-server view cutdown ip.21 excluded
snmp-server view cutdown ip.22 excluded
snmp-server community public view cutdown RO
snmp-server community private view cutdown RW
snmp-server community rtsnmp view cutdown RO
snmp-server enable traps snmp
snmp-server enable traps casa
snmp-server enable traps isdn call-information
snmp-server enable traps isdn layer2
snmp-server enable traps channel
snmp-server enable traps hsrp
snmp-server enable traps config
snmp-server enable traps entity
snmp-server enable traps envmon
snmp-server enable traps bgp
```

```
snmp-server enable traps rsvp
snmp-server enable traps frame-relay
snmp-server enable traps rtr
snmp-server enable traps dlsw
snmp-server enable traps dial
snmp-server enable traps voice poor-qov
!
line con 0
 transport input none
line aux 0

!
end

Sprint#
Sprint#sh ver
Cisco Internetwork Operating System Software
IOS (tm) 7200 Software (C7200-IS-M), Version 12.0(7)XE1, EARLY DEPLOYMENT RELEAS
E SOFTWARE (fc1)
TAC:Home:SW:IOS:Specials for info
Copyright (c) 1986-2000 by cisco Systems, Inc.
Compiled Fri 04-Feb-00 21:31 by lstringr
Image text-base: 0x60008900, data-base: 0x60FF4000

ROM: System Bootstrap, Version 11.1(10) [dschwart 10], RELEASE SOFTWARE (fc1)
BOOTFLASH: 7200 Software (C7200-BOOT-M), Version 11.1(13a)CA1, EARLY
DEPLOYMENT
RELEASE SOFTWARE (fc1)

Sprint uptime is 33 weeks, 5 days, 5 hours, 40 minutes
System returned to ROM by reload
System image file is "slot0:c7200-p-mz.120-17.S.bin"

cisco 7206 (NPE150) processor with 122880K/8192K bytes of memory.
R4700 CPU at 150Mhz, Implementation 33, Rev 1.0, 512KB L2 Cache
6 slot midplane, Version 1.3

Last reset from power-on
Bridging software.
X.25 software, Version 3.0.0.
1 FastEthernet/IEEE 802.3 interface(s)
1 Serial network interface(s)
1 ATM network interface(s)
125K bytes of non-volatile configuration memory.
1024K bytes of packet SRAM memory.

16384K bytes of Flash PCMCIA card at slot 0 (Sector size 128K).
4096K bytes of Flash internal SIMM (Sector size 256K).
Configuration register is 0x102
```

Redback Switch – Before Migration

[local]SMS#sh conf context ruralnet
context ruralnet
 domain *domain-name(1)*
 domain *domain-name(2)*
 domain *domain-name(3)*
 domain *domain-name(4)*
 domain *domain-name(5)*
 domain *domain-name(6)*
 domain *domain-name(7)*
 aaa authentication subscriber radius
 aaa accounting subscriber radius
 radius server *ip-address* key rural oldports
 radius timeout 20
 radius max-outstanding 10
 radius accounting server *ip-address* key rural oldports
 default radius accounting max-outstanding
 dhcp relay server *ip-address*
 dhcp relay option
 interface e3/0
  ip address *ip-address subnet-mask*
  ip arp arpa
 interface downstream
  ip address *ip-address subnet-mask*
  ip arp arpa
  dhcp relay size 250
 interface HPMH/Hays
  ip address *ip-address subnet-mask*
  ip arp arpa
 interface Quinter/HS
  ip address *ip-address subnet-mask*
  ip arp arpa
 interface Quinter/GS
  ip address *ip-address subnet-mask*
  ip arp arpa
 interface Wakeeny/GS
  ip address *ip-address subnet-mask*
  ip arp arpa
 interface Wakeeny/HS
  ip address *ip-address subnet-mask*
  ip arp arpa
 interface Wakeeny/Detcntr
  ip address *ip-address subnet-mask*
  ip arp arpa
 interface downstream2
  ip address *ip-address subnet-mask*
  ip arp arpa
  dhcp relay size 500

interface LacrosseHS/GBT
 ip address *ip-address subnet-mask*
 ip arp arpa
interface ASrouting/Hillcty
 ip address *ip-address subnet-mask*
 ip arp arpa
interface ASrouting/Lenora
 ip address *ip-address subnet-mask*
 ip address *ip-address subnet-mask* secondary
 ip address *ip-address subnet-mask* secondary
 ip address *ip-address subnet-mask* secondary
 ip address *ip-address subnet-mask* secondary
 ip address *ip-address subnet-mask* secondary
 ip arp arpa
interface Cityof/Hays
 ip address *ip-address subnet-mask*
 ip arp arpa
interface ASrouting/GBT
 ip address *ip-address subnet-mask*
 ip arp arpa
interface ASrouting/Hays
 ip address *ip-address subnet-mask*
 ip arp arpa
interface NessCityHS/GBT
 ip address *ip-address subnet-mask*
 ip arp arpa
interface CrossMfrLewis/GBT
 ip address *ip-address subnet-mask*
 ip arp arpa
interface EllisHS/GBT
 ip address *ip-address subnet-mask*
 ip arp arpa
interface VictoriaGS/VICT
 ip address *ip-address subnet-mask*
 ip arp arpa
interface VictoriaMS/VICT
 ip address *ip-address subnet-mask*
 ip arp arpa
interface VictoriaHS/VICT
 ip address *ip-address subnet-mask*
 ip arp arpa
interface Occam/Palco
 ip address *ip-address subnet-mask*
 ip address *ip-address subnet-mask* secondary
 ip address *ip-address subnet-mask* secondary
 ip arp arpa
interface ContactAM/VICT
 ip address *ip-address subnet-mask*
 ip arp arpa

interface TMP/Hays
 ip address *ip-address subnet-mask*
 ip arp arpa
interface loganhsgateway
 ip address *ip-address subnet-mask*
 ip arp arpa
interface mccrackenhsgateway
 ip address *ip-address subnet-mask*
 ip arp arpa
interface ransomhsgateway/GBT
 ip address *ip-address subnet-mask*
 ip arp arpa
interface Rainbow
 ip address *ip-address subnet-mask*
 ip arp arpa
interface HillCity/Multi
 ip address *ip-address subnet-mask*
 ip address *ip-address subnet-mask* secondary
 ip address *ip-address subnet-mask* secondary
 ip arp arpa
interface routed@nextechgate
 ip address *ip-address subnet-mask*
 ip arp arpa
interface hillcitygsgateway
 ip address *ip-address subnet-mask*
 ip arp arpa
interface Occam/Voicegateway
 ip address *ip-address subnet-mask*
 ip arp arpa
interface Midwayhs/Rainbow
 ip address *ip-address subnet-mask*
 ip arp arpa
interface Westernsupply/Hays
 ip address *ip-address subnet-mask*
 ip arp arpa
interface downstream3
 ip address *ip-address subnet-mask*
 ip arp arpa
 dhcp relay size 250
interface AltonJrH/Alton
 ip address *ip-address subnet-mask*
 ip arp arpa
interface GS/Selden
 ip address *ip-address subnet-mask*
 ip arp arpa
interface Prgain/Victoria/Multi
 ip address *ip-address subnet-mask*
 ip arp arpa
interface routed1@nextechgate
 ip address *ip-address subnet-mask*
 ip arp arpa

interface nortonhs@nextech
 ip address *ip-address subnet-mask*
 ip arp arpa
interface newage@nextech
 ip address *ip-address subnet-mask*
 ip arp arpa
interface Carsonbridge2/multi
 ip address *ip-address subnet-mask*
 ip arp arpa
interface GBTcablebridge/multi
 ip address *ip-address subnet-mask*
 ip arp arpa
interface MWCoop/Quinter
 ip address *ip-address subnet-mask*
 ip arp arpa
interface FirstStateBankNess/GBT
 ip address *ip-address subnet-mask*
 ip arp arpa
operator helpdesk encrypted 1
operator dennis encrypted 1
operator GBT encrypted 1
subscriber default
 dns primary *ip-address*
 dns secondary *ip-address*
ip route *ip-address subnet-mask next-hop-ip-address interface-name/interface-number*
ip route *ip-address subnet-mask next-hop-ip-address* FirstStateBankNess/GBT
ip route *ip-address subnet-mask next-hop-ip-address* CrossMfrLewis/GBT
ip route *ip-address subnet-mask next-hop-ip-address* hillcitygsgateway
ip route *ip-address subnet-mask next-hop-ip-address* EllisHS/GBT
ip route *ip-address subnet-mask next-hop-ip-address* Midwayhs/Rainbow
ip route *ip-address subnet-mask next-hop-ip-address* newage@nextech
ip route *ip-address subnet-mask next-hop-ip-address* ASrouting/Lenora
ip route *ip-address subnet-mask next-hop-ip-address* ASrouting/Lenora
ip route *ip-address subnet-mask next-hop-ip-address* ASrouting/Lenora
ip route *ip-address subnet-mask next-hop-ip-address* MWCoop/Quinter
ip route *ip-address subnet-mask next-hop-ip-address* Quinter/HS
ip route *ip-address subnet-mask next-hop-ip-address* GS/Selden
ip route *ip-address subnet-mask next-hop-ip-address* Quinter/GS
ip route *ip-address subnet-mask next-hop-ip-address* ContactAM/VICT
ip route *ip-address subnet-mask next-hop-ip-address* newage@nextech
ip route *ip-address subnet-mask next-hop-ip-address* AltonJrH/Alton
ip route *ip-address subnet-mask next-hop-ip-address* Wakeeny/HS
ip route *ip-address subnet-mask next-hop-ip-address* Wakeeny/GS
ip route *ip-address subnet-mask next-hop-ip-address* GS/Selden
ip route *ip-address subnet-mask next-hop-ip-address* VictoriaGS/VICT
ip route *ip-address subnet-mask next-hop-ip-address* VictoriaMS/VICT
ip route *ip-address subnet-mask next-hop-ip-address* VictoriaHS/VICT
ip route *ip-address subnet-mask next-hop-ip-address* ASrouting/Hays
ip route *ip-address subnet-mask next-hop-ip-address* ASrouting/Hays
ip route *ip-address subnet-mask next-hop-ip-address* Cityof/Hays
ip route *ip-address subnet-mask next-hop-ip-address* ASrouting/Hillcty

ip route *ip-address subnet-mask next-hop-ip-address* ASrouting/GBT
ip route *ip-address subnet-mask next-hop-ip-address* EllisHS/GBT
ip route *ip-address subnet-mask next-hop-ip-address* Cityof/Hays
ip route *ip-address subnet-mask next-hop-ip-address* ASrouting/Hays
ip route *ip-address subnet-mask next-hop-ip-address* Westernsupply/Hays
ip route *ip-address subnet-mask next-hop-ip-address* ransomhsgateway/GBT
ip route *ip-address subnet-mask next-hop-ip-address* ASrouting/Hays
ip route *ip-address subnet-mask next-hop-ip-address* LacrosseHS/GBT
ip route *ip-address subnet-mask next-hop-ip-address* CrossMfrLewis/GBT
ip route *ip-address subnet-mask next-hop-ip-address* nortonhs@nextech
ip route *ip-address subnet-mask next-hop-ip-address* routed1@nextechgate
ip route *ip-address subnet-mask next-hop-ip-address* ASrouting/GBT
ip route *ip-address subnet-mask next-hop-ip-address* ASrouting/Lenora
ip route *ip-address subnet-mask next-hop-ip-address* ASrouting/Lenora
ip route *ip-address subnet-mask next-hop-ip-address* ASrouting/Lenora
ip route *ip-address subnet-mask next-hop-ip-address* Occam/Palco
ip route *ip-address subnet-mask next-hop-ip-address* ASrouting/GBT
ip route *ip-address subnet-mask next-hop-ip-address* ASrouting/GBT
ip route *ip-address subnet-mask ip-address* ASrouting/GBT
ip route *ip-address subnet-mask next-hop-ip-address* ASrouting/GBT
ip route *ip-address subnet-mask next-hop-ip-address* Occam/Palco
ip route *ip-address subnet-mask next-hop-ip-address* ASrouting/Hays
ip route *ip-address subnet-mask next-hop-ip-address* ASrouting/Lenora
ip route *ip-address subnet-mask next-hop-ip-address* ASrouting/GBT
ip route *ip-address subnet-mask next-hop-ip-address* ASrouting/GBT
ip route *ip-address subnet-mask next-hop-ip-address* Wakeeny/Detcntr
ip route *ip-address subnet-mask next-hop-ip-address* mccrackenhsgateway
ip route *ip-address subnet-mask next-hop-ip-address* Quinter/HS
ip route *ip-address subnet-mask next-hop-ip-address* ASrouting/Hillcty
ip route *ip-address subnet-mask next-hop-ip-address* ASrouting/Lenora
ip route *ip-address subnet-mask next-hop-ip-address* ASrouting/Lenora
ip route *ip-address subnet-mask next-hop-ip-address* ASrouting/Lenora
ip route *ip-address subnet-mask next-hop-ip-address* ASrouting/Hays
ip route *ip-address subnet-mask next-hop-ip-address* ASrouting/GBT
ip route *ip-address subnet-mask next-hop-ip-address* ASrouting/GBT
ip domain-lookup
ip name-servers *ip-address*
ppp keepalive 5
[local]SMS#

[local]SMS#sh ver
Redback Networks AOS Release 5.0.4.0 PRODUCTION RELEASE
Copyright (c) 1997-2002 by Redback Networks, Inc.
Compiled 2002-Jan-30 04:44:01 GMT by wheatley
Image text-base: 0x00108000, data-base: 0x008526d0

Hardware Platform: SMS-500 with 8MB FE memory

System Bootloader Version 3.1.3.5 PRODUCTION MAINTENANCE RELEASE

SMS uptime is 4 days, 13 hours, 53 minutes

```
System restarted by reload at 17:25:28 Thu Apr 4 2002
System image file is "/flash/REDBACK.BIN"

Startup configuration file(s):
   /flash/redmulti.cfg
```

Palco 5200 Router #2 – Before Migration

```
Palco_52#sh run
Building configuration...

Current configuration:
!
! Last configuration change at 20:19:37 CDT Mon Apr 8 2002
! NVRAM config last updated at 20:22:03 CDT Mon Apr 8 2002
!
version 11.3
service timestamps debug uptime
service timestamps log uptime
no service password-encryption
service udp-small-servers
service tcp-small-servers
!
hostname hostname
!
aaa new-model
aaa authentication login default radius
aaa authentication login vty line
aaa authentication login console line
aaa authentication ppp default radius
aaa authentication ppp enable radius
aaa authentication ppp radius radius
aaa accounting exec default start-stop radius
aaa accounting network default start-stop radius
aaa accounting system default start-stop radius
enable secret
!
ip subnet-zero
ip domain-name domain-name
ip name-server ip-address
prompt Palco_52%p
clock timezone CST -6
clock summer-time CDT recurring
!
!
controller T1 0
 clock source line primary
 cas-group 1 timeslots 1-24 type fxs-loop-start
!
controller T1 1
 clock source line secondary
 cas-group 1 timeslots 1-24 type fxs-loop-start
!
process-max-time 200
!
```

```
interface Loopback0
 ip address ip-address subnet-mask
 no ip directed-broadcast
 no ip route-cache
 no ip mroute-cache
!
interface Ethernet0
 ip address ip-address subnet-mask secondary
 ip address ip-address subnet-mask
 no ip directed-broadcast
 no ip route-cache
 no ip mroute-cache
 bridge-group 1
!
interface Serial0
 no ip address
 encapsulation frame-relay IETF
 no ip route-cache
 no ip mroute-cache
 frame-relay lmi-type ansi
!
interface Serial0.1 point-to-point
 ip address ip-address subnet-mask
 no ip directed-broadcast
 no ip route-cache
 no ip mroute-cache
 frame-relay interface-dlci 16 IETF
!
interface Serial0.2 point-to-point
 no ip directed-broadcast
 no ip route-cache
 no ip mroute-cache
 frame-relay interface-dlci 17
 bridge-group 1
!
interface Serial1
 no ip address
 no ip route-cache
 no ip mroute-cache
 shutdown
!
interface Group-Async1
 ip unnumbered Loopback0
 no ip directed-broadcast
 encapsulation ppp
 no ip route-cache
 ip tcp header-compression passive
 no ip mroute-cache
 async mode interactive
 peer default ip address pool default
 ppp authentication pap
```

```
 group-range group-range
!
ip local pool default 10.2.4.3 10.2.4.47
ip classless
ip route ip-address subnet-mask next-hop-ip-address
ip route ip-address subnet-mask nex-hop-ip-address
!
snmp-server community
radius-server host ip-address auth-port port-number acct-port port-number
radius-server key rural
bridge irb
bridge 1 protocol ieee
bridge 1 route ip
banner motd ^C
+------------------------------------------------------------+
|                                                            |
|                                                            |
|                   Property of Rural Telephone              |
|                                                            |
|                   Unauthorized Use Prohibited              |                |
|
|                                                            |
|                                                            |
                |            Palco      Internet Dialup          |         |
                                        |
|                                                            |
|                                                            |
+------------------------------------------------------------+
^C
!
line con 0
 password
 login authentication console
 transport input none
line 1 48
 autoselect arap
 autoselect during-login
 autoselect ppp
 modem Dialin
 transport preferred pad
 transport input all
 autohangup
line aux 0
line vty 0 4
 exec-timeout 30 0
 password
 login authentication vty
!
ntp clock-period 17180247
ntp server ip-address
end

Palco_52#
```

```
Palco_52#sh ver
Cisco Internetwork Operating System Software
IOS (tm) 5200 Software (C5200-I-L), Version 11.3(11a)AA, EARLY DEPLOYMENT RELEASE
```

Sprint Internet Core Router – After Migration

```
Sprint#sh run
Building configuration...

Current configuration:
!
version 12.0
no service pad
service tcp-keepalives-in
service tcp-keepalives-out
service timestamps debug datetime msec localtime show-timezone
service timestamps log uptime
service password-encryption
service linenumber
!
hostname Sprint
!
boot system flash slot0:c7200-p-mz.120-17.S.bin
no logging console
enable secret
!
ip subnet-zero
ip cef
no ip finger
ip tcp window-size 32000
ip tcp path-mtu-discovery
ip host cw ip-address
ip host rb ip-address
ip name-server ip-address
!
no ip bootp server
!
!
interface FastEthernet0/0
 ip address ip-address subnet-mask secondary
 ip address ip-address subnet-mask
 no ip redirects
 no ip directed-broadcast
 no ip proxy-arp
 media-type MII
 full-duplex
 no cdp enable
!


interface Serial1/0
 ip address ip-address subnet-mask
 no ip redirects
 no ip directed-broadcast
 scramble
```

```
 framing c-bit
 cablelength 10
 dsu bandwidth 12000
 no cdp enable
!
interface ATM6/0
 no ip address
 no ip directed-broadcast
 no atm clock INTERNAL
 atm scrambling cell-payload
 atm framing cbitplcp
 atm uni-version 3.0
 atm pvc vcd vpi vci aal-encap
 atm pvc vcd vpi vci aal-encap
 no atm ilmi-keepalive
!
interface ATM6/0.1 multipoint
 ip address ip-address subnet-mask
 no ip directed-broadcast
 lane client ethernet
 no cdp enable
!
interface ATM6/0.35 point-to-point
 ip address ip-address subnet-mask
 no ip directed-broadcast
 atm pvc vcd vpi vci aal5snap cir burst
!
interface ATM6/0.36 point-to-point
 ip address ip-address subnet-mask
 no ip directed-broadcast
 atm pvc vcd vpi vci aal5snap cir burst
!
interface ATM6/0.43 point-to-point
 ip address ip-address subnet-mask
 no ip directed-broadcast
 atm pvc vcd vpi vci aal5snap cir burst
!
interface ATM6/0.45 point-to-point
 ip address ip-address subnet-mask
 no ip directed-broadcast
 atm pvc vcd vpi vci aal5snap cir burst
!
interface ATM6/0.55 point-to-point
 ip address ip-address subnet-mask
 no ip directed-broadcast
!
interface ATM6/0.56 point-to-point
 ip address ip-address subnet-mask
 no ip directed-broadcast
 atm pvc vcd vpi vci aal5snap cir burst
!
```

```
interface CBR6/0
 no ip address
 no ip directed-broadcast
!
interface CBR6/1
 no ip address
 no ip directed-broadcast
!
interface CBR6/2
 no ip address
 no ip directed-broadcast
!
interface CBR6/3
 no ip address
 no ip directed-broadcast
!
router ospf 1000
 redistribute connected
 redistribute static subnets
 passive-interface Serial1/0
 passive-interface ATM6/0
 network network-number subnet-mask area area
 default-information originate always metric 200
!
router bgp 14155
 no synchronization
 network ip-address mask subnet-mask route-map route-map-name
 network ip-address mask subnet-mask route-map route-map-name
 neighbor internal peer-group
 neighbor internal remote-as as-number
 neighbor internal version 4
 neighbor internal send-community
 neighbor ip-address peer-group internal
 neighbor ip-address remote-as as-number
 neighbor ip-address version 4
 neighbor ip-address route-map route-map-name in
 neighbor ip-address route-map route-map-name out
!
ip classless
ip route 10.2.3.2 255.255.255.0 10.2.6.1
ip route 10.2.4.2 255.255.255.0 10.2.6.1
ip route 10.2.2.1 255.255.255.0 10.2.6.1
ip route destination-prefix destination-prefix-mask next-hop-ip-address
interface interface-number
ip route destination-prefix destination-prefix-mask next-hop-ip-address
ip route destination-prefix destination-prefix-mask next-hop-ip-address
ip route destination-prefix destination-prefix-mask next-hop-ip-address
ip route destination-prefix destination-prefix-mask next-hop-ip-address
ip route destination-prefix destination-prefix-mask next-hop-ip-address
ip route destination-prefix destination-prefix-mask next-hop-ip-address
ip route destination-prefix destination-prefix-mask next-hop-ip-address
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ip route *destination-prefix destination-prefix-mask next-hop-ip-address*
ip route *destination-prefix destination-prefix-mask next-hop-ip-address*
ip route *destination-prefix destination-prefix-mask next-hop-ip-address*
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ip route *destination-prefix destination-prefix-mask next-hop-ip-address*

```
ip route destination-prefix destination-prefix-mask next-hop-ip-address
ip route destination-prefix destination-prefix-mask next-hop-ip-address
ip route destination-prefix destination-prefix-mask next-hop-ip-address
ip route destination-prefix destination-prefix-mask next-hop-ip-address
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ip route destination-prefix destination-prefix-mask next-hop-ip-address
ip route destination-prefix destination-prefix-mask next-hop-ip-address
ip route destination-prefix destination-prefix-mask next-hop-ip-address
ip route destination-prefix destination-prefix-mask next-hop-ip-address
no ip http server
ip bgp-community new-format
ip community-list 1 permit 14155:100
ip as-path access-list 70 permit ^1239$
ip as-path access-list 70 permit _701_
ip as-path access-list 70 permit _3549_
ip as-path access-list 70 permit _10310_
ip as-path access-list 70 permit ^(1239_)+([0-9]+_)$
ip as-path access-list 71 permit _3561_
ip as-path access-list 72 permit _701_
ip as-path access-list 72 permit _3549_
ip as-path access-list 72 permit _12076_
ip as-path access-list 72 permit _1_
ip as-path access-list 72 permit _7018_
ip as-path access-list 72 permit _8070_
ip as-path access-list 72 permit _8069_
ip as-path access-list 72 permit _13694_
ip as-path access-list 72 permit _174_
ip as-path access-list 72 permit _1668_
ip as-path access-list 72 permit _6461_
ip as-path access-list 72 permit _6172_
ip as-path access-list 72 permit _6503_
ip as-path access-list 72 permit _209_
ip as-path access-list 72 permit _2914_
ip as-path access-list 72 permit _577_
ip as-path access-list 72 permit _6327_
ip as-path access-list 72 permit _4755_
ip as-path access-list 72 permit _10029_
ip as-path access-list 72 permit _11060_
ip as-path access-list 73 permit _3561_
ip as-path access-list 95 permit ^$
ip as-path access-list 96 permit .*
```

```
!
logging ip-address
access-list 101 permit ip any any log-input
no cdp run
route-map transit-out permit 10
 match as-path 95
 match community 1
!
route-map sprint-in permit 5
 match as-path 73
 set local-preference 90
 set community 14155:73
!
route-map sprint-in permit 20
 match as-path 70
 set metric 0
 set local-preference 115
 set community 14155:70
!
route-map sprint-in permit 30
 match as-path 72
 set metric 0
 set local-preference 112
 set community 14155:72
!
route-map sprint-in permit 40
 match as-path 96
 set local-preference 100
 set community 14155:96
!
route-map ruraltelco-out permit 10
 set community 14155:100
!
snmp-server engineID local 0000000902000030969D0800
snmp-server view cutdown internet included
snmp-server view cutdown at excluded
snmp-server view cutdown ip.21 excluded
snmp-server view cutdown ip.22 excluded
snmp-server community public view cutdown RO
snmp-server community private view cutdown RW
snmp-server community rtsnmp view cutdown RO
snmp-server enable traps snmp
snmp-server enable traps casa
snmp-server enable traps isdn call-information
snmp-server enable traps isdn layer2
snmp-server enable traps channel
snmp-server enable traps hsrp
snmp-server enable traps config
snmp-server enable traps entity
snmp-server enable traps envmon
snmp-server enable traps bgp
```

```
snmp-server enable traps rsvp
snmp-server enable traps frame-relay
snmp-server enable traps rtr
snmp-server enable traps dlsw
snmp-server enable traps dial
snmp-server enable traps voice poor-qov
!
line con 0
 transport input none
line aux 0

!
end

Sprint#
Sprint#sh ver
Cisco Internetwork Operating System Software
IOS (tm) 7200 Software (C7200-IS-M), Version 12.0(7)XE1, EARLY DEPLOYMENT RELEAS
E SOFTWARE (fc1)
TAC:Home:SW:IOS:Specials for info
Copyright (c) 1986-2000 by cisco Systems, Inc.
Compiled Fri 04-Feb-00 21:31 by lstringr
Image text-base: 0x60008900, data-base: 0x60FF4000

ROM: System Bootstrap, Version 11.1(10) [dschwart 10], RELEASE SOFTWARE (fc1)
BOOTFLASH: 7200 Software (C7200-BOOT-M), Version 11.1(13a)CA1, EARLY
DEPLOYMENT
RELEASE SOFTWARE (fc1)

Sprint uptime is 33 weeks, 5 days, 5 hours, 40 minutes
System returned to ROM by reload
System image file is "slot0:c7200-p-mz.120-17.S.bin"

cisco 7206 (NPE150) processor with 122880K/8192K bytes of memory.
R4700 CPU at 150Mhz, Implementation 33, Rev 1.0, 512KB L2 Cache
6 slot midplane, Version 1.3

Last reset from power-on
Bridging software.
X.25 software, Version 3.0.0.
1 FastEthernet/IEEE 802.3 interface(s)
1 Serial network interface(s)
1 ATM network interface(s)
125K bytes of non-volatile configuration memory.
1024K bytes of packet SRAM memory.

16384K bytes of Flash PCMCIA card at slot 0 (Sector size 128K).
4096K bytes of Flash internal SIMM (Sector size 256K).
Configuration register is 0x102
```

Redback Switch – After Migration

```
[local]SMS#
[local]SMS#sh conf context ruralnet
context ruralnet
 domain domain-name(1)
 domain domain-name(2)
 domain domain-name(3)
 domain domain-name(4)
 domain domain-name(5)
 domain domain-name(6)
 domain domain-name(7)
 aaa authentication subscriber radius
 aaa accounting subscriber radius
 radius server ip-address key rural oldports
 radius timeout 20
 radius max-outstanding 10
 radius accounting server ip-address key rural oldports
 default radius accounting max-outstanding
 dhcp relay server ip-address
 dhcp relay option
 interface e3/0
  ip address ip-address subnet-mask
  ip arp arpa
 interface downstream
  ip address ip-address subnet-mask
  ip arp arpa
  dhcp relay size 250
 interface HPMH/Hays
  ip address ip-address subnet-mask
  ip arp arpa
 interface Quinter/HS
  ip address ip-address subnet-mask
  ip arp arpa
 interface Quinter/GS
  ip address ip-address subnet-mask
  ip arp arpa
 interface Wakeeny/GS
  ip address ip-address subnet-mask
  ip arp arpa
 interface Wakeeny/HS
  ip address ip-address subnet-mask
  ip arp arpa
 interface Wakeeny/Detcntr
  ip address ip-address subnet-mask
  ip arp arpa
 interface downstream2
  ip address ip-address subnet-mask
  ip arp arpa
  dhcp relay size 500
```

```
interface LacrosseHS/GBT
 ip address ip-address subnet-mask
 ip arp arpa
interface ASrouting/Hillcty
 ip address ip-address subnet-mask
 ip arp arpa
interface ASrouting/Lenora
 ip address ip-address subnet-mask
 ip address ip-address subnet-mask secondary
 ip address ip-address subnet-mask secondary
 ip address ip-address subnet-mask secondary
 ip address ip-address subnet-mask secondary
 ip address ip-address subnet-mask secondary
 ip arp arpa
interface Cityof/Hays
 ip address ip-address subnet-mask
 ip arp arpa
interface ASrouting/GBT
 ip address ip-address subnet-mask
 ip arp arpa
interface ASrouting/Hays
 ip address ip-address subnet-mask
 ip arp arpa
interface NessCityHS/GBT
 ip address ip-address subnet-mask
 ip arp arpa
interface CrossMfrLewis/GBT
 ip address ip-address subnet-mask
 ip arp arpa
interface EllisHS/GBT
 ip address ip-address subnet-mask
 ip arp arpa
interface VictoriaGS/VICT
 ip address ip-address subnet-mask
 ip arp arpa
interface VictoriaMS/VICT
 ip address ip-address subnet-mask
 ip arp arpa
interface VictoriaHS/VICT
 ip address ip-address subnet-mask
 ip arp arpa
interface Occam/Palco
 ip address ip-address subnet-mask
 ip address ip-address subnet-mask  secondary
 ip address 10.2.2.2 255.255.255.0 secondary
 ip address 10.1.2.1 255.255.255.0 secondary
 ip address 10.1.1.1 255.255.255.0 secondary
 ip arp arpa
interface ContactAM/VICT
 ip address ip-address subnet-mask
 ip arp arpa
```

interface TMP/Hays
 ip address *ip-address subnet-mask*
 ip arp arpa
interface loganhsgateway
 ip address *ip-address subnet-mask*
 ip arp arpa
interface mccrackenhsgateway
 ip address *ip-address subnet-mask*
 ip arp arpa
interface ransomhsgateway/GBT
 ip address *ip-address subnet-mask*
 ip arp arpa
interface Rainbow
 ip address *ip-address subnet-mask*
 ip arp arpa
interface HillCity/Multi
 ip address *ip-address subnet-mask*
 ip address *ip-address subnet-mask* secondary
 ip address *ip-address subnet-mask* secondary
 ip arp arpa
interface routed@nextechgate
 ip address *ip-address subnet-mask*
 ip arp arpa
interface hillcitygsgateway
 ip address *ip-address subnet-mask*
 ip arp arpa
interface Occam/Voicegateway
 ip address *ip-address subnet-mask*
 ip arp arpa
interface Midwayhs/Rainbow
 ip address *ip-address subnet-mask*
 ip arp arpa
interface Westernsupply/Hays
 ip address *ip-address subnet-mask*
 ip arp arpa
interface downstream3
 ip address *ip-address subnet-mask*
 ip arp arpa
 dhcp relay size 250
interface AltonJrH/Alton
 ip address *ip-address subnet-mask*
 ip arp arpa
interface GS/Selden
 ip address *ip-address subnet-mask*
 ip arp arpa
interface Prgain/Victoria/Multi
 ip address *ip-address subnet-mask*
 ip arp arpa
interface routed1@nextechgate
 ip address *ip-address subnet-mask*
 ip arp arpa

interface nortonhs@nextech
 ip address *ip-address subnet-mask*
 ip arp arpa
interface newage@nextech
 ip address *ip-address subnet-mask*
 ip arp arpa
interface Carsonbridge2/multi
 ip address *ip-address subnet-mask*
 ip arp arpa
interface GBTcablebridge/multi
 ip address *ip-address subnet-mask*
 ip arp arpa
interface MWCoop/Quinter
 ip address *ip-address subnet-mask*
 ip arp arpa
interface FirstStateBankNess/GBT
 ip address *ip-address subnet-mask*
 ip arp arpa
interface ASroutingEllis/GBT
 ip address *ip-address subnet-mask*
 ip arp arpa
operator helpdesk encrypted
operator dennis encrypted
operator GBT encrypted
subscriber default
 dns primary *ip-address*
 dns secondary *ip-address*
ip route *ip-address subnet-mask ip-address interface-name/interface-number*
ip route *ip-address subnet-mask next-hop-ip-address* FirstStateBankNess/GBT
ip route *ip-address subnet-mask next-hop-ip-address* CrossMfrLewis/GBT
ip route *ip-address subnet-mask next-hop-ip-address* hillcitygsgateway
ip route *ip-address subnet-mask next-hop-ip-address* EllisHS/GBT
ip route *ip-address subnet-mask next-hop-ip-address* Midwayhs/Rainbow
ip route *ip-address subnet-mask next-hop-ip-address* newage@nextech
ip route *ip-address subnet-mask next-hop-ip-address* ASrouting/Lenora
ip route *ip-address subnet-mask next-hop-ip-address* ASrouting/Lenora
ip route *ip-address subnet-mask next-hop-ip-address* ASrouting/Lenora
ip route *ip-address subnet-mask next-hop-ip-address* MWCoop/Quinter
ip route *ip-address subnet-mask next-hop-ip-address* Quinter/HS
ip route *ip-address subnet-mask next-hop-ip-address* GS/Selden
ip route *ip-address subnet-mask next-hop-ip-address* Quinter/GS
ip route *ip-address subnet-mask next-hop-ip-address* ContactAM/VICT
ip route *ip-address subnet-mask next-hop-ip-address* newage@nextech
ip route *ip-address subnet-mask next-hop-ip-address* AltonJrH/Alton
ip route *ip-address subnet-mask next-hop-ip-address* Wakeeny/HS
ip route *ip-address subnet-mask next-hop-ip-address* Wakeeny/GS
ip route *ip-address subnet-mask next-hop-ip-address* GS/Selden
ip route *ip-address subnet-mask next-hop-ip-address* VictoriaGS/VICT
ip route *ip-address subnet-mask next-hop-ip-address* VictoriaMS/VICT
ip route *ip-address subnet-mask next-hop-ip-address* VictoriaHS/VICT
ip route 10.2.3.2 255.255.255.0 10.1.2.1 Occam/Palco

ip route *ip-address subnet-mask next-hop-ip-address* ASrouting/Hays
ip route *ip-address subnet-mask next-hop-ip-address* ASrouting/Hays
ip route *ip-address subnet-mask next-hop-ip-address* Cityof/Hays
ip route *ip-address subnet-mask next-hop-ip-address* ASrouting/Hillcty
ip route *ip-address subnet-mask next-hop-ip-address* ASrouting/GBT
ip route *ip-address subnet-mask next-hop-ip-address* EllisHS/GBT
ip route *ip-address subnet-mask next-hop-ip-address* Cityof/Hays
ip route *ip-address subnet-mask next-hop-ip-address* ASrouting/Hays
ip route *ip-address subnet-mask next-hop-ip-address* Westernsupply/Hays
ip route *ip-address subnet-mask next-hop-ip-address* ransomhsgateway/GBT
ip route *ip-address subnet-mask next-hop-ip-address* ASrouting/Hays
ip route *ip-address subnet-mask next-hop-ip-address* LacrosseHS/GBT
ip route *ip-address subnet-mask next-hop-ip-address* CrossMfrLewis/GBT
ip route *ip-address subnet-mask next-hop-ip-address* nortonhs@nextech
ip route *ip-address subnet-mask next-hop-ip-address* routed1@nextechgate
ip route *ip-address subnet-mask next-hop-ip-address* ASrouting/GBT
ip route *ip-address subnet-mask next-hop-ip-address* ASrouting/Lenora
ip route *ip-address subnet-mask next-hop-ip-address* ASrouting/Lenora
ip route *ip-address subnet-mask next-hop-ip-address* ASrouting/Hays
ip route *ip-address subnet-mask next-hop-ip-address* Occam/Palco
ip route *ip-address subnet-mask next-hop-ip-address* ASrouting/GBT
ip route *ip-address subnet-mask next-hop-ip-address* ASrouting/GBT
ip route *ip-address subnet-mask next-hop-ip-address* ASrouting/GBT
ip route 10.2.4.2 255.255.255.0 10.1.1.2 Occam/Palco
ip route *ip-address subnet-mask next-hop-ip-address* ASrouting/GBT
ip route *ip-address subnet-mask next-hop-ip-address* Occam/Palco
ip route *ip-address subnet-mask next-hop-ip-address* ASroutingEllis/GBT
ip route *ip-address subnet-mask next-hop-ip-address* ASrouting/Hays
ip route *ip-address subnet-mask next-hop-ip-address* ASrouting/Lenora
ip route *ip-address subnet-mask next-hop-ip-address* ASrouting/GBT
ip route *ip-address subnet-mask next-hop-ip-address* ASrouting/GBT
ip route *ip-address subnet-mask next-hop-ip-address* Wakeeny/Detcntr
ip route *ip-address subnet-mask next-hop-ip-address* mccrackenhsgateway
ip route *ip-address subnet-mask next-hop-ip-address* Quinter/HS
ip route *ip-address subnet-mask next-hop-ip-address* ASrouting/Hillcty
ip route *ip-address subnet-mask next-hop-ip-address* ASrouting/Lenora
ip route *ip-address subnet-mask next-hop-ip-address* ASrouting/Lenora
ip route *ip-address subnet-mask next-hop-ip-address* ASrouting/Lenora
ip route *ip-address subnet-mask next-hop-ip-address* ASrouting/Hays
ip route *ip-address subnet-mask next-hop-ip-address* ASrouting/GBT
ip route *ip-address subnet-mask next-hop-ip-address* ASrouting/GBT
ip domain-lookup
ip name-servers *ip-address*
ppp keepalive 5

Palco 5200 Router #2 – After Migration

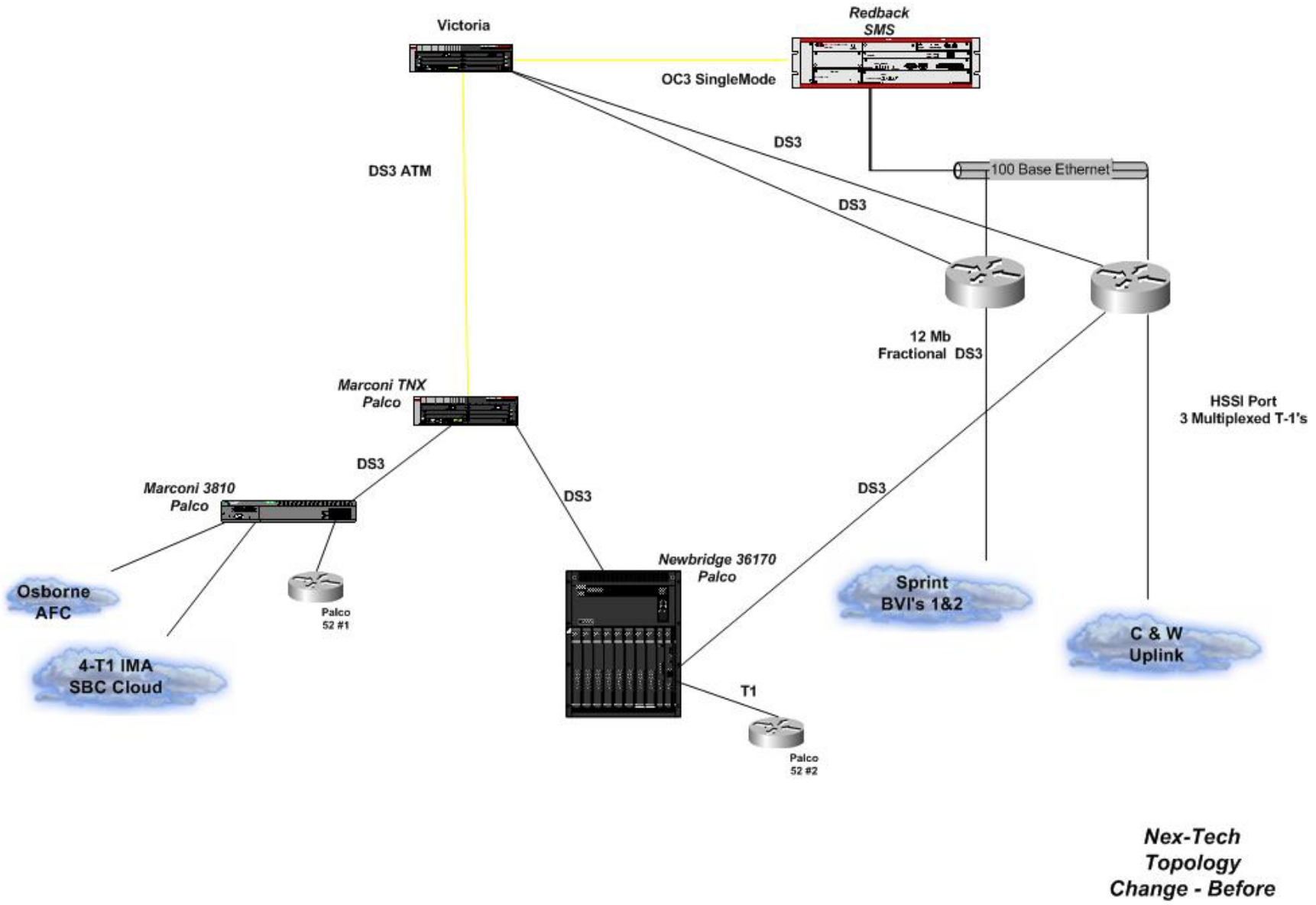
```
Palco_52#sh run
Building configuration...

Current configuration:
!
! Last configuration change at 07:41:24 CDT Thu Apr 18 2002
! NVRAM config last updated at 07:50:27 CDT Thu Apr 18 2002
!
version 12.0
no service pad
service timestamps debug uptime
service timestamps log uptime
no service password-encryption
service udp-small-servers
service tcp-small-servers
!
hostname host-name
!
aaa new-model
aaa authentication login default radius
aaa authentication login vty line
aaa authentication login console line
aaa authentication ppp default radius
aaa authentication ppp enable radius
aaa authentication ppp radius radius
aaa accounting exec default start-stop radius
aaa accounting network default start-stop radius
aaa accounting system default start-stop radius
enable secret
!
ip subnet-zero
ip domain-name domain-name
ip name-server ip-address
prompt Palco_52%p
clock timezone CST -6
clock summer-time CDT recurring
!
controller T1 0
 clock source line primary
 cas-group 1 timeslots 1-24 type fxs-loop-start
!
controller T1 1
 clock source line secondary
 cas-group 1 timeslots 1-24 type fxs-loop-start
!
process-max-time 200
!
interface Ethernet0
```

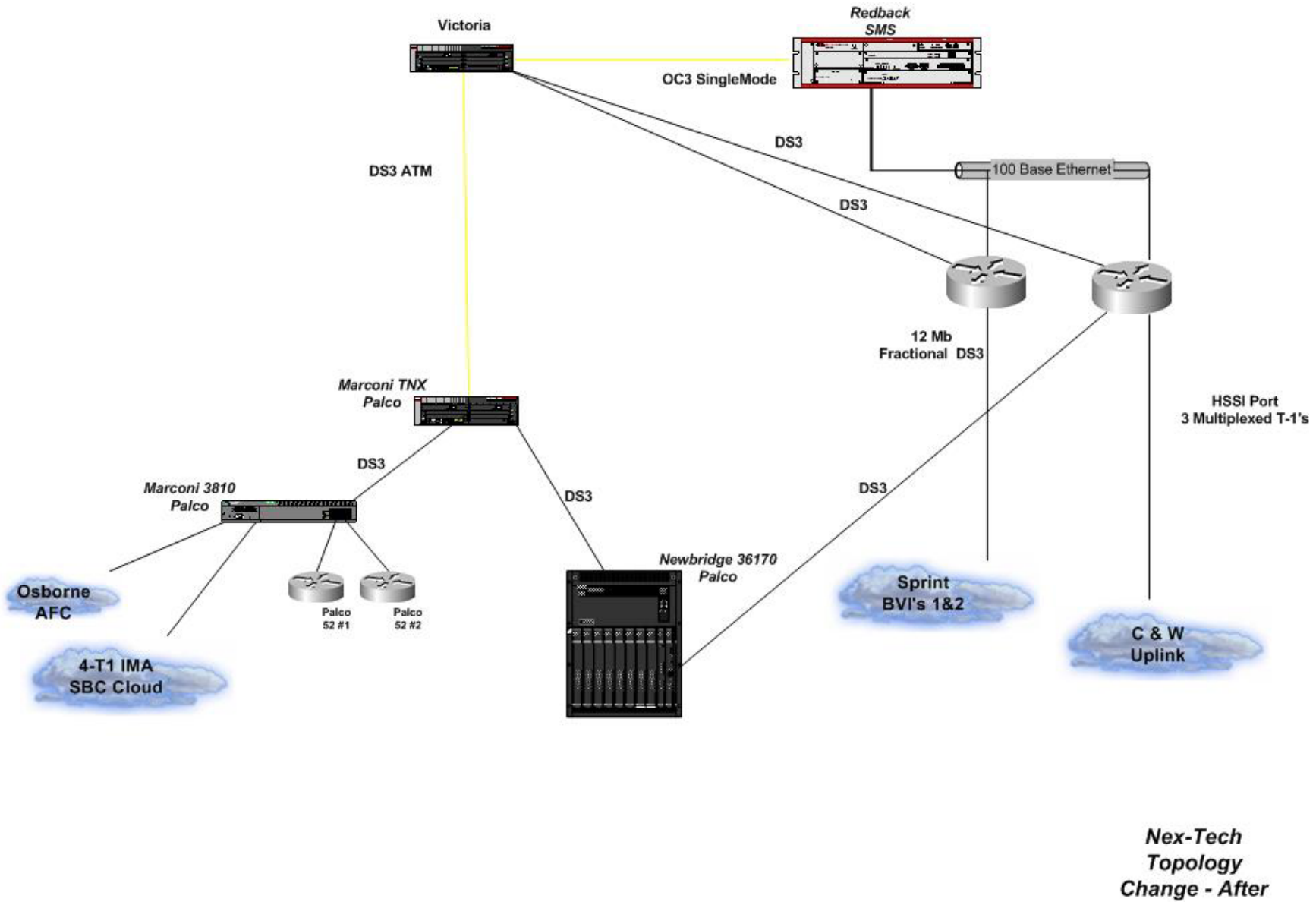
```
 ip 10.1.1.2 255.255.255.0
 no ip directed-broadcast
 no ip route-cache
 no ip mroute-cache
!
interface Serial0
 no ip address
 no ip directed-broadcast
 no ip route-cache
 no ip mroute-cache
 shutdown
!
interface Serial1
 no ip address
 no ip directed-broadcast
 no ip route-cache
 no ip mroute-cache
 shutdown
!
interface Group-Async1
 ip unnumbered Ethernet0
 no ip directed-broadcast
 encapsulation ppp
 no ip route-cache
 ip tcp header-compression passive
 no ip mroute-cache
 async mode interactive
 peer default ip address pool default
 ppp authentication pap
 group-range group-range
!
ip local pool default 10.2.4.3 10.2.4.47
ip classless
ip route 0.0.0.0 0.0.0.0 10.1.1.1
!
snmp-server community
radius-server host ip-address auth-port port-number acct-port port-number
radius-server key rural
banner motd ^CC
```

```
+------------------------------------------------------------+
|                                                            |
|                                                            |
|                  Property of Rural Telephone               |
|                                                            |
|                  Unauthorized Use Prohibited               |               |
|
|                                                            |
|                                                            |
|                  Palco       Internet Dialup               |               |
|
|                                                            |
|                                                            |
+------------------------------------------------------------+
^C
!
line con 0
 password
 login authentication console
 transport input none
line 1 48
 autoselect arap
 autoselect during-login
 autoselect ppp
 modem Dialin
 transport preferred pad
 transport input all
 autohangup
line aux 0
line vty 0 4
 exec-timeout 30 0
 password
 login authentication vty
!
ntp clock-period 17180240
ntp server ip-address
end

Palco_52#sh ver
Cisco Internetwork Operating System Software
IOS (tm) 5200 Software (C5200-I-L), Version 12.0(5), RELEASE SOFTWARE (fc1)
Copyright (c) 1986-1999 by cisco Systems, Inc.
Compiled Wed 16-Jun-99 05:14 by phanguye
Image text-base: 0x2203197C, data-base: 0x00005000

ROM: System Bootstrap, Version 11.1(474A) [jdisimon 104], INTERIM SOFTWARE
BOOTFLASH: 5200 Software (C5200-BOOT-L), Version 11.3(11a), RELEASE SOFTWARE
(fc1)

Palco_5248 uptime is 14 hours, 38 minutes
System restarted by bus error at PC 0x225989B8, address 0x20400000 at 18:21:49 C
DT Wed Apr 17 2002
System image file is "flash:c5200-i-l.120-5.bin"
```

cisco AS5200 (68030) processor (revision D) with 16384K/4096K bytes of memory.
Processor board ID 05820815
Bridging software.
X.25 software, Version 3.0.0.
Primary Rate ISDN software, Version 1.1.
Mother board with terminator card.
1 Ethernet/IEEE 802.3 interface(s)
2 Serial network interface(s)
48 terminal line(s)
2 Channelized T1/PRI port(s)
128K bytes of non-volatile configuration memory.
8192K bytes of processor board System flash (Read ONLY)
4096K bytes of processor board Boot flash (Read/Write)

Configuration register is 0x2102


Victoria
Redback
SMS
OC3 SingleMode
DS3
DS3 ATM
100 Base Ethernet
DS3
12 Mb
Fractional DS3
Marconi TNX
Palco
HSSI Port
3 Multiplexed T-1's
DS3
DS3
DS3
Marconi 3810
Palco
Newbridge 36170
Palco
Osborne
AFC
Palco
52 #1
Sprint
BVI's 1&2
C & W
Uplink
4-T1 IMA
SBC Cloud
T1
Palco
52 #2
Nex-Tech
Topology
Change - Before



Nex-Tech Topology Change - After