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ISPadmin: DHCP services



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IN THIS EDITION OF ISPADMIN, I TAKE a look at the area of DHCP [1] services. DHCP stands for “Dynamic Host Configuration Protocol” and is used by many Ethernet-based networks for handing out IP addresses to client devices (PCs) in an easy, scalable manner. It is based upon the older BOOTP protocol though it does have its own IETF standards (RFC2131 [2] and RFC2132 are primary; see [3] for a more complete list). DHCP is closely related to other network protocols such as TFTP and DNS, which is why many commercial software vendors package their DHCP offerings with these (and other) related protocol servers.

Background

Of course, traditional enterprise networks are a big user of DHCP services, allowing easy dynamic and persistently available IP addresses for business users. In provider networks, DHCP is used only in certain access methods, such as cable modems and traditional end subscriber Ethernet access (e.g., switches and some wireless access points) for use in deployments such as apartment buildings. Wireless access points (such as those from Colubris) often support multiple IP address assignment methods, including RADIUS and DHCP [4]. Other access technologies (such as DSL and dialup) are typically assigned IP addresses via RADIUS or similar authentication protocol, and therefore they are not usually associated with DHCP services.

DHCP Feature Requirements

At a basic level, the service provider requires very similar features to an enterprise needing address assignment services. Some of the more important features required in just about every DHCP deployment include:

- Assignment of “persistent” IP addresses to specific MAC addresses
- A graphical user interface (GUI) to help support personnel troubleshoot problems
- Flexibility in managing address pools

You might be wondering why I included a GUI as a must-have. Support personnel are a different breed of folks and need a GUI in order to efficiently handle customer trouble requests. Also, a

small organization will want a Microsoft-type GUI instead of a command line for managing DHCP on a small network.

For a service provider (or large enterprise), additional DHCP features required often include:

- The ability to easily extend the server's functionality
- Command-line access
- Large-scale deployments (millions of clients)
- An interface to provider provisioning systems
- An easy-to-use Application Programming Interface

Many of these features are found in the DHCP servers targeted at carrier-class service providers covered in this article.

Deploying a DHCP Server

Planning is key to bringing up any new network infrastructure and DHCP is no exception. DHCP startups can be phased in, by pointing only a limited number of LAN segments (say, a single class C of 254 possible clients) at the new DHCP server in question. Going back to the original DHCP server is easy, as it involves just changing the DHCP helper address on the LAN segment you moved in the first place.

Designing advanced options such as RFC 3046 (Option 82), called the Relay Agent Information Option [5], can be tricky, because they are often specific to the hardware vendor in question. Option 82 is a DHCP feature where the client gives the server additional information about itself so that the server can select the proper IP address for the client and assist the client in self-configuration. It pays to test these features completely in the lab prior to rollout, so that vendor promises can be turned into reality without nasty surprises late in the rollout!

Solutions

There are many DHCP solutions available on the market, and most have decent support for service providers. Many of the service-provider-directed solutions are part of “suites” that handle other functionality, such as overall IP address management, DNS, TFTP, and similar functions.

ISC DHCPD

The reference DHCP implementation is ISC's full-featured DHCPD [6]. Here is a listing of DHCPD features from the ISC Web site:

- DHCP Failover Protocol support
- OMAPI, an API for accessing and modifying the DHCP server and client state
- Conditional behavior
- The ability to store arbitrary information on leases
- Address pools with access control
- Client classing
- Address allocation restriction by class
- Relay agent information option support
- Dynamic DNS updates
- Many bug fixes, performance enhancements, and minor new DHCP protocol features

Many smaller service providers utilize ISC's DHCPD on their networks. However, to use it in a large production network, additional development work would probably be required. For example, a GUI would likely be needed for support personnel, and a provisioning interface/system would have to be developed.

MICROSOFT DHCP

Microsoft's DHCP server [7] is probably the leader in terms of the sheer number of DHCP servers in use, but there are likely few large deployments. (I don't know of many good sources of DHCP server market data, though Birds-eye.net [8] offers one somewhat dated source.) Anecdotal evidence suggests that Microsoft is only used in small-service-provider deployments. The Microsoft DHCP server has come a long way since NT 3.5 and now includes features such as clustering/failover [9] and better management of address scopes and ranges.

LUCENT VITALQIP

The VitalQIP [10] server is a product from Lucent that contains a DHCP server along with other functions in one application, including IP address management and a DNS server. VitalQIP's real strength is its scalability, as the software is designed from the ground up for very large networks. To this end, it is a "manager of manager" of sorts, able to manage different underlying DHCP platform types (MS Windows, IBM AIX, and Lucent's own) all from one interface. Of course, if you are a service provider who doesn't have several million clients, then this solution is probably too large (and likely too expensive) for you.

NOMINUM

Nominum [11] is a big player in the carrier-class service provider software market for DNS and DHCP servers. In fact, according to its Web site, its "products were developed by Nominum engineers based on lessons they learned from writing BIND (version 9) and ISC-DHCP (version 3)." Its DHCP product offering, called the Dynamic Configuration Server (DCS), is part of its "Triple Play" product line, including authoritative as well as caching DNS servers. Similar to the other carrier-grade solutions, the Nominum solution is designed around scalability, reliability, speed, and ease of use and integration into service provider provisioning systems. Like Lucent's offering, unless you support millions of subscribers, this solution probably isn't for you.

INCOGNITO

Incognito Software [12] is a relative unknown in the DHCP market, though the company has been around since 1992. It has a nice product suite, with solutions to many of the issues service providers face:

- DHCP
- DNS
- ENUM [13]
- SIP
- IP address management
- TFTP

Incognito's DHCP product is called IP Commander and is a native application running on a number of platforms, including Microsoft Windows NT/2000/XP/2003, Sun Solaris 8, and Red Hat 9/AS3/ES3. It includes support for a number of protocols, including DHCP, DNS, and TFTP. This product has all of the features one would expect in a carrier-grade product, including scalability, reliability, performance, and easy integration with back-end provisioning systems. The only feature missing is a Web interface for support personnel, though it wouldn't be very hard to build one on top of the provided command-line interface. All in all, this is a good product for any provider to look into further.

CISCO CNR

Cisco's carrier-class DHCP offering is called Cisco Network Registrar (CNR) [14]. This is a very scalable, flexible, and robust DHCP server, offering TFTP, DNS, and IP address management capabilities. One of the biggest benefits of CNR is how it scales from one server to one cluster of servers to multiple clusters of servers over very large networks. Another big benefit to CNR is how extensible it is: One can write embedded scripts to handle all the customizations one needs when running a DHCP network of any size. CNR has both a CLI and a Web-based GUI, though the GUI could use some extensive human factors improvements. (In other words, I found it hard to use when evaluating the GUI.) CNR is another good option for a small but growing provider who needs DHCP and associated services.

Conclusion

For the service provider, DHCP is a core part of the cable modem and traditional Ethernet-based networks (apartment complexes and such). Service providers have many of the same DHCP-related requirements a traditional enterprise network operator has, plus a few others. These additional requirements include ease of extending the capabilities server, provisioning, CLI access, and very large-scale deployments.

The reference DHCP implementation is the ISC DHCPD server, which is good for many smaller installations. Microsoft incorporates a DHCP server as part of many versions of Windows, which is a good option for small providers. A small to mid-size provider would do well to look at Incognito's IP Commander and Cisco Registrar, both excellent choices for these markets. A large carrier might consider any of the DHCPs listed previously, in addition to Lucent's VitalQIP or Nominum.

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