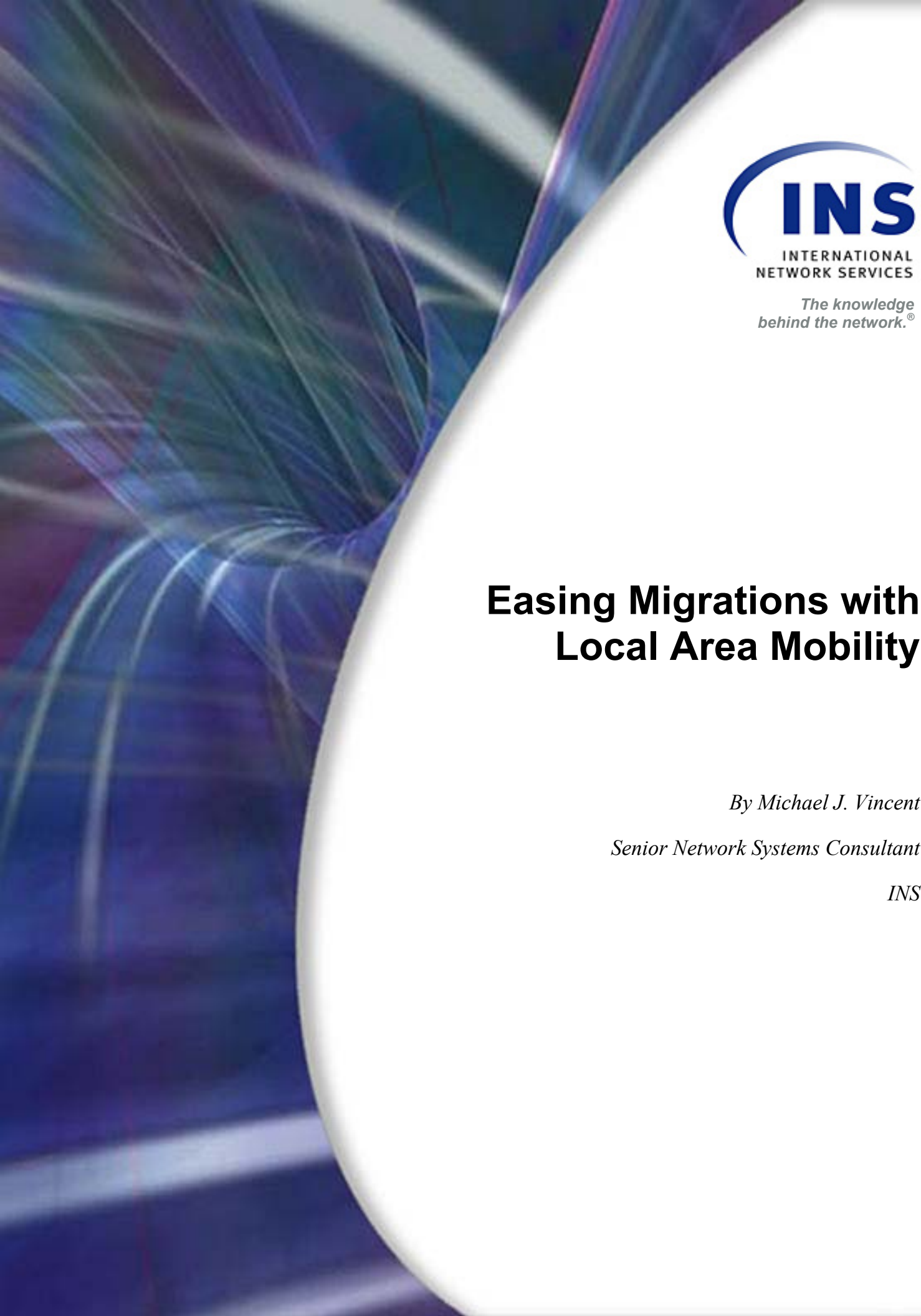

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Easing Migrations with Local Area Mobility

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INS

Easing Migrations with Local Area Mobility

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Introduction

A major issue in network migrations is solving how one IP network can exist in two places at the same time in the same enterprise and still work. Take for instance a server farm in one geographic location that needs to move to another geographic location. IP readdressing is one approach, but all clients throughout the enterprise that reference a migrated server by its original IP address will need to be reconfigured. Network Address Translation (NAT) is a possibility, but NAT to an address on a network that exists elsewhere is not only cumbersome to configure and deploy, but as routing protocols go, it's not dynamic and doesn't accommodate the IP address change, making it a long-term implementation. Tunneling protocols have complex configurations and can present troubleshooting issues. Finally, picking up all the servers and moving them at once is not logistically feasible.

Cisco's Local Area Mobility (LAM), a precursor to Cisco's standards-based Mobile IP solutions, allows statically addressed hosts to move between subnets within an enterprise while still maintaining their original IP address. LAM is transparent to the user, any applications and most of all, the mobile host itself.

This white paper will explain how Cisco's LAM can be used to ease migrations of static IP addressed hosts.

What is LAM?

Initially, LAM solved the problem that mobile users faced when roaming in an enterprise network. Before wireless and standards-based Mobile IP solutions, LAM was created to deal with mobile computers (laptops) in a static IP environment where no DHCP was available. LAM allowed laptop users to connect at any point in the enterprise network transparently – without the need for changes to the laptop IP settings. Though now overshadowed by Cisco's solutions for standards-based Mobile IP, LAM can still be used to temporarily ease migrations of static IP addressed hosts that need to maintain their network identity – their original IP address.

How LAM Works

For end stations to communicate on the same logical IP network, Layer 2 communication is used. That is, the source station sends a broadcast Address Resolution Protocol (ARP) request to the wire requesting the Media Access Control (MAC) address that corresponds to the IP address for the destination station. The destination station answers the ARP request with its MAC address. If an end station needs to talk to another end station not on the same logical IP network, the source station sends an ARP request to its configured default gateway and forwards the frame to the router.

When LAM is configured on a Cisco router, the router listens for ARP requests originating from hosts that do not match the IP network of the router's interface. When the router configured for LAM notices these

foreign ARP requests, the router installs a route to the specific host in the local routing table and, if configured to do so, distributes this route via the Interior Gateway Protocol (IGP) running on the network. At the same time, the router sends a proxy ARP reply to the requesting end station.

Given that Cisco routers, by default, perform the proxy ARP function, and will route to networks based on the longest matching routing information in the routing table, the routers on the original network and the hosting network can proxy ARP for the relocated hosts when end station ARP requests are made. Additionally, all routers in the domain can route to the relocated host based on the specific route installed and shared by the LAM configured router.

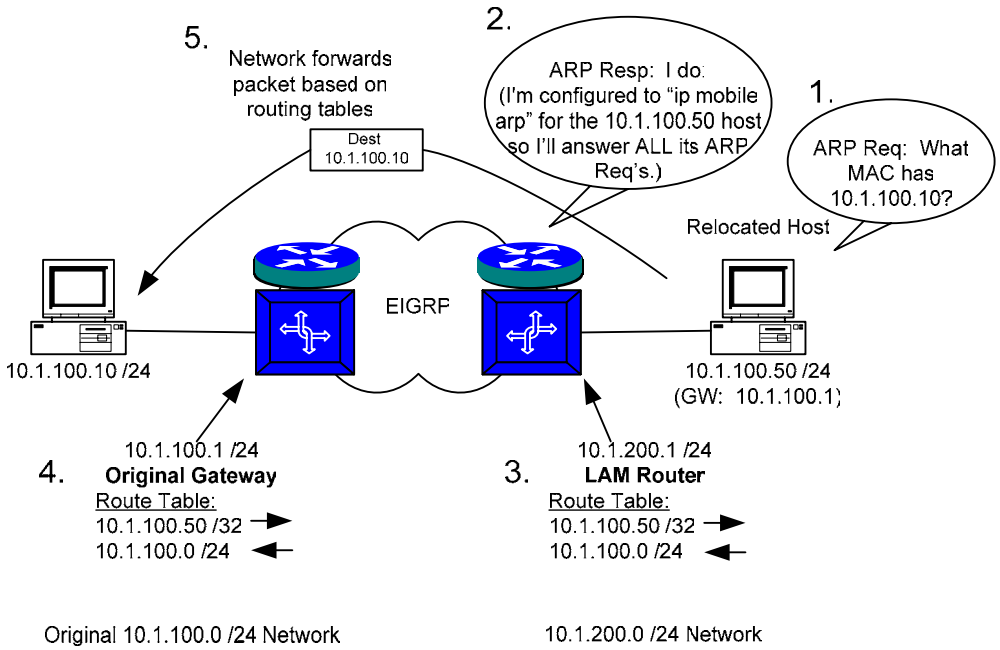
LAM, although exclusive to Cisco devices, will work in a mixed vendor environment because it uses standards-based means to achieve its goal. No special packets, no special authentication, no network tunnels and, most importantly, no end station reconfigurations are required. Non-Cisco switches will be unaware that LAM is configured on the Cisco router acting as their default gateway. Likewise, non-Cisco routers in the enterprise will support connectivity as long as they route based on the most specific network prefix in their routing tables. Finally, since no end-host awareness is required, any end station with an IP stack, regardless of operating system, will work with LAM.

Example 1: Relocated Host to Original Network Communication

The following example illustrates the life of a packet when the relocated host wants to contact a host on the original network. In this example, Enhanced Interior Gateway Routing Protocol (EIGRP) is used as the IGP; however, it should be noted that any IGP could be used as long as it supports classless routing.

In Figure 1, end station 10.1.100.50 is physically relocated to a different subnet within the enterprise while keeping its original IP address. The relocated host 10.1.100.50 now needs to send data to the 10.1.100.10 host on the original network. The host 10.1.100.50 compares its mask to its IP address to find out what IP network it is on. It realizes that the destination (the 10.1.100.10 host on the original network) is on the same logical IP network, so 10.1.100.50 issues an ARP request asking for the MAC address that owns 10.1.100.10 as shown by step 1.

Figure 1: Communication from the LAM Host



In a normal situation, the 10.1.100.10 host is actually on the same network and can respond with its own MAC address. However, with a LAM configuration, the LAM Router is listening for ARP requests that do not match the network for which it is configured (10.1.200.0 /24). The ARP request from the 10.1.100.50 host is intercepted and a proxy ARP reply is sent (step 2). Additionally, the LAM Router, if it has not already done so, introduces a host route into its routing table (step 3) and redistributes the route – as it is configured to do – to all other EIGRP speakers (step 4).

After receiving the ARP reply, the 10.1.100.50 host sends the data frame to the LAM Router and assumes it has spoken directly to the host.

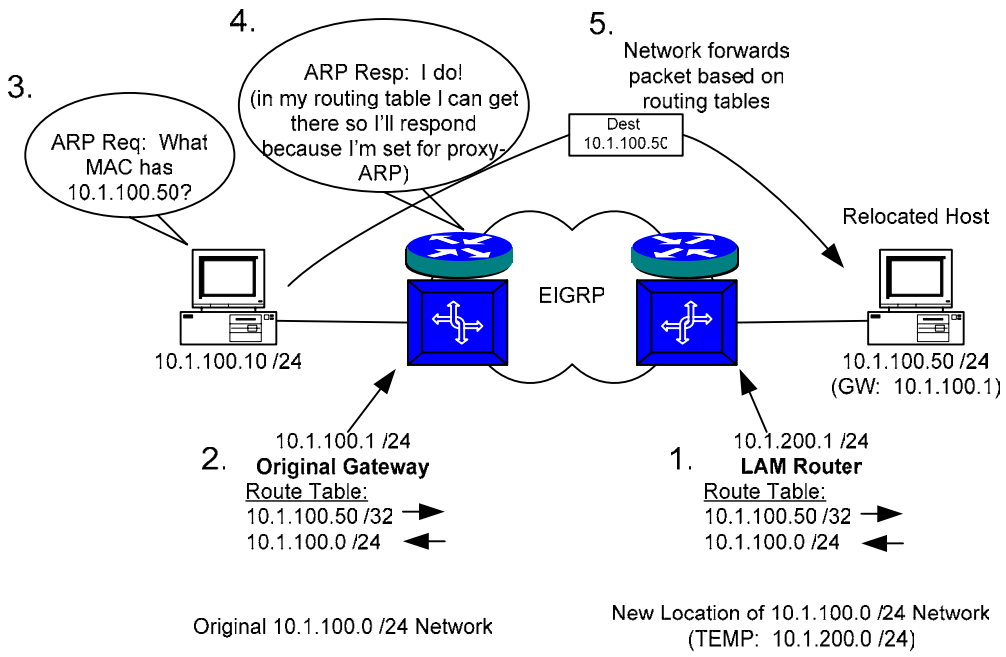
The LAM Router, upon receiving the frame, examines the destination IP address for routing. In this example, the destination is 10.1.100.10. The LAM Router has a route for 10.1.100.0 /24 in its routing table; thus, it forwards the packet (step 5). The Original Gateway router receives the packet destined for 10.1.100.10. It has a directly connected interface to that network, so it sends the frame to the host.

Example 2: Original Network to Relocated Host Communication

This second example builds on the previous one by illustrating the life of a packet when a host on the original network wants to contact the relocated host.

In Figure 2, the host 10.1.100.10 on the original network compares its IP address and mask to verify that the destination – 10.1.100.50 – is on the same network and then issues an ARP request as shown by step 3.

Figure 2: Communication to the LAM Host



Again, in a normal situation, the 10.1.100.50 host is actually on the same network and will respond with its own MAC address. However, with LAM configured, the LAM Router is redistributing a host route for 10.1.100.50 /32 to all EIGRP speaking routers (step 1).

The Original Gateway router picks up the host route (step 2) and can now respond with a proxy ARP reply stating that it owns the 10.1.100.50 IP address.

The proxy ARP reply (step 4) sent to 10.1.100.10 has the MAC address of the Original Gateway as the owner of the 10.1.100.50 IP address. The 10.1.100.10 host then sends its frame to the Original Gateway and assumes it has spoken directly to the host.

Upon receiving the frame, the Original Gateway examines the destination IP address for routing. The destination is 10.1.100.50. The Original Gateway router has a more specific route for 10.1.100.50 in its routing table; thus, it forwards the packet (step 5). The LAM Router receives the packet destined for 10.1.100.50. It has a directly connected route out the 10.1.200.0 /24 interface for 10.1.100.50 because of its LAM configuration, so it forwards the packet to the host.

Note that any host on any network in the domain can communicate to either the original 10.1.100.0 /24 network or any LAM relocated host by sending the communications to its own default gateway – as it would in any normal situation where LAM is not in use. In this example, the default gateway will have the routing information for the 10.1.100.0 /24 network, and the 10.1.100.50 host route due to the LAM Router redistribution. The packets will be forwarded through the network accordingly.

Configuration

To configure LAM, enter configuration mode on the Cisco router that will perform the LAM operation.

1. Create a standard IP access-list (1 – 99) to include all the host addresses that will require LAM service

   ```
   access-list 50 permit host 10.1.100.50
   ```

   Note that this step is required to help secure the LAM configuration. If it is configured to do so, LAM will work without an access list by responding to all foreign ARP requests it sees.

2. Enable LAM and proxy ARP on the LAM Router default gateway interface

   ```
   interface fastethernet0/0
    ip mobile arp access-group 50
    ip proxy-arp
   ```

   Note that the default gateway interface may be a VLAN. In the case of multiple routers using Hot Standby Router Protocol (HSRP), all steps must be configured for all interfaces participating in the HSRP group for LAM to continue working during HSRP failovers.

3. Add the LAM redistribution command to the routing protocol on the LAM Router

   ```
   router eigrp 10
    redistribute mobile metric 1000000 1 255 1 1500
   ```

   Note that the "`redistribute mobile`" command can be used under any IGP that supports classless routing. The provided redistribute command references the examples provided in this paper – where EIGRP is the IGP and the metrics provided mimic a VLAN interface.

Proxy ARP must also be enabled on the Original Gateway. The Original Gateway can be configured with proxy ARP by entering configuration mode and typing the "`ip proxy-arp`" command under the default gateway interface.

Troubleshooting

There are no show commands for LAM. Only commands that provide status on parts of the LAM configuration are available. For instance, LAM uses access lists and redistribution commands. Make sure that the access list is registering matches for the LAM host (`show access-lists`) and verify that the route is seen locally as a mobile route, and on remote routers as a host route in the IGP.

```
LAM-Router#show ip route
Codes: C - connected, S - static, R - RIP, M - mobile, B - BGP
    D - EIGRP, EX - EIGRP external, O - OSPF, IA - OSPF inter area
    N1 - OSPF NSSA external type 1, N2 - OSPF NSSA external type 2
    E1 - OSPF external type 1, E2 - OSPF external type 2
    i - IS-IS, su - IS-IS summary, L1 - IS-IS level-1, L2 - IS-IS level-2
    ia - IS-IS inter area, * - candidate default, U - per-user static route
    o - ODR, P - periodic downloaded static route

Gateway of last resort is 10.1.1.1 to network 0.0.0.0

M  10.1.100.50/32 [3/1] via 10.1.100.50, FastEthernet0/0
D  10.1.100.0/24 [90/1000] via Serial0/0
C  10.1.200.0/24 is directly connected, FastEthernet0/0
```

```
Original-Gateway#show ip route
Codes: C - connected, S - static, R - RIP, M - mobile, B - BGP
    D - EIGRP, EX - EIGRP external, O - OSPF, IA - OSPF inter area
    N1 - OSPF NSSA external type 1, N2 - OSPF NSSA external type 2
    E1 - OSPF external type 1, E2 - OSPF external type 2
    i - IS-IS, su - IS-IS summary, L1 - IS-IS level-1, L2 - IS-IS level-2
    ia - IS-IS inter area, * - candidate default, U - per-user static route
    o - ODR, P - periodic downloaded static route

Gateway of last resort is 10.1.1.1 to network 0.0.0.0

D EX 10.1.100.50/32 [170/1000] via Serial0/0
C  10.1.100.0/24 [90/1000] via Serial0/0
D  10.1.200.0/24 is directly connected, FastEthernet0/0
```

How Can LAM Help Migrations?

Because of the transparency of LAM to the end stations, LAM can assist in the mobility of any statically addressed end station – be it a roaming user's laptop or a production server. The following two examples show how INS consultants used LAM to assist clients with difficult migrations.

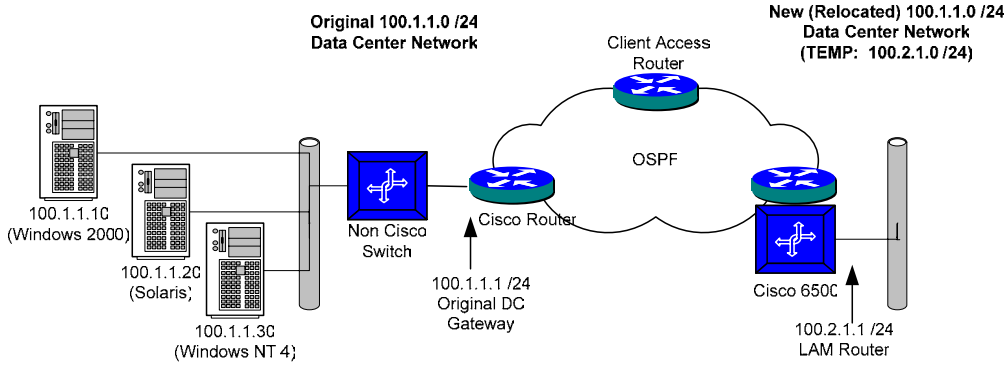
Example 1: Data Center Relocation

Revisiting the server farm example in the Introduction section, INS used LAM to assist a financial industry client that geographically relocated its production data center.

The client had a user base of more than 100 clients, all using a home-grown software application. Simple DNS remapping or client software configuration changes were not options due to hardcoded IP addresses of the production data center servers in the application programming. Fearing that a software upgrade and deployment schedule would need to be incorporated into the migration to accommodate an impending data center subnet change, IP readdressing was the last option the client wanted to consider.

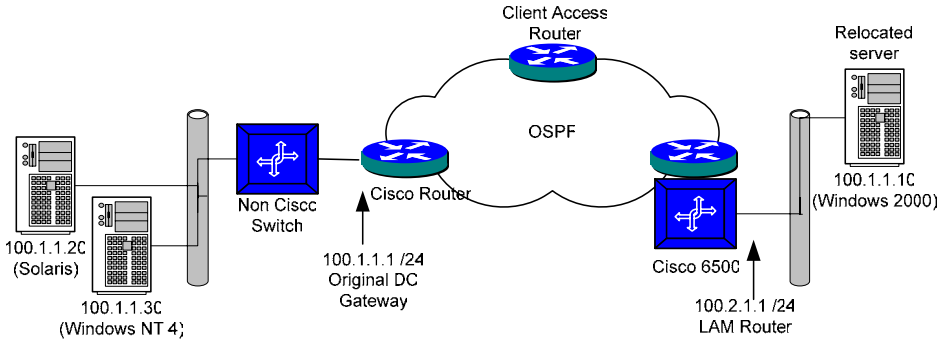
INS created the new data center network and established temporary connectivity to the existing data center (Figure 3).

Figure 3: Phase 1 – New DC Temporary Network



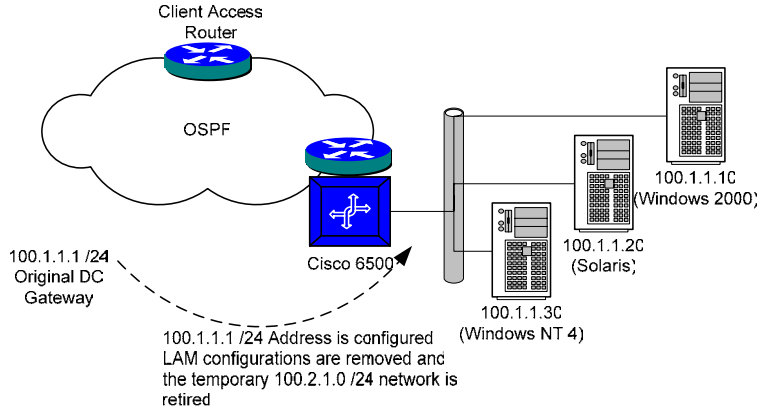
Using LAM, INS migrated the servers one by one during maintenance windows over the migration schedule (Figure 4)

Figure 4: Phase 2 – Migration



Once all the servers were migrated to the new data center, the LAM configuration was removed and the original IP network existed only in the new location (Figure 5).

Figure 5: Phase 3 – Completion



Without the need to update client applications, the migration was finished on time and under budget.

Example 2: Distributed Application Readdressing

INS used LAM to help a large healthcare corporation migrate a legacy patient medicine application during a multi-campus upgrade. The upgrade involved redesign from a flat Layer 2 topology to a Cisco routed architecture with Quality of Service (QoS); thus, IP readdressing was a design requirement.

The patient medicine application servers kept static tables of the IP addresses of all the client dispensing and ordering stations. Likewise, each client station used a static table to track the IP addresses of the servers and the other clients. The client stations were connected to approximately 20 different closets that were scheduled throughout the five-month migration schedule. Without mitigation, the hospital faced 480 hours of external vendor application technician time [3 technicians x 8 hours (average closet migration time) x 20 closet migrations] to update the static tables on all application devices during each affected closet migration to maintain operation of the mission critical application.

INS solved this task by using LAM during the affected closet migrations to allow the patient medicine application devices to maintain their original IP addresses while all other devices connected to the closet were migrated to the new network. After all affected closets were on the new network, the application readdressing was scheduled in groups over the course of four weekends. By using this method, INS reduced the external vendor application technician time to just 120 hours [3 technicians x 10 hours x 4 visits (to readdress all devices in the 20 closets)]. With external medical application vendor rates running from $350 to $750 per hour, INS's strategy saved the hospital between $126,000 and $270,000.

The LAM strategy was so successful it was used again in a limited deployment to accomplish the hospital's third data center move in three years. Without the need to readdress some of the data center servers yet again, the hospital IT department was able to build trust and confidence with their user community.

Conclusion

As networking systems become more highly available and interdependent, the need to provide transparency to applications and end users during a network migration becomes increasingly important for business continuity. Along with user mobility, Cisco's LAM offers an alternative approach to an enterprise faced with a large-scale network migration. LAM eliminates changes in application connectivity, creating the illusion of transparency for the end user and providing seamless network operation throughout a migration.

LAM is not a permanent solution for IP Mobility; however, it can be leveraged during time-dependent migrations where IP readdressing is best avoided or tackled separately. LAM does introduce host routes and may not fall in line with network address summarization boundaries; therefore, a justification to implement LAM should be accompanied by a complete plan to phase it out after the project.

References

http://www.cisco.com/en/US/tech/tk722/tk721/technologies_white_paper09186a00800a3ca5.shtml

About INS

INS (International Network Services Inc.) provides IT infrastructure consulting services, software, and business solutions to help companies build, secure, and manage their business-critical networks. Our end-to-end consulting solutions address customers' needs in IT Strategy and Planning, IT Infrastructure, Operating Systems and Directory Services, Storage Systems and Services, Security, Network and Systems Management, and Project Management, helping them optimize their business to better face competitive challenges and meet future demands. The Diamond IP family of software from INS provides flexible and scalable solutions for today's complex IP networks. We are one of the world's largest independent network consulting and solutions providers with a track record of thousands of successful engagements. INS is headquartered in Santa Clara, Calif. and has offices across the U.S. and Europe. For additional information, please contact INS at 1-888-767-2788 in the U.S., 44 (0) 1628 503000 in Europe, or 1-408-330-2700 worldwide, or visit www.ins.com.