Network Station Manager
Version 2

Planning and Design Considerations

IBM Network Computer Division
July 1999

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Objectives/Contents

- **Hardware decisions**

- **Network decisions**

- **Boot related decisions**

- **Boot server decisions**

- **Terminal configuration decisions**

- **Authentication server decisions**

- **Application server decisions**

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Notes

The objective of this presentation is to provide an overview of some of the important decisions facing an administrator while planning to implement a network of Network Stations.

The intent is not so much to provide specific answers as to draw attention to the right questions that should be asked when designing such an environment.

We shall first take a look at hardware related decisions, which are fairly simple, and then move on to the network and boot related questions, followed by a look at decisions related to each of the logical servers we discussed in the architecture topic.

Some of these decisions can be fairly involved and we do not have the time to cover all the details in this particular presentation. We will therefore summarize a lot and direct you to the Planning and Design chapter in the draft redbook on V2R1 on this CD for a lot more details.

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Hardware Decisions Summary

Choices	Factors to consider
Model	Application types and mix
Memory Size	Number of simultaneous applications (real memory) and print buffer requirements.
Adapter Type	Choice of technology (TRN or Ethernet)
Monitor Type	Applications used and user requirements
Video Support	Resolution needed by user or application
Mouse	Normally 2-button (shipped); Can use 3-button for AIX.
I/O Ports and Devices	Audio, serial and parallel are standard; PCI, PCMCIA, Flash card, Touch screens, Mutiple Serial adapter card, and others based on special needs

Notes

Here is the first set of decisions faced by the administrator.

For each section, we use the same format, which is to summarize the choices that are to be made and look at the factors to be taken into account for each of these choices.

For example, the model of the Network Station needs to be chosen in light of the application mix to be processed on a particular station.

The memory size of a station depends on the number and type of applications to be run simultaneously as well as on the print buffer requirements if the station has one or more printers attached.

And so on for the different the other hardware characteristics.

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Network Station Models/CPU/RAM
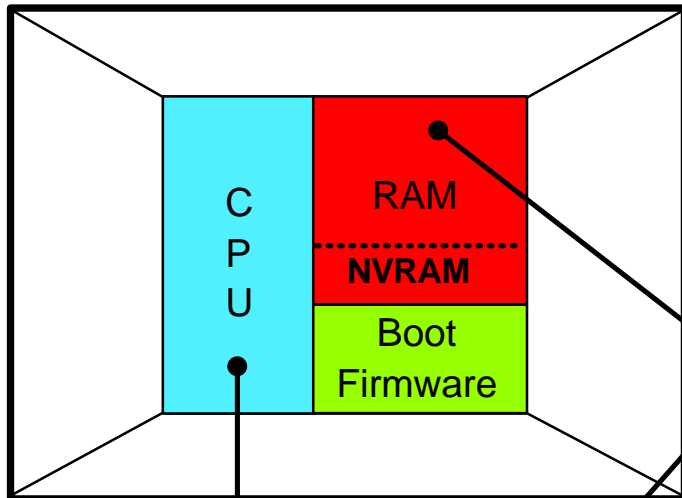
IBM Network Station

Model	Description
8361-100	Series 100 Ethernet
8361-200	Series 100 Token-Ring
8361-110	Series 300 Ethernet
8361-210	Series 300 Token-Ring
8361-341	Series 300 Twinax
8362-A22	Series 1000 Token-Ring (32M)
8362-A23	Series 1000 Token-Ring (64M)
8362-A52	Series 1000 Ethernet (32M)
8362-A53	Series 1000 Ethernet (64M)
8363-Txx	Series 2200 Token-Ring
8363-Exx	Series 2200 Ethernet
8364-Txx	Series 2800 Token-Ring
8364-Exx	Series 2800 Ethernet

Model	Technology	Speed
Series 100	Power PC 403	33 MHz
Series 300	Power PC 403	66 MHz
Series 1000	Power PC 603	200 MHz
Series 2200	Intel Pentium MMX	233 MHz
Series 2800	Intel Pentium MMX	266 MHz

Model	Min.	Max.
Series 100	8 M	64 M
Series 300	16 M	64 M
Series 1000	32 M	64 M
Series 2200	32 M	288 M
Series 2800	64 M	256 M

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Notes

This chart summarizes the Network Station models available, the speed of the processor and the amount of RAM memory available on each of the model families.

For these characteristics, the driving factor is the set of applications to be run on the station.

Each family of Network Station is designed for a particular set of applications. For example, the Series 300 is most appropriate for host access but not really Web access or Java. The Series 1000 and 2200 are most appropriate to Web browser and light Java while the Series 2800 is more suited to heavier Java work.

The memory size is then selected based mainly on the number of simultaneous applications to be executed as the Network Station is a real memory system. More memory does not increase performance but does allow more applications to be run simultaneously.

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Network Station - LAN adapter and Video Support

Monitor Support	All models	Video Graphics Array (VGA) Super Video Graphics Array (SVGA) Super Extended Graphics Array (SXGA)
Video Support	All models	Minimum: 640x480 VGA Maximum: 1600X1200 SXGA

Video memory	Series 100 Series 300	1 MB Base 2 MB Maximum
	Series 1000	2 MB base and maximum
	Series 2200	3 MB base and maximum
	Series 2800	4 MB base and maximum

Window Manager

C P U

RAM

Boot Firmware

LAN Adapter Manager
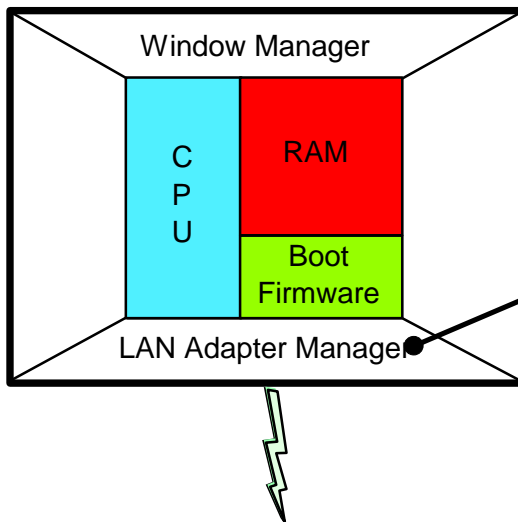
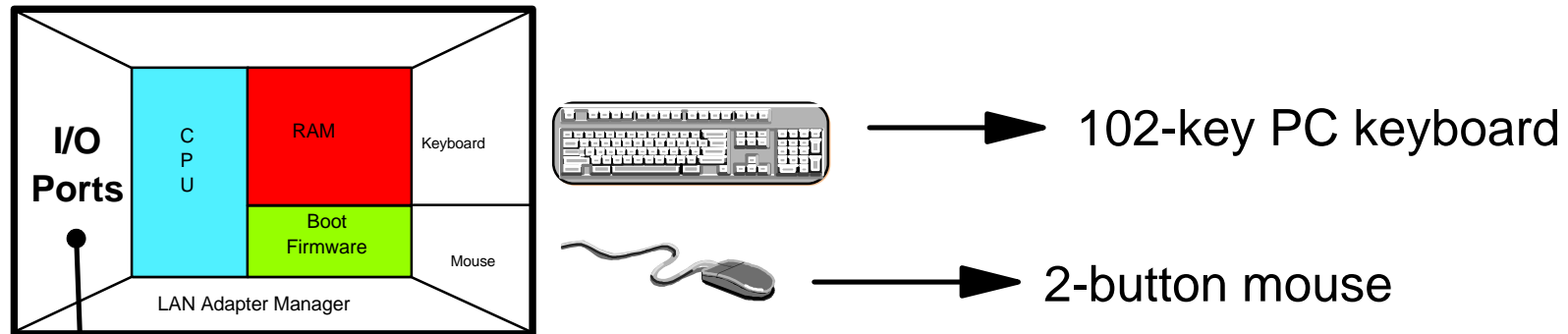| Model	Ethernet	Token-ring
Series 100	10 base T	Auto 4/16 Mb
Series 300	10 base T	Auto 4/16 Mb
Series 1000	10/100 Mb	Auto 4/16 Mb
Series 2200	10/100 Mb	Auto 4/16 Mb
Series 2800	10/100 Mb	Auto 4/16 Mb

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Notes

This chart summarizes the LAN and video support.

The LAN support is nearly the same for all models, that is a choice of either TRN or Ethernet adapters and the decision of which adapter to use is most likely determined by the existing network topology in existence.

The video support is similar for all models except for the amount of video memory available, but in most cases, there is no choice to be made as the base and maximum video memory is the same.

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I/O Ports and Devices

```
┌─────────────────────────────────────┐
│  I/O      │ C │  RAM    │ Keyboard   │
│  Ports    │ P │         │            │
│           │ U │─────────│────────────│
│           │   │ Boot    │            │
│           │   │ Firmware│ Mouse      │
│     LAN Adapter Manager              │
└─────────────────────────────────────┘
```

102-key PC keyboard

2-button mouse

I/O Ports	Series 100	Series 300	Series 1000	Series 2200	Series 2800
Audio	8-bit Speaker	8-bit Speaker	16-bit Jack	16-bit Stereo Output Jack Mono Input Jack	16-bit Stereo Output Jack Mono Input Jack
Serial Port	1	1	1	No	2
Parallel Port	1	1	1	No	1
PCI Adapter Slots (half-length)	None	None	None	No	2
PCMCIA Type II	Yes	Yes	Optional	No	No
USB Ports	No	No	No	2	2
Flash Memory Cards	PCMCIA (linear C/D) (8 to 40 MB)	PCMCIA (linear C/D) (8 to 40 MB)	PCMCIA (linear C/D) (8 to 40 MB)	Compact Flash (8 MB to 96+ MB)	Compact Flash (8 MB to 96+ MB)

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Notes

Finally, the last hardware related decisions concern the choice of the I/O devices required.

Here the administrator faces a lot more diversity between the different models of the Network Station.

In general, all models have at least one native serial and parallel port, except for the Series 2200 which only has two USB ports.

Adapter card support consisted of PCMCIA adapters on the previous Power PC models, replaced with PCI adapters in the newer model (Series 2800).

Finally, the flash card support consisted of linear flash cards with a maximum capacity of 40 MB whereas the newer models (2200 and 2800) support the compact flash cards which can hold upwards of 96 MB at this time.

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Network Planning Decisions

- Assess the impact of the additional traffic generated by the boot and application activities of the new devices
- Determine whether the current capacity of the network can handle the additional traffic and if not, what changes are required in the current topology.
- Analyse where the different logical server functions should be located in order to meet the service level criteria of the enterprise.
- Analyse the location of the servers in light of the administrative and network management policies of the organization.
- Assess whether the planned implementation meets the security guidelines of the network.
- Determine the level of fail-safe operation and backup that needs to be implemented.
- Take into account the level of IT skills required at each level in the network.
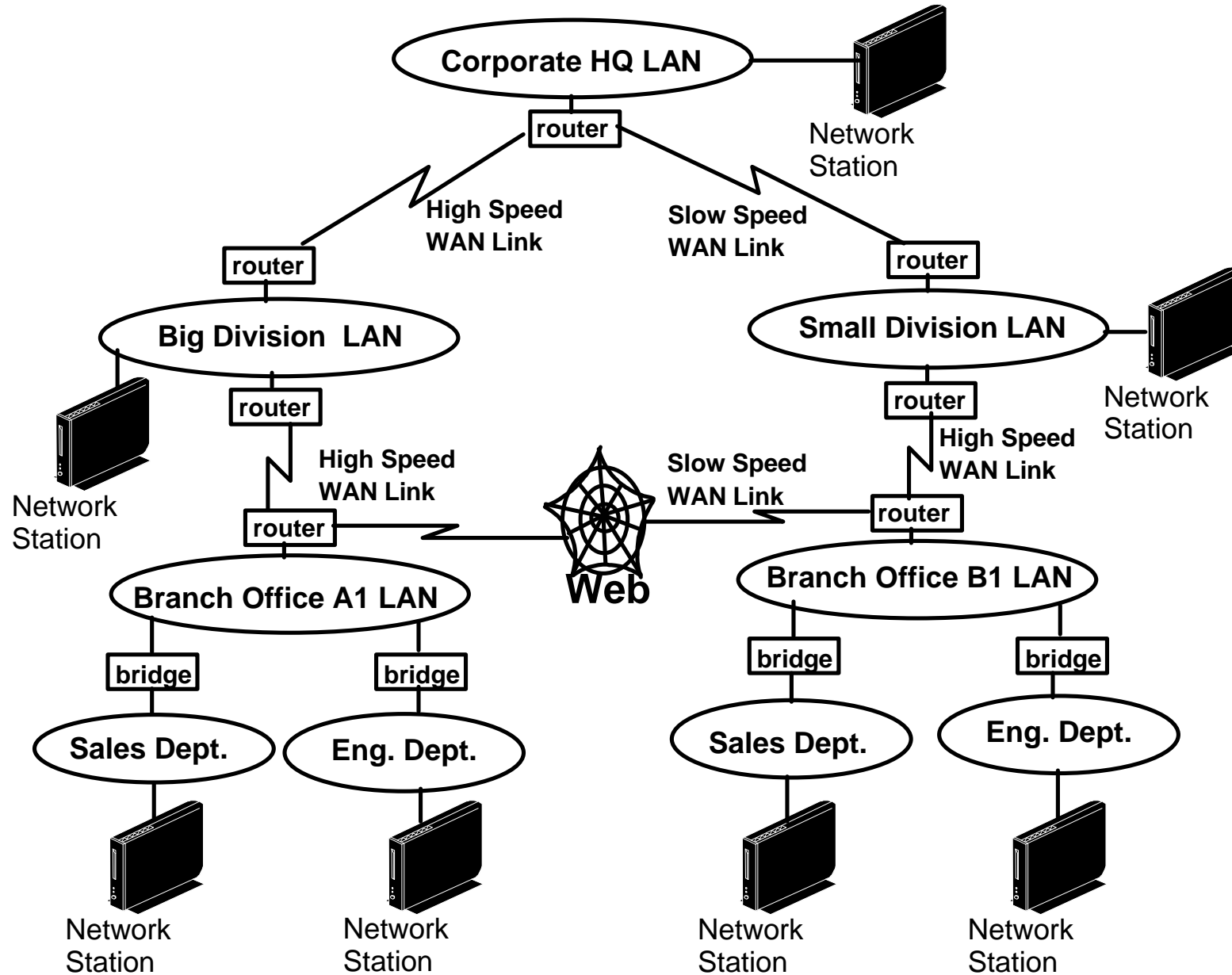
© IBM Corporation

Notes

There are three primary areas of planning to consider for network stations:
- The installation and configuration of the Network Station units themselves. This is the easy part.
- The installation and configuration of the servers required to support these Network Stations which represents medium difficulty.
- The network design and analysis activities required to ensure that the underlying network infrastructure can support the traffic volumes and patterns generated by the Network Stations.

Planning the proper network infrastructure is by far the most involved and difficult aspect of the planning cycle and this chart identifies some of the activities that must take place to ensure a proper infrastructure.

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Network Topology Example

Corporate HQ LAN

Network Station

router

High Speed WAN Link

Slow Speed WAN Link

router

Big Division LAN

router

Small Division LAN

router

Network Station

Network Station

High Speed WAN Link

Slow Speed WAN Link

High Speed WAN Link

router

Web

router

Branch Office A1 LAN

Branch Office B1 LAN

bridge

bridge

bridge

bridge

Sales Dept.

Eng. Dept.

Sales Dept.

Eng. Dept.

Network Station

Network Station

Network Station

Network Station

Notes

This chart represents what we might call a typical network topology into which we might want to insert Network Stations.

This sample corporation has multiple remote branch offices, and each branch office has a branch office LAN segment as well as a LAN segment for each department in the branch office. Since all departments are within the same physical facility, all LAN segments in the branch are bridged together, effectively providing a single logical LAN segment.

Each branch office's LAN is connected to it's divisional headquarters by a WAN link.

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v2 Redesign

Boot Related Decisions

Choices	Factors to consider
Boot using NVRAM or Network	Number of Network Stations in the network. NVRAM only for small number or special cases, otherwise use DHCP.
BootP or DHCP Server	DHCP Server recommended; more flexibility than BootP
DHCP Server Platform	Depends mainly on existing network and/or equipment. Platform itself is not relevant.
DHCP Server Product	Depends on the features and functions desired, such as unlisted client support, or class support, or others.
DHCP Server Location	Depends on policies of decentralization as well as expected topology of the network in terms of the presence of bridges and routers
Number of DHCP Servers	This depends on the centralization policies of the organization, the performance required and the amount of desired redundancy

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Notes

This chart summarizes the main decisions related to the booting process.

The primary decision is whether to use the NVRAM method of booting or BOOTP/DHCP.

If the decision is to use DHCP, which is the recommended choice in most cases, all other decisions are DHCP-related and many are general in nature and not necessarily specific to Network Stations.

The main aspect of DHCP design with Network Station clients is that they require more options than PCs. Not only do they need to be served an IP address but they also need to be served with the address of a boot server, the path to the kernel file, possibly the address of a terminal configuration server, possibly failover addresses for these servers, and so on.

In addition, because the clients (that is the Network Stations) come in different hardware models and different vintages (like the previous Power PC models and the new X86 models), some information for a DHCP client needs might be different from another client.

Finally, there is also the question of the mix of different devices and possibly different versions of the NSM software to coexist in the same environment, which introduces some additional complexity in the design of a DHCP solution.

Let us take a look at a few of the choices.

DHCP and BOOTP Differences

BOOTP Frame

Code-Hw type-Length-Hops
Transaction ID
Flags
Client IP Address
Your IP Adrress
Server IP Address
Router IP Address
Client hardware address
Server Hostname
Boot file name
Vendor specific area (64 bytes)

DHCP Frame

Code-Hw type-Length-Hops
Transaction ID
Flags
Client IP Address
Your IP Adrress
Server IP Address
Router IP Address
Client hardware address
Server Hostname
Boot file name
Options (312 bytes)

cbechard-06/97

For example:

- Option 1 - Subnet Mask
- Option 3 - Default Router
- Option 4 - Time Server
- Option 6 - Domain Name Server
- Option 12 - Host Name
- Option 15 - Domain Name
- Option 28 - Broadcast Address
- Option 50 - Requested IP Address
- Option 51 - IP Address Lease Time
- Option 66 - Boot server Address
- Option 67 - Boot File name
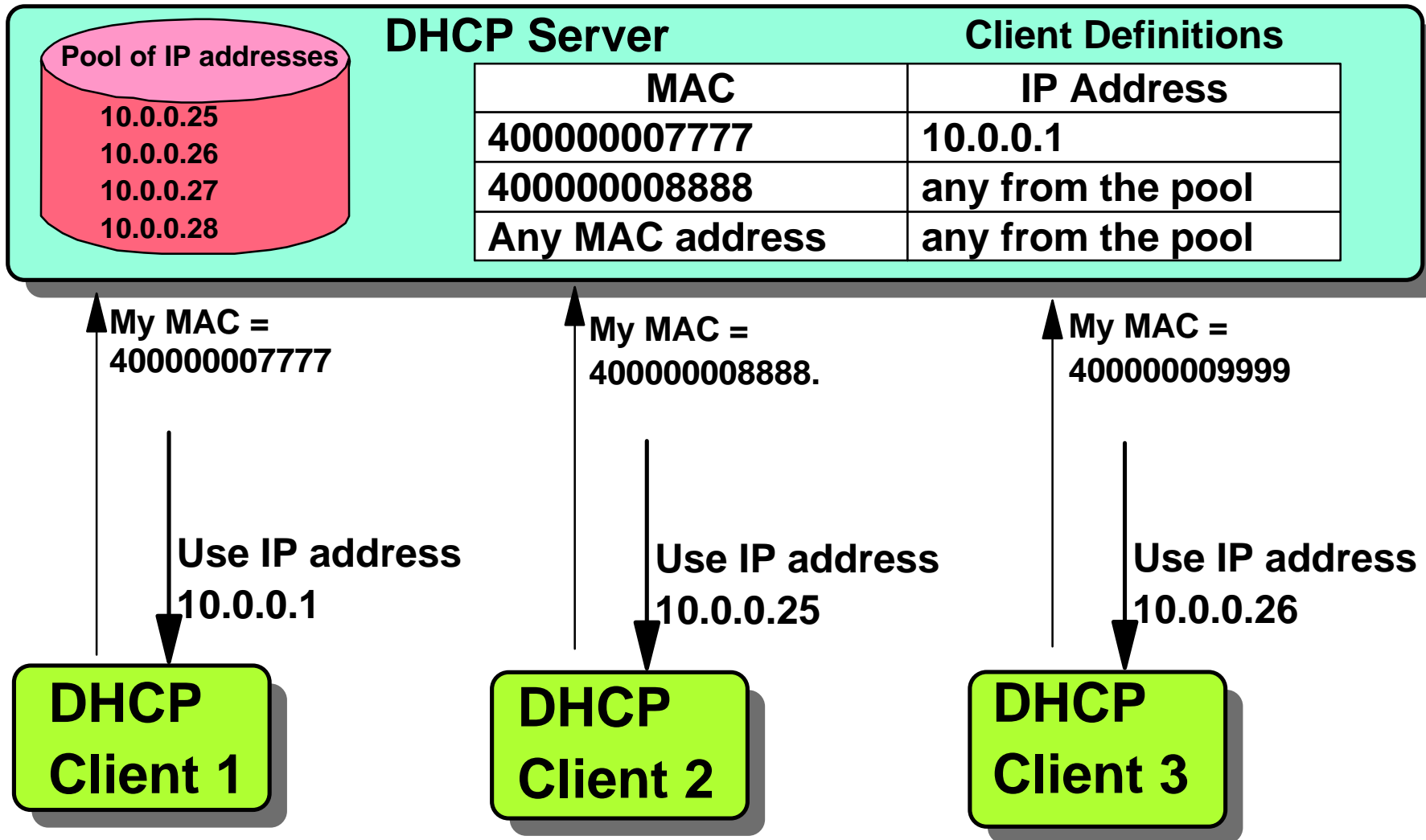
© IBM Corporation

Notes

This chart illustrates the main difference between BootP and DHCP.

It is clear that DHCP has a lot more flexibility and capabilities than Bootp mainly because it has the capability to server a lot more specific pieces of information to its clients, which is what we need in a Network Station environment.

We therefore do not dwell very much on this and assume that DHCP is the default choice that all will make.

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Network Computer Division 19

Unlisted Client Support

DHCP Server

Pool of IP addresses
- 10.0.0.25
- 10.0.0.26
- 10.0.0.27
- 10.0.0.28

Client Definitions

MAC	IP Address
400000007777	10.0.0.1
400000008888	any from the pool
Any MAC address	any from the pool

My MAC =
400000007777

My MAC =
400000008888.

My MAC =
400000009999

Use IP address
10.0.0.1

Use IP address
10.0.0.25

Use IP address
10.0.0.26

DHCP Client 1

DHCP Client 2

DHCP Client 3

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Notes

One of the choices to be made is what actual DHCP product is used, and that is driven mainly by the features that are available on that product to satisfy the needs of the clients.

One of those features is the "unlisted client support" which is the ability to have a DHCP server respond to any client, even if that client's MAC address has not been defined in the DHCP server's configuration file.

This is useful in cases where you do not want to keep track of MAC addresses and yet be able to respond to any client, which we believe is the most common situation.

In this diagram, DHCP Client1 asks the DHCP server for an IP address. The server already has the MAC address (7777) of the client identified in its configuration table and has a fixed IP address already reserved for that specific client.

DHCP Client2 asks for an address; its MAC address is also present in the DHCP server configuration table, but this time the configuration simply states that any address can be used. That causes the server to allocate the next available address for a pool of addresses, in this case 10.0.0.25.

DHCP Client3 on the other hand does not have its MAC address specifically defined in the configuration table, but the server does have a configuration parameter that directs it to allocate the next available address from the pool, in this case 10.0.0.26, and this is what unlisted client support is. In other words, even though DHCP Client 3 is unknown, it still gets served an IP address.

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Network Station DHCP Classes

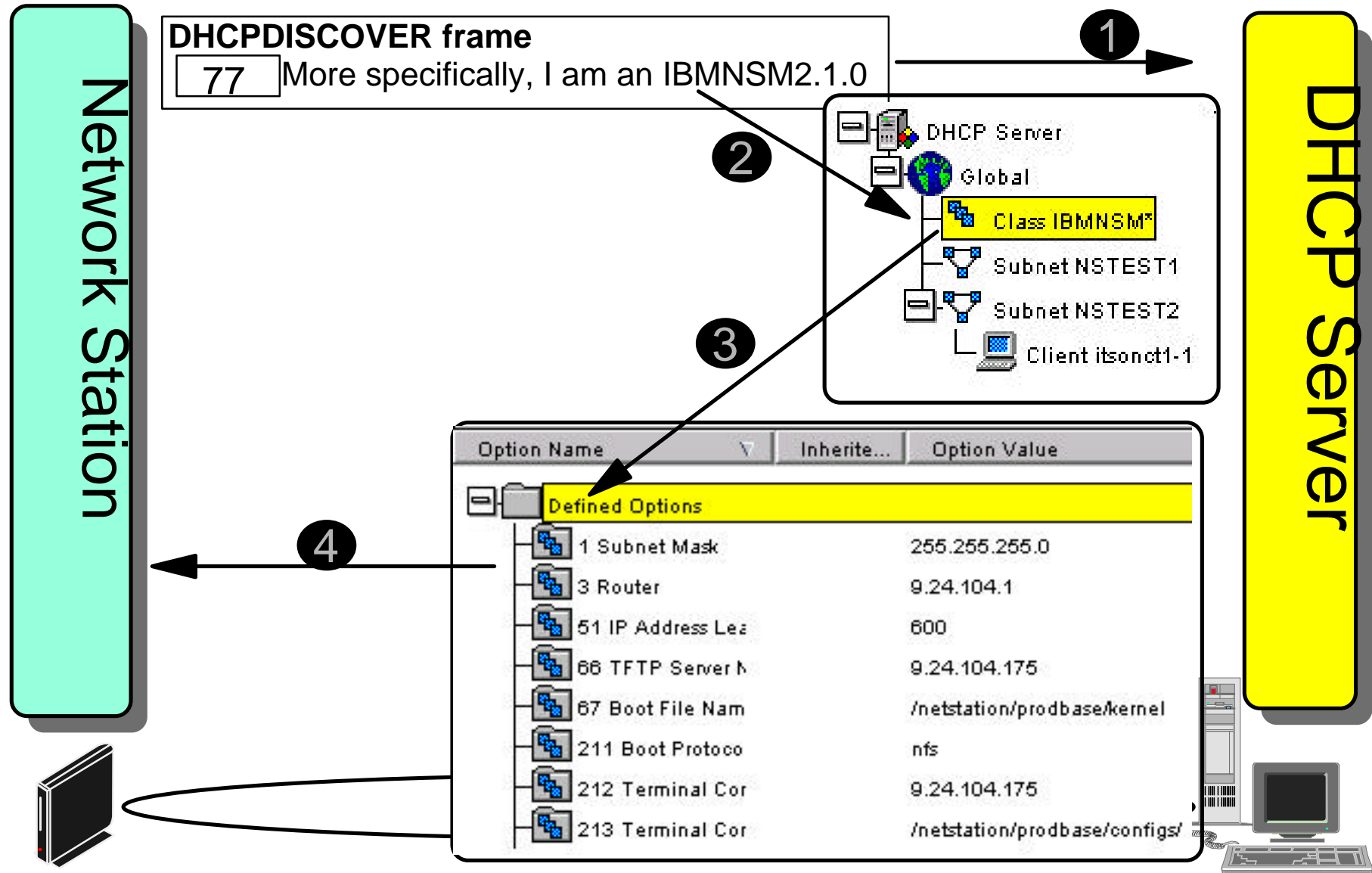| IBM Network Station Model	Description	DHCP Class
8361-100	Series 100 - Ethernet - 8 MB	IBMNSM 2.0.0
8361-200	Series 100 - Token-Ring - 8 MB	IBMNSM 2.1.0
8361-110	Series 300 - Ethernet - 16 MB	IBMNSM 1.0.0
8361-210	Series 300 - Token-Ring - 16 MB	IBMNSM 1.1.0
8361-341	Series 300 - Twinax - 1 MB	IBMNSM 3.4.1
8361-A22	Series 1000/32 MB-TRN	IBMNSM A.2.0
8361-A23	Series 1000/64 MB -TRN	IBMNSM A.2.0
8361-A52	Series 1000/32 MB - ETH	IBMNSM A.5.0
8361-A53	Series 1000/64 MB - ETH	IBMNSM A.5.0
8363-Exx	Series 2200 - Ethernet	8363-EXX
8363-Txx	Series 2200 - Token-ring	8363-TXX
8364-Exx	Series 2800 - Ethernet	8364-EXX
8364-Txx	Series 2800 - Token-Ring	8364-TXX

Notes

The next very important feature is the ability of a DHCP server to support DHCP classes.

A DHCP server already identifies a DHCP client specifically by its MAC address. But there is a need also to identify a client not necessarily as a specific unit but as a unit type.

To give you a better idea of what a DHCP class is, we list in this chart all the classes for all the models of the IBM Network Stations.

Notice that each specific model has an associated class. A DHCP server can therefore identify a station as a particular model without necessarily knowing which specific unit it is.

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DHCP Class Support

DHCPDISCOVER frame

| 77 | More specifically, I am an IBMNSM2.1.0 |

1

Network Station

DHCP Server

2

DHCP Server

Global

Class IBMNSM*

Subnet NSTEST1

Subnet NSTEST2

Client itsonct1-1

3

Option Name	▽	Inherite...	Option Value
Defined Options			
1 Subnet Mask			255.255.255.0
3 Router			9.24.104.1
51 IP Address Lea			600
66 TFTP Server N			9.24.104.175
67 Boot File Nam			/netstation/prodbase/kernel
211 Boot Protoco			nfs
212 Terminal Cor			9.24.104.175
213 Terminal Cor			/netstation/prodbase/configs/

4

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Notes

Here is a simple example of using a DHCP class.

In this chart, the Network Station on the left sends a DHCPDISCOVER frame looking for a DHCP server to respond.

That frame contains the MAC address of the station, as well as possibly other options, one of which is option 77 that contains the class of this unit.

In this example, the client identifies itself as belonging to the IBMNSM2.1.0 class. From this, we know that this is a Series 100 Token-ring machine with 8 MB.
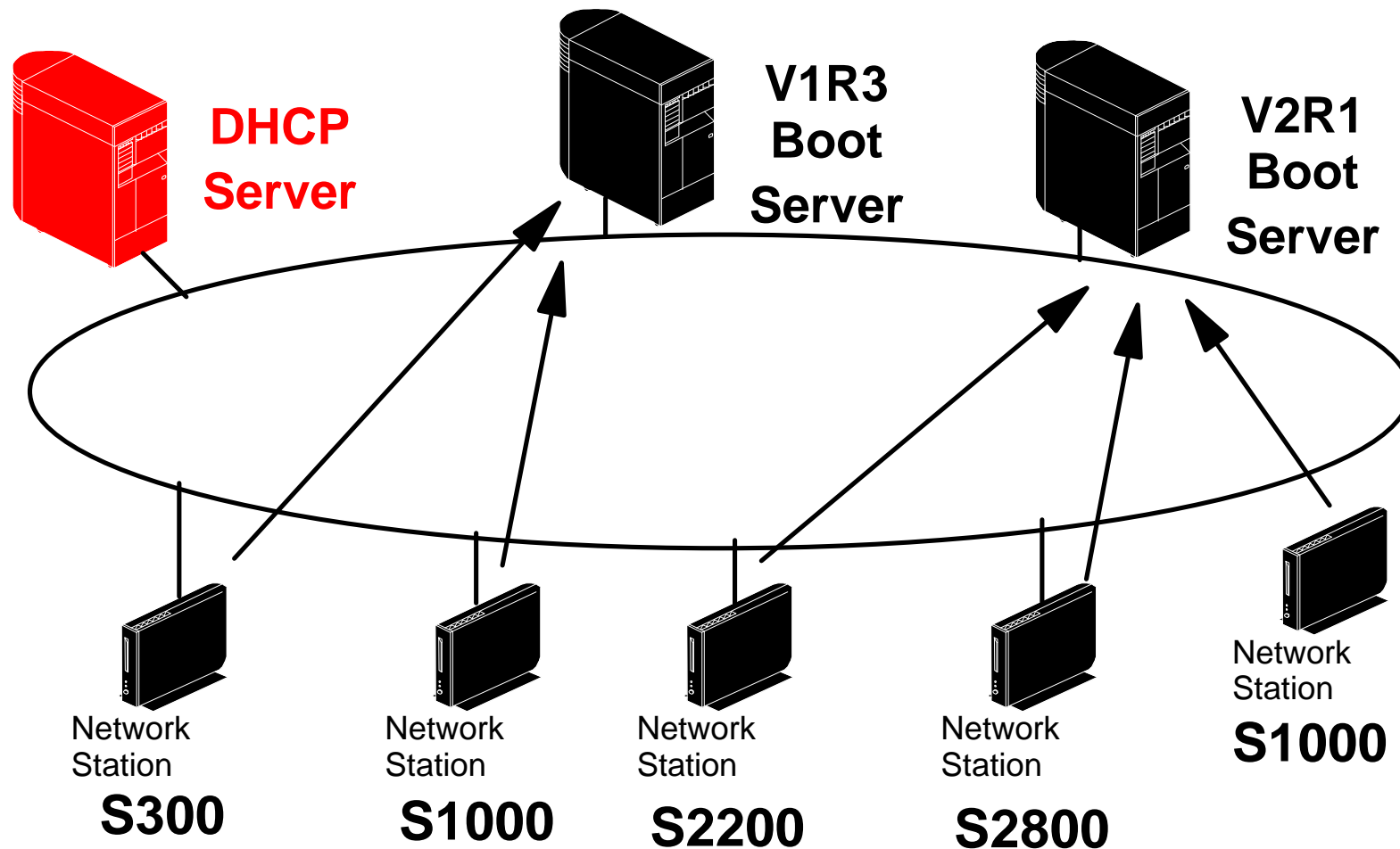
The DHCP server configuration file does not have a specific IBMNSM2.1.0 class defined (although it could) but it has a class configured as IBMNSM*. This actually means that all the classes beginning with IBMNSM are acceptable.

As a result, this client is offered all the options that are defined under that class, as shown in the bottom of the diagram (options 1 to 213).

If the client had been a regular PC instead of a Network Station, it would identify itself as a member of an IBMNSM* class and would therefore not be offered these options.

What this means in terms of a Network Station client is that we can tailor the options to be served based on the model of the Network Station.

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Using Classes for Co-existence

DHCP Server

V1R3 Boot Server

V2R1 Boot Server

Network Station
S300

Network Station
S1000

Network Station
S2200

Network Station
S2800

Network Station
S1000

Notes

DHCP classes can be extremely useful in a coexistence environment where there is a mix of PPC based station and X86 based stations, some still being served by V1R3 boot servers and some being served by V2R1 servers.

When a particular station is served by the DHCP server, the fact that the DHCP server knows what type of hardware it is allows a much easier way to ensure that the proper configuration information is sent to the station.

For example, all X86 based stations can be directed at a V2R1 server since they are not supported by a V1R3 server.

This is rather simplistic, and there can be much more complicated scenarios where PPC stations are using both V1R3 and V2R1 servers, and are located in different subnets, etc. and those need to be analyzed individually to determine the best solution. Nevertheless, the use of classes can simplify the solution in many cases.

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Creating a User Defined DHCP Option

Create New Option

Value format:

String ▼

Option Description:

Option name: `Cfg Server Protocol`

Option number: `214`

Brief description of option

Option value description:

OK   Cancel   Help

Option 98 - Authentication Server
Option 211 - Base Code Server Protocol
Option 212 - Configuration Server Address
Option 213 - Configuration Files Directory
Option 214 - Configuration Server Protocol
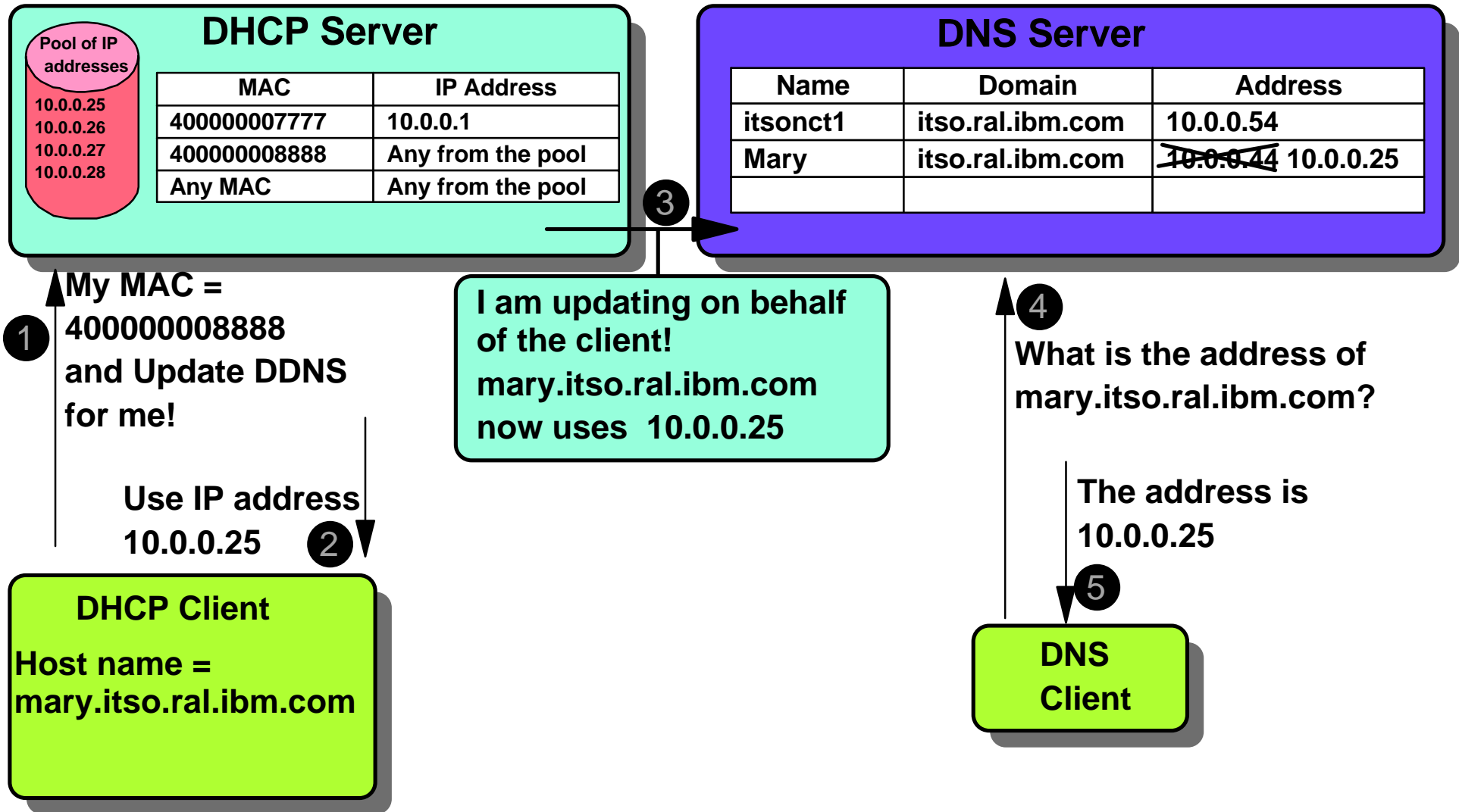**Option 219 - Failover Boot Server**

Notes

Most DHCP server today have the ability to let the administrator create user-defined options, that is, DHCP options 129 to 254.

This panel is from the IBM DHCP server for Microsoft Windows NT where option 214 is being created, which is the option that represents the protocol to be used by the terminal configuration server.

Remember a DHCP server can serve many options to a client but the client must have the ability to recognize these options in order for these options to have any effect.

With NSM V2R1, the options shown in the bottom left hand corner are used and recognized by the Network Station DHCP client code.

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DHCP Server Updating DDNS

DHCP Server

Pool of IP addresses
10.0.0.25
10.0.0.26
10.0.0.27
10.0.0.28

MAC	IP Address
400000007777	10.0.0.1
400000008888	Any from the pool
Any MAC	Any from the pool

DNS Server

Name	Domain	Address
itsonct1	itso.ral.ibm.com	10.0.0.54
Mary	itso.ral.ibm.com	~~10.0.0.44~~ 10.0.0.25

1 My MAC = 400000008888 and Update DDNS for me!

2 Use IP address 10.0.0.25

3 I am updating on behalf of the client! mary.itso.ral.ibm.com now uses 10.0.0.25

4 What is the address of mary.itso.ral.ibm.com?

5 The address is 10.0.0.25

DHCP Client

Host name = mary.itso.ral.ibm.com

DNS Client

Notes

This chart illustrates the process of a DHCP server updating a DDNS server after having served a DHCP client with a new address.

Because the IP address of the client has changed, there is a need to automatically update the DNS server so that the host name that this client was using correctly reflects the new IP address.

To know more on this subject, please refer to the specific DHCP/DDNS presentation.

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DHCP Broadcast
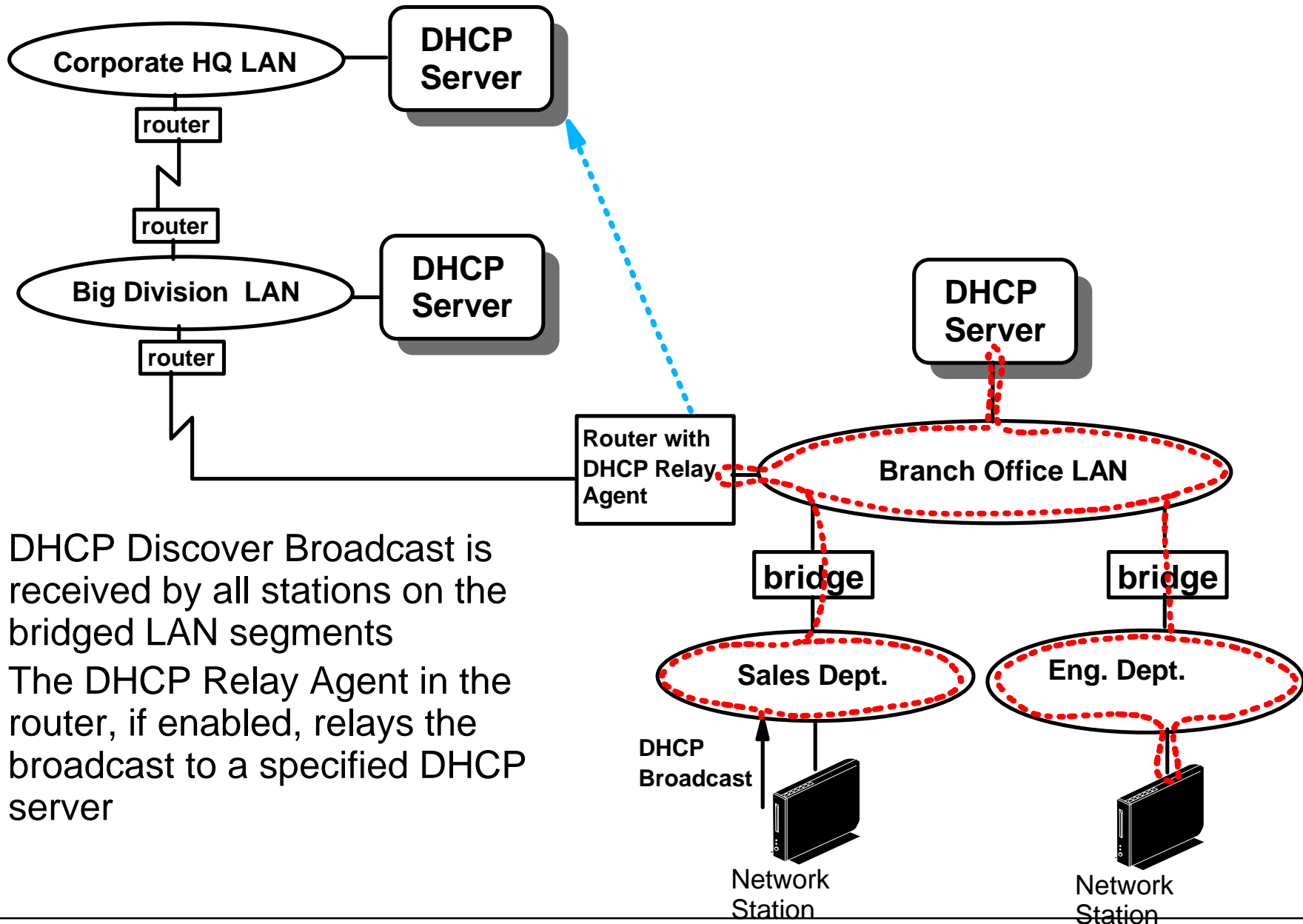
- DHCP Discover Broadcast is received by all stations on the bridged LAN segments
- The DHCP Relay Agent in the router, if enabled, relays the broadcast to a specified DHCP server

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Notes

An important notion to understand with DHCP is that a DHCP client uses a broadcast when it sends a DHCPDISCOVER frame, looking for a DHCP server.

In a routed (instead of a bridged) network however, routers typically do not forward broadcasts, which means that if the DHCP server is located on a LAN segment other than the one where the client is, the client's broadcast cannot reach the DHCP server.

To solve this problem, routers can be configured with a DHCP Relay agent that intercepts DHCP broadcasts and forwards them to a specific DHCP server.

For example, in this chart, the dotted line shows the travel of a DHCPDISCOVER broadcast issued by a Network Station in the Sales Department's LAN segment.
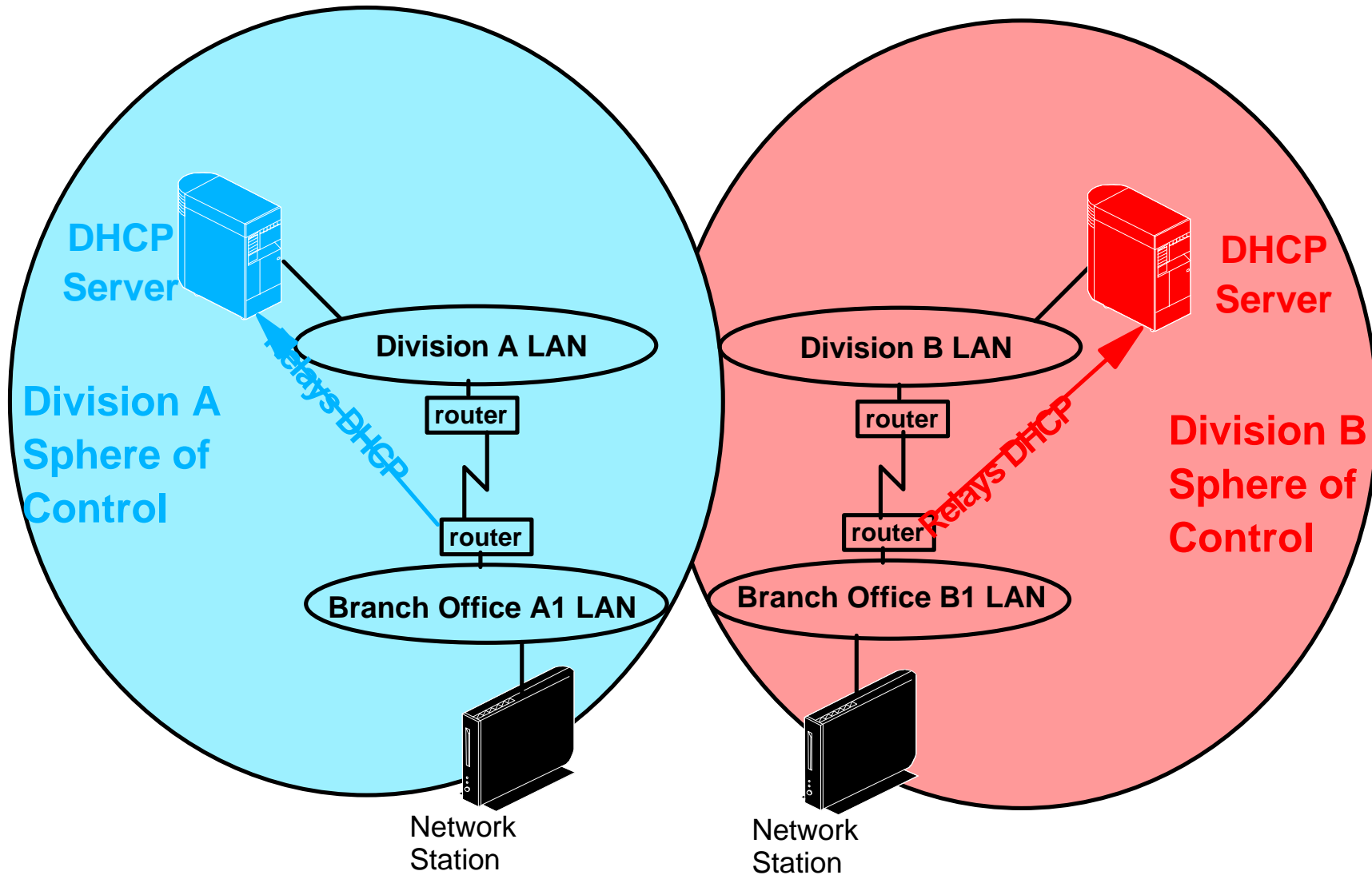
The broadcast travels on all three LAN segments and is received by the DHCP server on the branch office LAN, which presumably might respond, dependent on how it is configured.

The broadcast is also received by the Router on the Branch Office LAN, and because the router has a DHCP relay agent running, the agent looks up its configuration file to determine the address of the DHCP server that should be the target for this broadcast, and forwards the broadcast directly to that designated server (after placing its own IP address in the frame so that the reply willl be sent to him).

That server would also presumably respond, dependent on its configuration, but it responds to the DHCP relay agent which turns around and forwards the server's reply to the station.

The overall effect is the same as if the remote DHCP server had been located in the same LAN segment as the DHCP client.

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Divisional DHCP Servers

DHCP Server

Division A LAN

Relays DHCP

Division A Sphere of Control

router

router

Branch Office A1 LAN

Network Station

DHCP Server

Division B LAN

Relays DHCP

Division B Sphere of Control

router
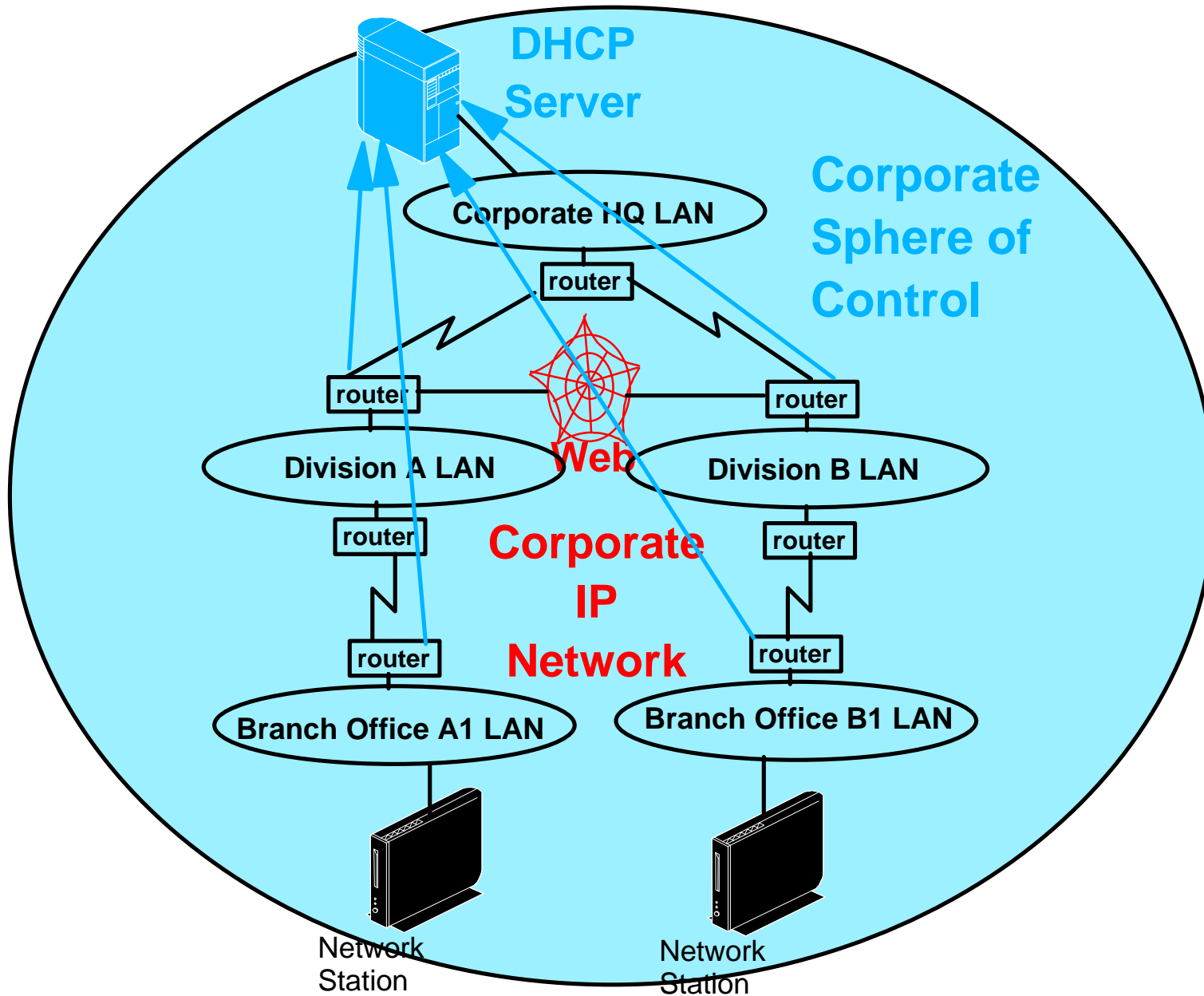
router

Branch Office B1 LAN

Network Station

Notes

This chart shows a topology where we use one DHCP server per division in a corporate network.

The sphere of control of a DHCP server is only over the resources in the division and all branch office routers must have the ability to relay DHCP broadcasts to the division's DHCP server.

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Corporate DHCP Server

DHCP Server

Corporate Sphere of Control

Corporate HQ LAN

router

Web

Corporate IP Network

router

router

Division A LAN

Division B LAN

router

router

router

router

Branch Office A1 LAN

Branch Office B1 LAN

Network Station

Network Station

© IBM Corporation

Notes

On the other hand, if a there is to be a corporate DHCP server, then all routers from all LAN segments must be able to relay DHCP broadcasts to the corporate DHCP server and its sphere of control is over the entire corporate network.

Whether divisional DHCP servers or corporate DHCP servers are used is most of the time more a policy decision than a technical decision, based on who has control over network facilities.

Obtaining an Operating System Decisions

Choices	Factors to consider
Boot server platform	Choices are AS/400, RS/6000, Windows NT Server, Flash Card, a peer Network Station, a thin server or actually any system that provides TFTP or NFS services.
Where to locate the server(s)	Proximity (how close it is) to the client, LAN media speed, network topology
Kernel download protocol	TFTP or NFS/RFS, download speed and server loading
Number of servers for boot performance	Desired boot time in normal and emergency situations
Number of servers for redundancy	Desired boot time with some components having failed

Notes

Now that our Network Station has obtained an IP address from a DHCP server, the next task is to obtain its operating system from a boot server.
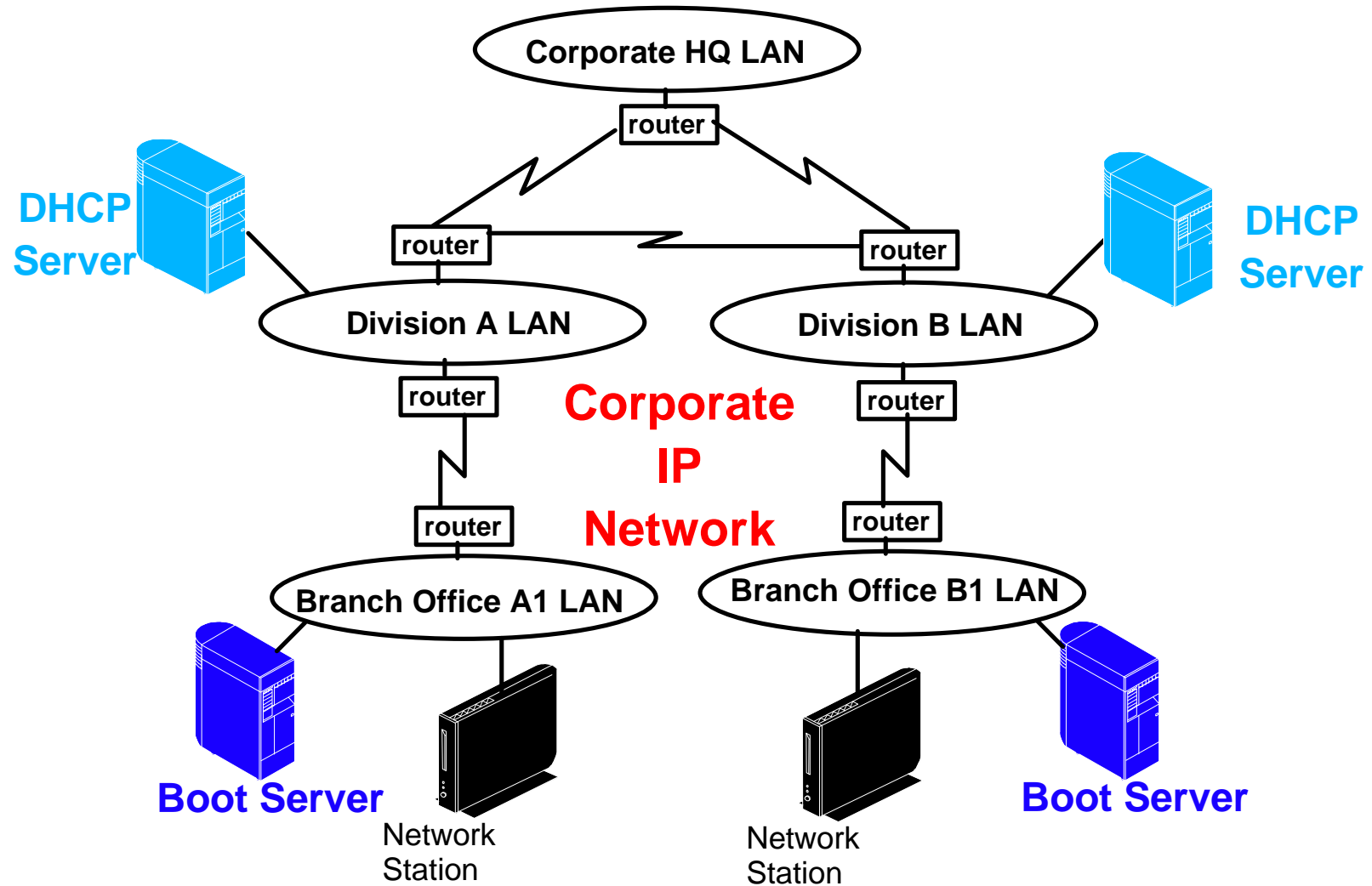
The types of decisions that must be taken concerning the boot server are summarized in this chart.

In this case, the first important decision is the platform to use for the boot server. The choices are:
- AS/400, AIX or Windows NT (and if one of these, do I use a dedicated server or not)
- A flash card in the station itself
- A flash card in a peer station
- A thin server
- Or in fact any system with a TFTP or NFS server

And the second decision is where to locate this server (except in the case of a flash card of course).

Local Boot Servers

Corporate HQ LAN

router

DHCP Server

router

router

DHCP Server

Division A LAN

Division B LAN

router

Corporate IP Network

router

router

router

Branch Office A1 LAN

Branch Office B1 LAN

Boot Server

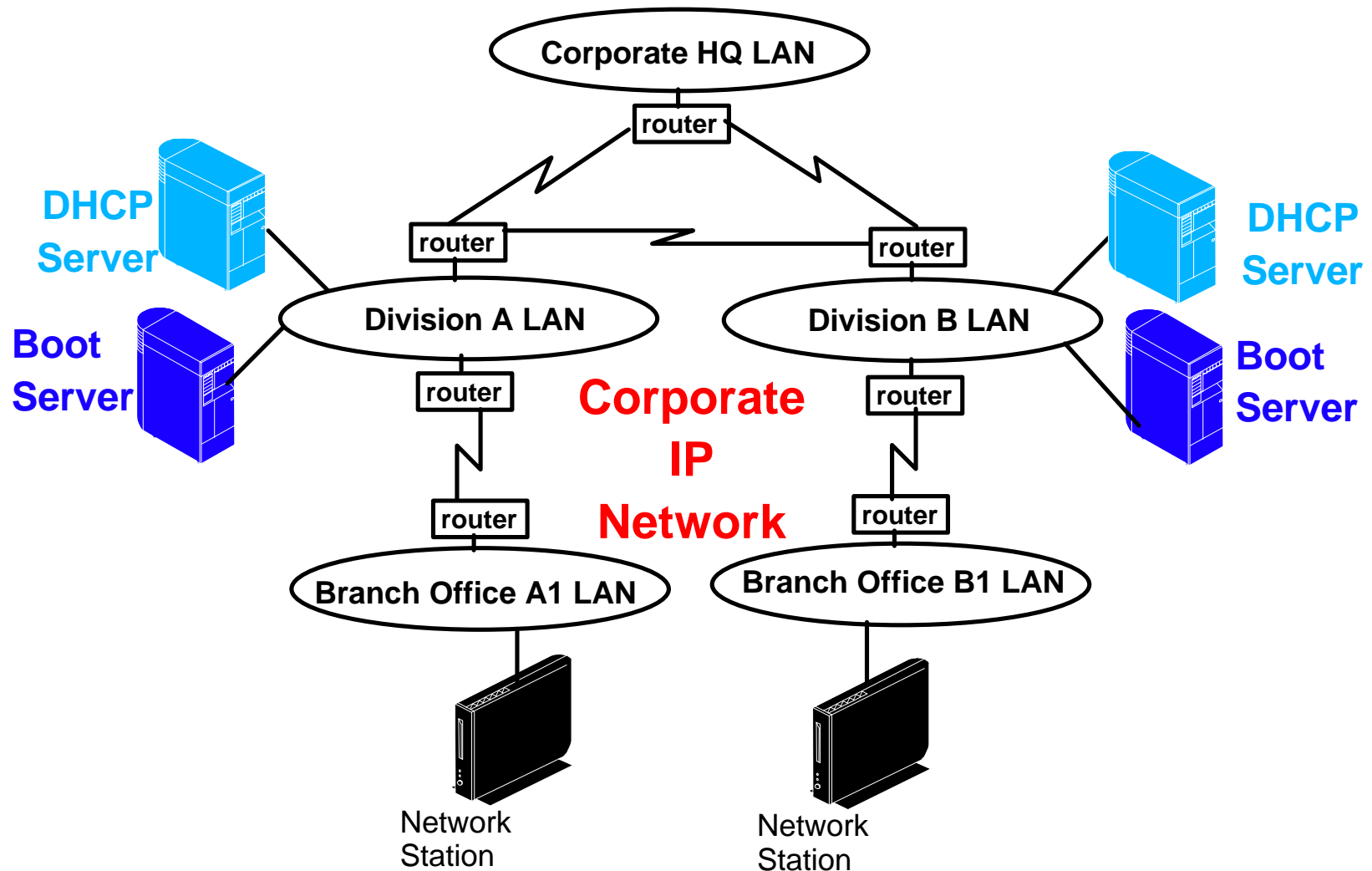Network Station

Network Station

Boot Server

Notes

This chart represents the ideal situation where there is a boot server located on each segment where there are Network Stations.

In fact, we might even be talking about more than one server, dependent on the number of stations there are on the LAN segment, on the performance that we expect, and on the redundancy that we need to build into the system, which are all questions that are part of the same decision about where to locate boot servers and how many to use.

Some of the questions to ask and to investigate are:
- How fast do I need the boot process to be?
- In the event of a power failure, how fast do I need to reboot all stations?
- In the event of the failure of one or more servers, what alternatives do I want to build into the system?
- What service level is expected by the users?

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Remote Boot Servers

Corporate HQ LAN

router

DHCP Server

router — router

Division A LAN

DHCP Server

Boot Server

router

Division B LAN

Boot Server

router

Corporate IP Network

router

Branch Office A1 LAN

router

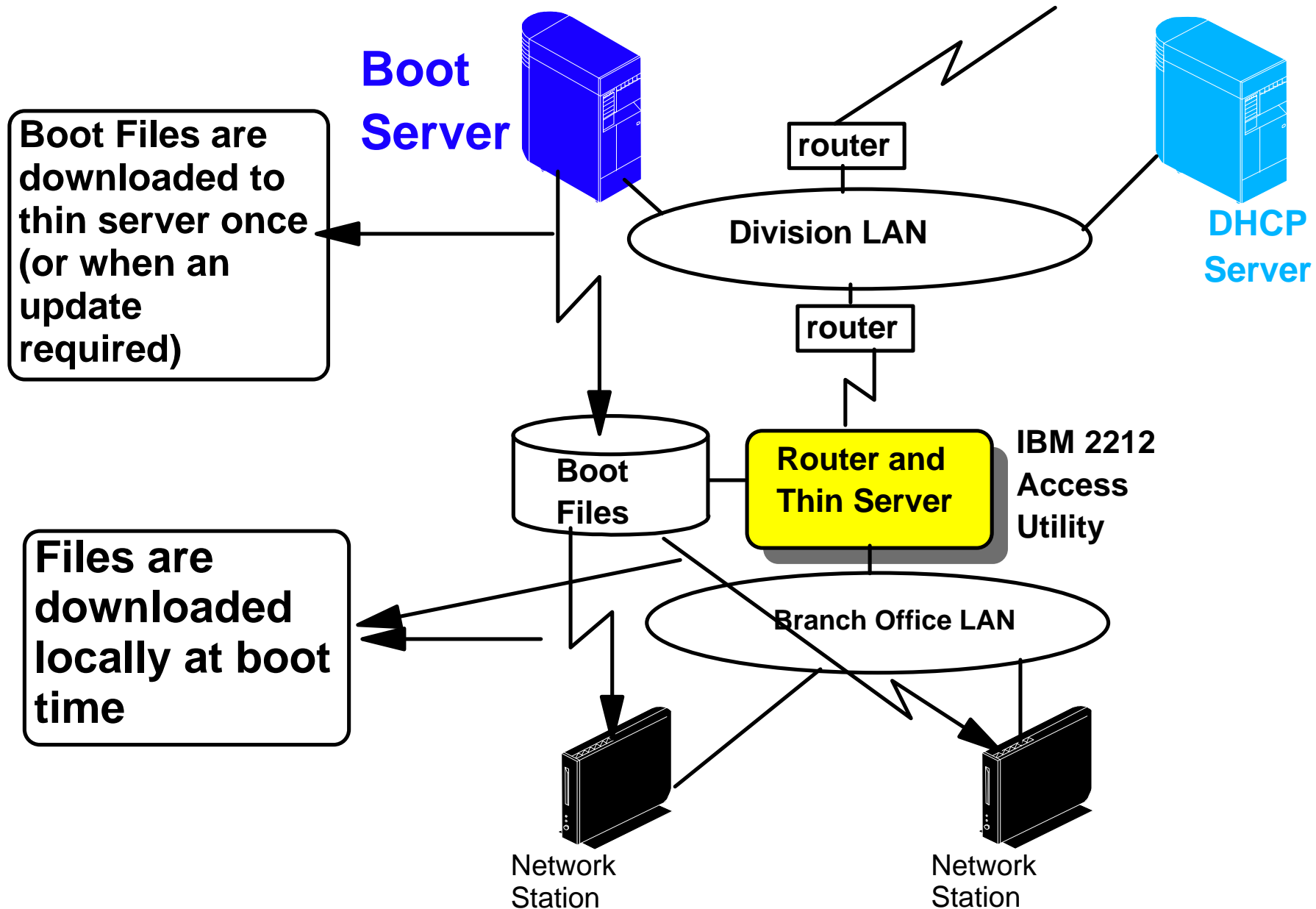**Branch Office B1 LAN**

Network Station

Network Station

© IBM Corporation

Notes

In this chart, we show boot servers located at the division level, across a WAN link from the LAN segments where the stations are located.

This is definitely not an option to consider, although it is possible, because unless there is a very small number of stations and a very high speed WAN link, it is likely that the boot performance will not be adequate.
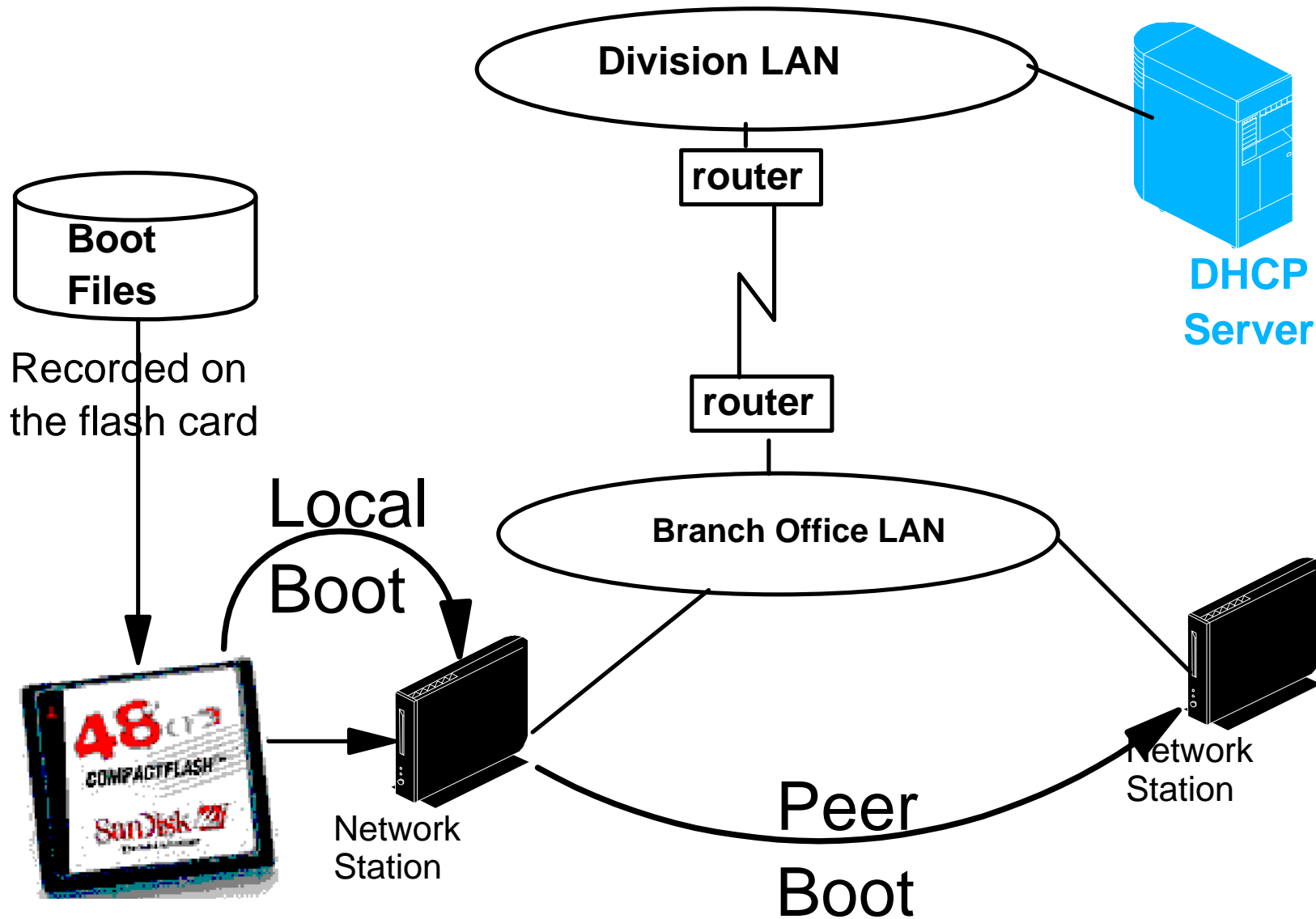
© IBM Corporation

v2rhdesign

Using Thin Servers

Boot Server

Boot Files are downloaded to thin server once (or when an update required)

router

Division LAN

DHCP Server

router

Boot Files

Router and Thin Server

IBM 2212 Access Utility

Files are downloaded locally at boot time

Branch Office LAN

Network Station

Network Station

© IBM Corporation

Notes

If boot servers cannot be located on the same LAN segment as the stations, one alternative is the use of thin servers.

Thin Servers are network components such as the IBM 2212 Access Utility that have the ability to act as a boot server by caching some of the files that are normally downloaded from a boot server.

In other words, the client makes its request from the thin server instead of the boot server, and the thin server is responsible for getting the proper level of the files from the boot server in cases where it does not have the files or if the files are outdated.

The advantage is that thin servers, which normally perform other functions such as routing, are typically located deeper into the network, and therefore much closer to clients. Load time and bandwidth utilization can therefore be optimized while loosing none of the advantages inherent to a central boot server.

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Using Flash Cards

Division LAN

router

DHCP Server

Boot Files

Recorded on the flash card

router

Branch Office LAN

Local Boot

Network Station

Peer Boot

Network Station

Notes

Flash cards are devices on which a copy of the operating system and other files such as font files and native applications modules can be stored. These devices can be used as a local storage device by inserting them into a Network Station.

This allows a Network Station to rapidly load its operating system locally without having to use any network bandwidth. The main advantage is the speed of booting and the minimal impact this has on the network.

In this chart, the Network Station on the left, after having a flash card inserted into it, can boot from that card as a local device. That Network Station can also be configured to provide the same service to a certain number of peer stations, usually no more than 10.

But there are also disadvantages to flash cards that must be understood. Not only do the cards themselves represent an additional cost but they also represent an additional cost in terms of having to manage the distribution of the cards and having to manage the level of the software that is recorded on the cards.

For V1R3, there were no tools that existed to manage flash cards and their contents but with V2R1, the situation is much better because NSM now includes a configuration task that allows the administrator to specify which components are to be recorded on a flash card and when flash cards should be updated.

So one must be careful not to negate the benefits inherent to thin clients where the software is managed and maintained in a central location (the boot server) and caution must therefore be exercised in choosing this option.

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Obtaining Terminal Configuration Files

Choices	Factors to consider
Terminal configuration server platform	Choices are AS/400, RS/6000, Windows NT Server, Flash Card, a peer Network Station, or a thin server.
Platform of the server	Any platform that can run the Network Station Manager application. Choice may depend on existing and available equipment.
Location of the server	Easily located across a WAN link. Most likely determined by which group has the management responsibility or by other policies or topology considerations.
Terminal identifier	Choices are MAC address, IP address in decimal notation, IP address in hex notation. MAC address is the only permanent identifier.

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Notes

The next logical step is to consider the terminal configuration server that is to server the terminal configuration profiles.
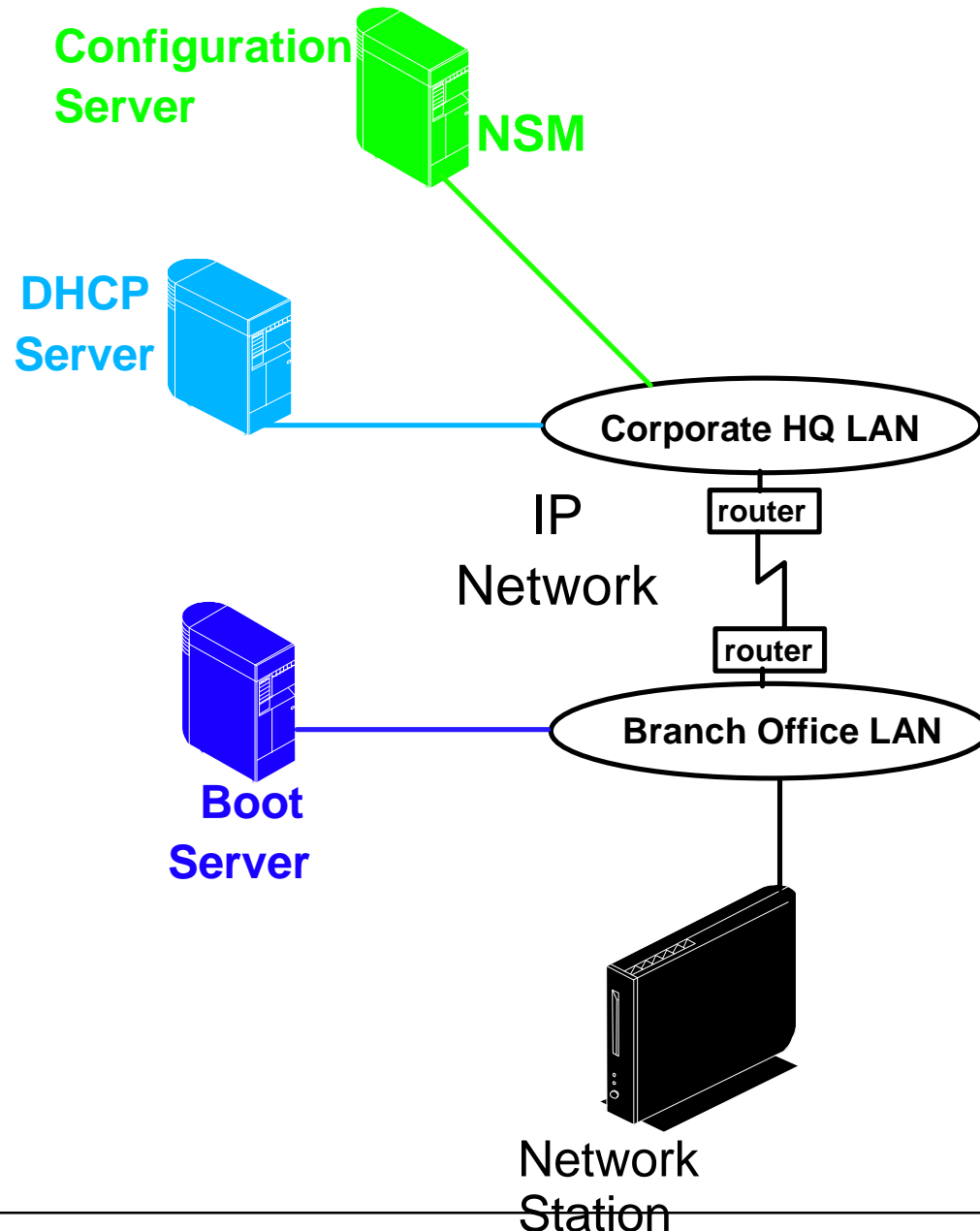
These are the profiles that contain the configuration parameters that determine the base operational characteristics of a particular station (before we even know about who the user is and his preferences).

These profiles are downloaded by the station prior to the user logging in. Notice that the decisions to be considered are similar to those we considered for the boot server, that is, which platform to use for the server and where to locate the server or servers.

However, even though the decisions are similar, the main influencing parameter is the amount of information to be downloaded. In this case, the amount of data is much less than for the boot files and it is therefore a viable option to locate this server across a WAN link.

Note the last entry in the table where a terminal identifier may need to be chosen. If the administrator needs to configure settings particular to specific units, then each unit must be able to be identified specifically and one must choose either MAC address, IP address or host name as an identifier.

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Configuration Server

Configuration Server

NSM

DHCP Server

Corporate HQ LAN

IP
Network

router

router

Boot Server
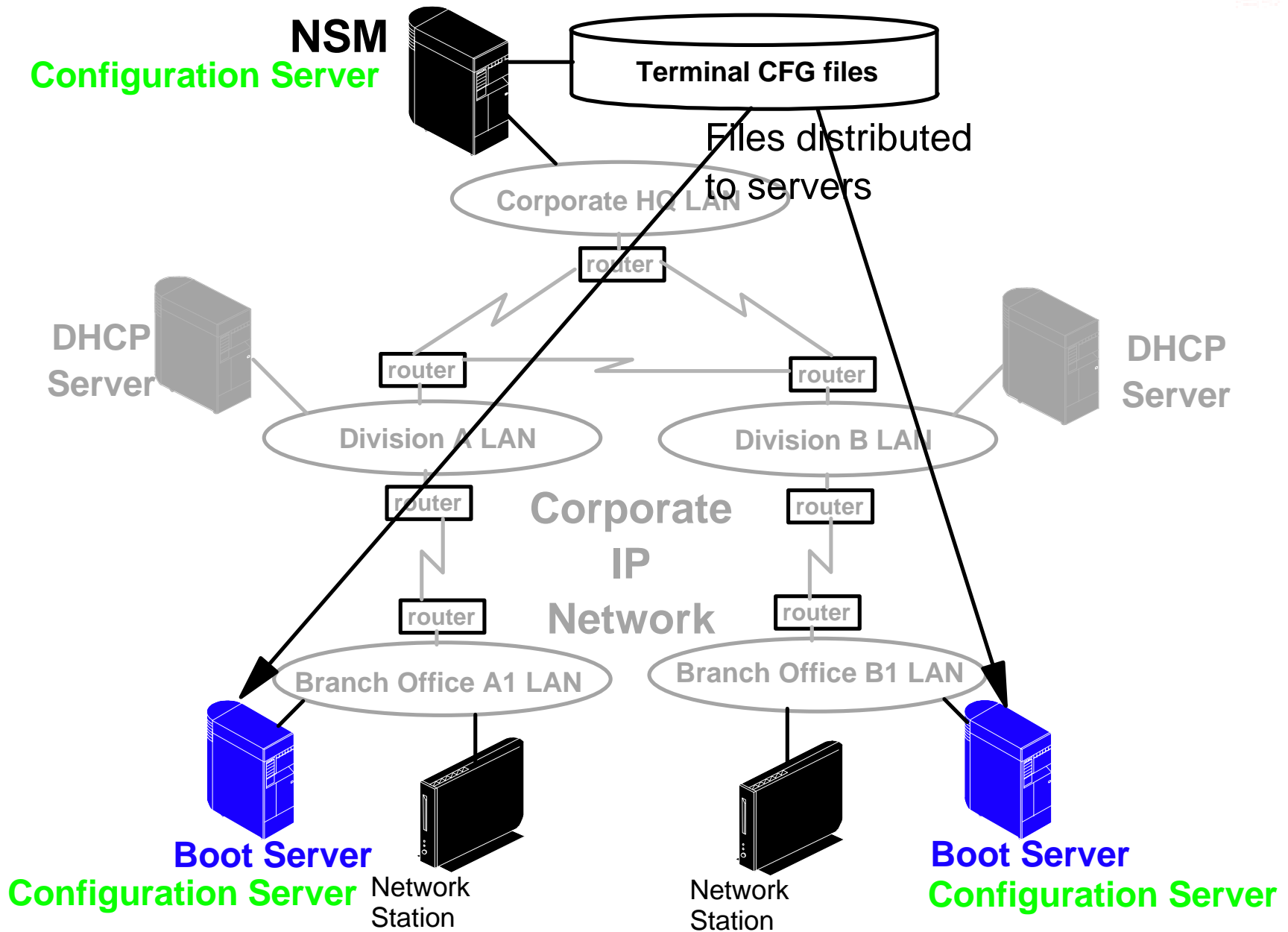
Branch Office LAN

Network Station

Notes

This chart represents probably the most typical situation where the terminal configuration server is located at the corporate levels where these configuration files can be centrally managed.

However, we are faced again with the fact that the corporate network administration policies might dictate that each division for example is responsible for managing its user, in which case there might be a political need to use multiple terminal configuration servers located at different levels in the organization.

In any case, the placement of these servers is less sensitive technically because the amount of data downloaded from these is much less than from boot servers.

Distributing Configuration Files

NSM
Configuration Server

Terminal CFG files

Files distributed to servers

Corporate HQ LAN

router

DHCP Server

router

router

DHCP Server

Division A LAN

Division B LAN

router

Corporate

router

IP

router

Network

router

Branch Office A1 LAN

Branch Office B1 LAN

Boot Server
Configuration Server

Network Station

Network Station

Boot Server
Configuration Server

© IBM Corporation

Notes

However, one characteristic of the terminal configuration files is that they are set initially and changes to these profiles can be infrequent. In fact, one of these files which contains the shipped defaults which should not be changed ever.

But even though they represent much less data to be downloaded than from a boot server, still they need to be downloaded everytime a station boots.

One way to avoid having to download these profiles over a WAN link is to locate them also on the boot server so that they are loaded locally from the LAN while still keeping the management of the files in a central location.

This diagram shows that the files reside at the corporate level on a server that runs NSM in order to manipulate the files. However, these profiles are copied to the boot servers (where they cannot be changed if NSM is not installed on the boot servers) and are loaded from the boot server by configuring the boot server also as the terminal configuration server.

Contacting an Authentication Server

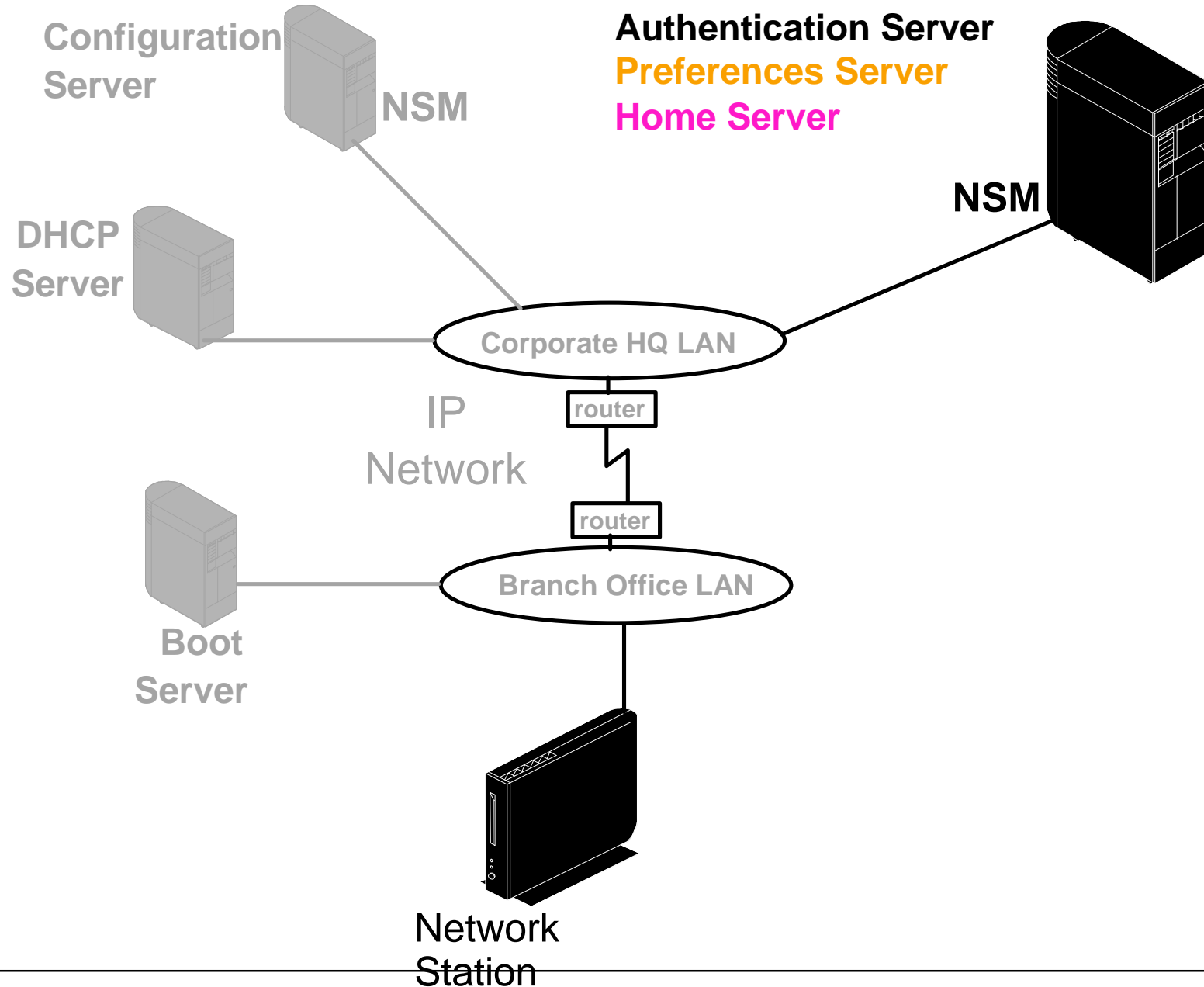| Choices	Factors to consider
Platform for the server	Same as those for the terminal configuration server.
Location of the server	Same as those for the terminal configuration server.
Location of user accounts	Policies, existing account information, additional network traffic if located on another server.

Notes

At this point in the boot process, we are ready to ask the user to identify himself and we have to validate the user with an authentication server.

This chart now starts to be familiar because we still have some of the same decisions to be made as with all the previous servers, mainly the choice of a platform and the location of the server or servers.

Most decisions here have the same characteristics as for the terminal configuration server.

In this case, whatever platform is chosen must be one where NSM can be installed because we need an important component called the Network Station Login Server which is required to communicate with the Network Station Login client on each station.

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Authentication Server

Configuration Server

NSM

DHCP Server

Authentication Server
Preferences Server
Home Server

NSM

Corporate HQ LAN

IP Network

router

router

Boot Server

Branch Office LAN
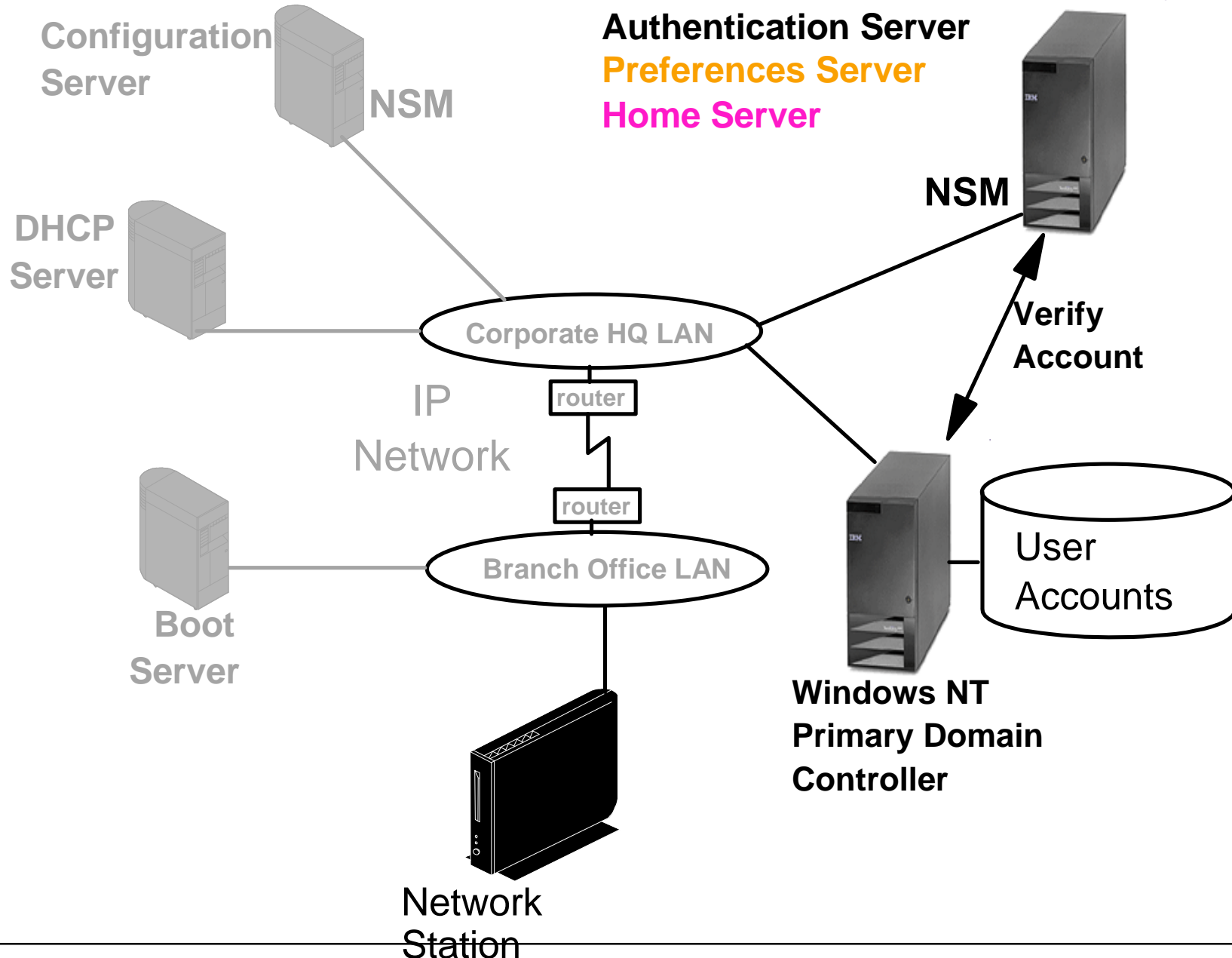
Network Station

© IBM Corporation

Notes

The authentication server, in this release as well as in the previous release, is also the user preferences server and the home server by default.

This means that all the user specific configuration profiles and the user's home directory are located on the same server that authenticates the users.

Actually, this is not entirely true because there is a way of manually altering the configuration files such that the user configuration profiles can be located on a server other than the authentication server; we direct you to the advanced configuration product information or the redbook to find out how to change this default setting.

The user home directory however must be located on the authentication server.

Authentication Server and User Accounts

Configuration Server

NSM

DHCP Server

Authentication Server
Preferences Server
Home Server

NSM

Corporate HQ LAN

Verify Account

IP Network

router

router

Branch Office LAN

Boot Server

Windows NT Primary Domain Controller

User Accounts

Network Station

© IBM Corporation

Notes

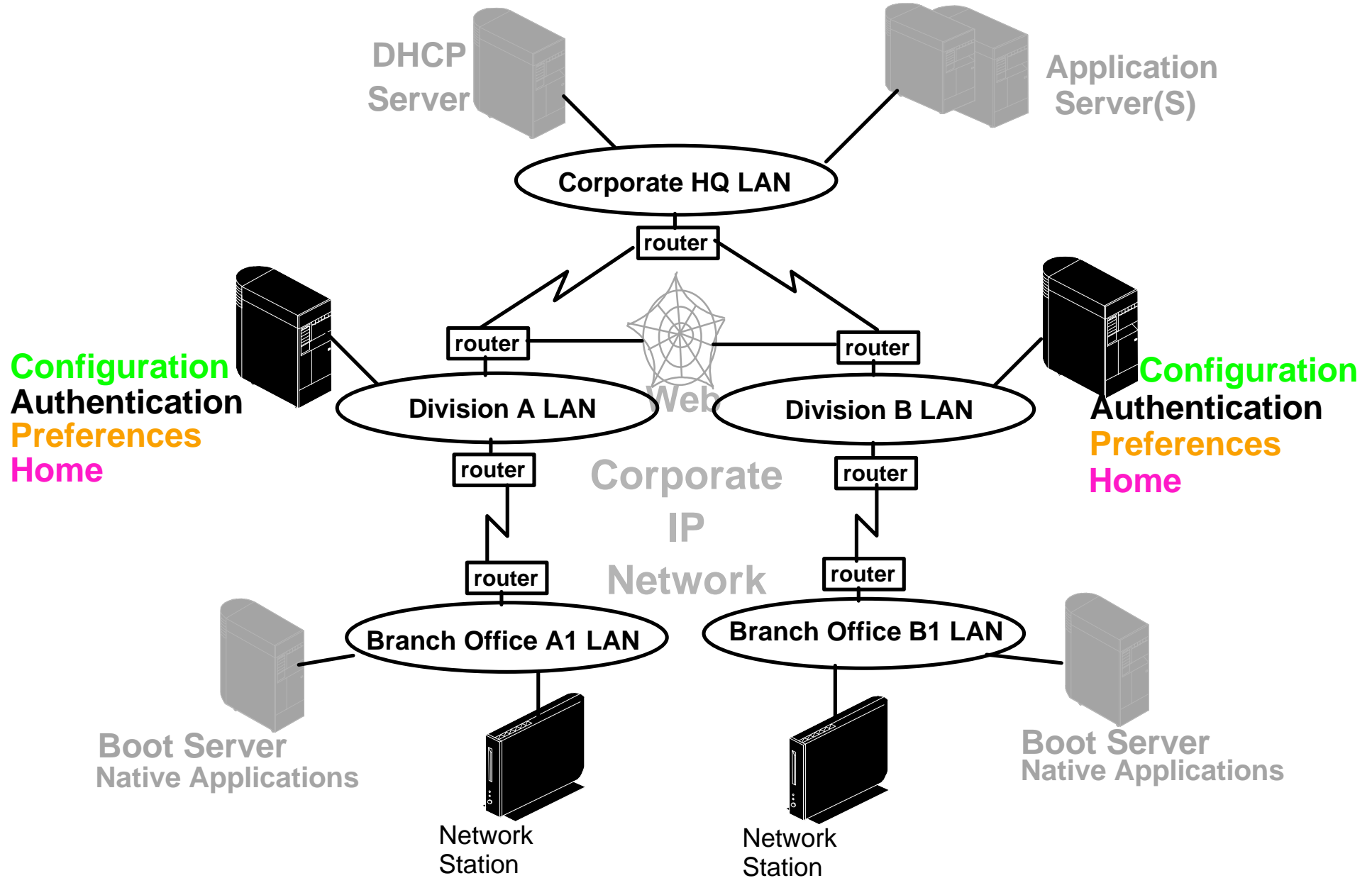Typically, this is again a case of determining the level in the network at which the users are managed.

If this is a highly decentralized organization, it is likely that the authentication server for a population of Network Station users will be located at the same level in the network where these user accounts are normally managed.

In a Microsoft Windows NT environment for example, if user accounts are located on a Primary Domain controller at the corporate level, it is likely that the authentication server will be located at the corporate level as well, although this is not a necessity technically speaking.

Note that the authentication server does not have to be on the same machine as the Primary Domain Controller. Users can be made part of a global group in the PDC and that global group can be specified as a member of the local NSMUser group on the authentication server. See the redbook for additional details on this and for additional insights as to how to accomplish this.

Note that the network traffic caused by access to the PDC from the authentication server is another consideration to be taken into account in the network design analysis.

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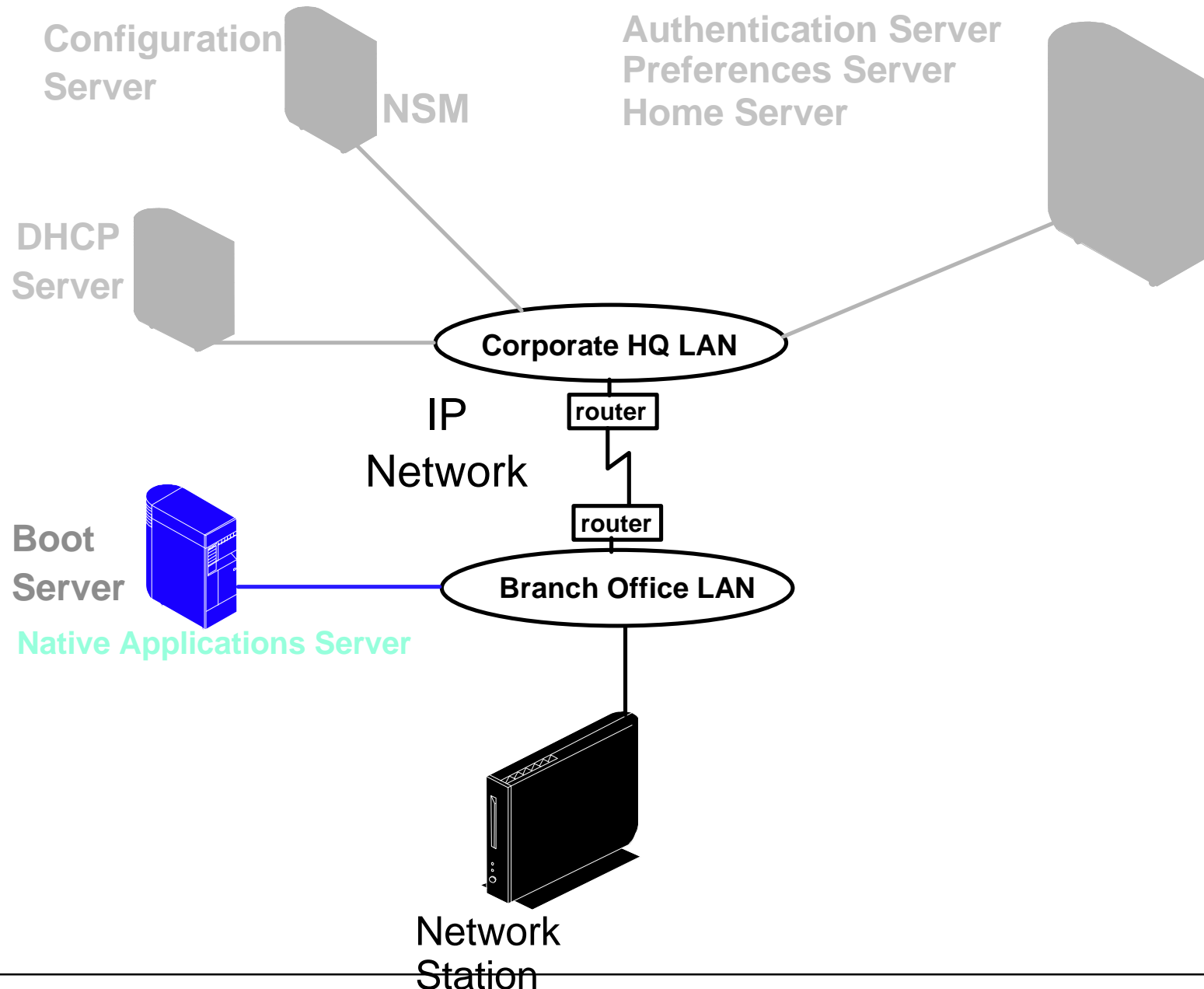
Divisional Authentication Server Example

DHCP Server

Application Server(S)

Corporate HQ LAN

router

Configuration
Authentication
Preferences
Home

router

Division A LAN

Web

router

Division B LAN

Configuration
Authentication
Preferences
Home

Corporate
IP
Network

router

router

router

Branch Office A1 LAN

Branch Office B1 LAN

Boot Server
Native Applications

Boot Server
Native Applications

Network
Station

Network
Station

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Notes

In the case where we want to delegate the user administration responsibility to the division's network administrators, it makes more sense then to have an authentication server in each division.

In that case, it might make sense to include the configuration server function as well on the same server, as illustrated in this chart.

In fact, until such time that we get the possibility of separating the home server from the authentication server, the dilemma we have is that if a lot of data is being stored in the user's directory, then we need to locate the authentication as close to the client as possible but, on the other hand, it is likely that from an administrative point of view, the authentication server is probably best located at the corporate level.

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Native Applications Server

Configuration
Server

NSM

Authentication Server
Preferences Server
Home Server

DHCP
Server

Corporate HQ LAN

IP
Network

router

router

Boot
Server

Branch Office LAN

Native Applications Server

Network
Station

Notes

The native applications server is really a non-issue as it cannot be separated from the boot server at this time.

In any case, it is best located on the boot server as some of the applications that need to be loaded can be quite sizable.

Application Servers Decisions

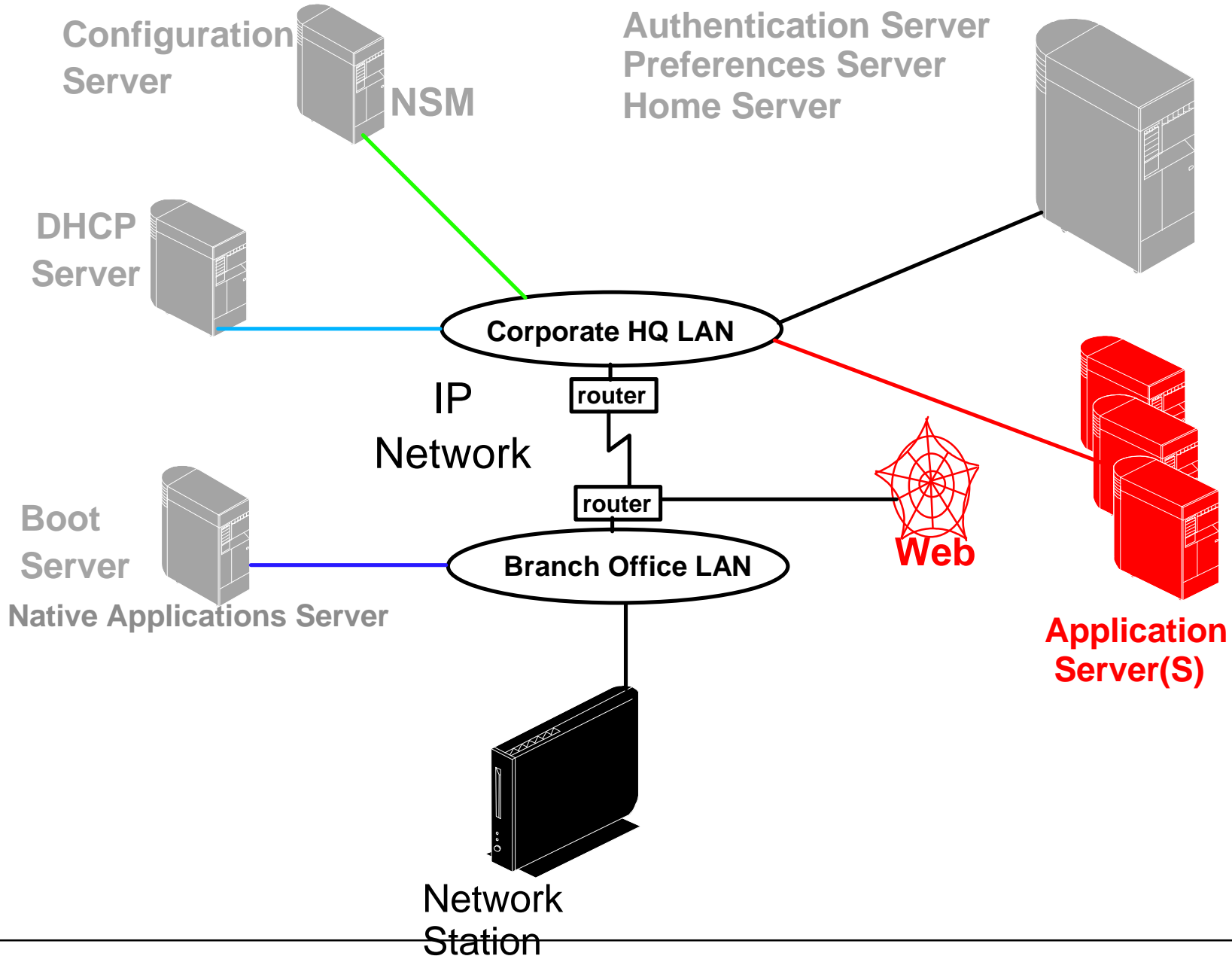| Choices	Factors to consider
Use native applications or applications on a MetaFrame type server	The features and functions required and the impact on the network of using one versus the other.
Autostart applications or not	Autostart only applications that are always in use by the user
Close applications or not	Close applications that will not be used for a significant period of time
Use pre-configured sessions	Strictly a user defined choice
Use Kiosk mode	If using a lobby environment or single application. Choose true kiosk mode (V2R1) or suppressed login (V1R3)
Domain Name Server	Access to a DNS server is required to be able to resolve IP host names, if IP hostnames are used.
Proxies	If accessing host in an external network, across a firewall, proxy servers are required
Printers	Where are printers located, local, remote, and which print data stream to use

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Notes

Finally, we get to connect to application servers, which is the whole objective of preparing the Network Station to do some useful work for the user.

As shown in this table, we do face a few other decisions here, but these may not be as difficult as some of the network topology decisions we saw previously.

Some of the easy ones are whether to autostart applications for the user or not, and whether to use kiosk mode, either true kiosk mode or suppressed login mode, for some users, and whether proxies are required for a browser to access the Internet, and where to locate printers, print servers and other file servers.

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Application Servers

Configuration Server

NSM

Authentication Server
Preferences Server
Home Server

DHCP Server

Corporate HQ LAN

router

IP Network

router

Web

Boot Server

Native Applications Server

Branch Office LAN

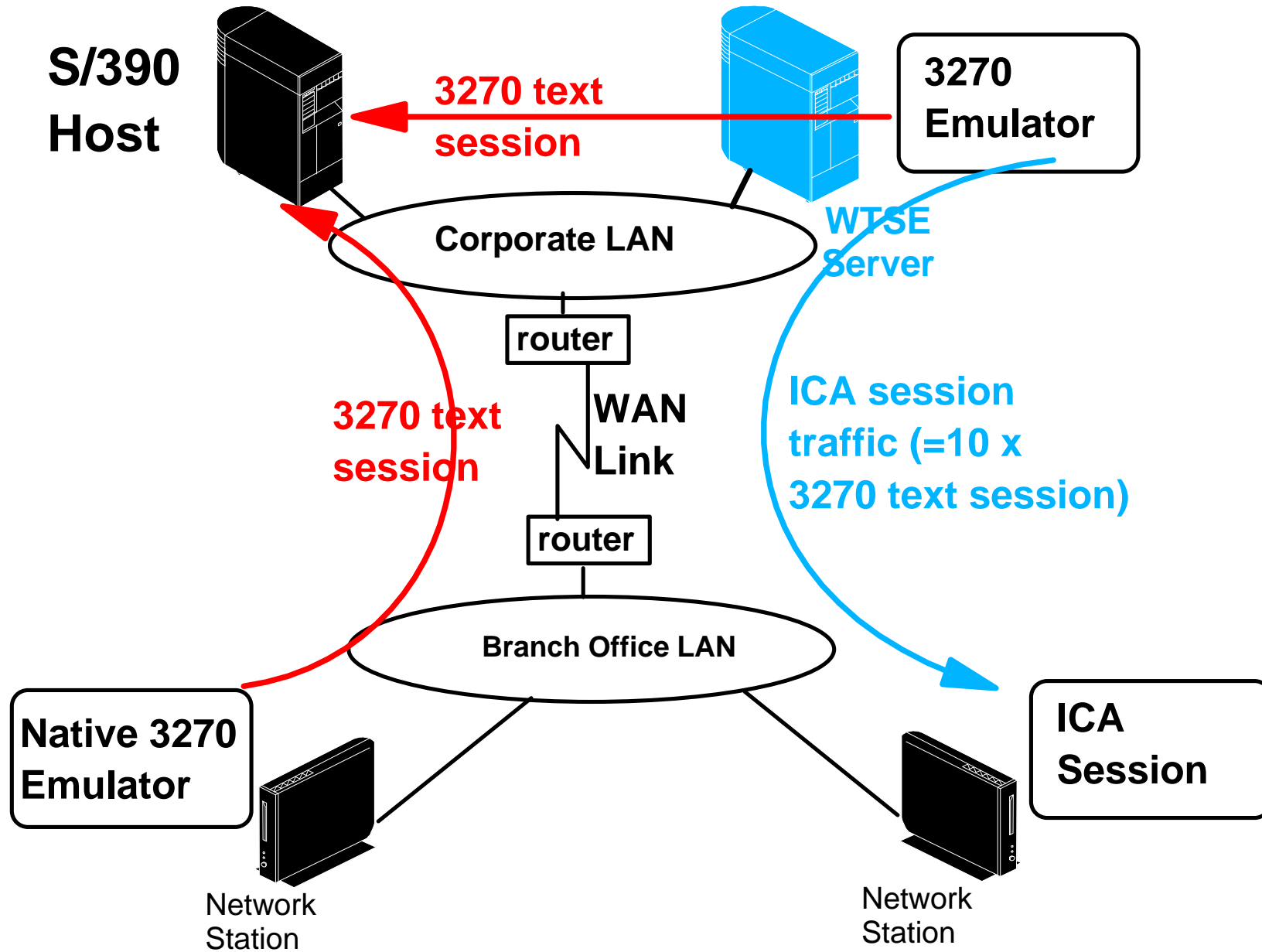Application Server(S)

Network Station

Notes

Where are application servers located? They might be just about anywhere. The applications we are talking about can be:

- A 3270 Emulator which typically has a S/390 host as the target, although it may often use an intermediate gateway to reach the actual target host.
- A 5250 Emulator session has an AS/400 as the target host.
- A Web browser typically goes out to either the Intranet or the Internet to access a variety of target IP hosts, either directly or through proxies.
- A VTxxx emulator session might go to any IP host, either as a telnet session or any other VTxxx session.
- An ICA session goes out to a WinFrame or MetaFrame server (multi-user Windows NT Server) to use Windows applications.
- An X terminal session typically goes out to a Unix host or a WinCenter server (another way of reaching Windows applications on a multi-user Windows NT server instead of using ICA).
- A local application can print to a local or remote printer.
- You might also have home grown Java applications that need access to file servers and print servers, etc.

These considerations are therefore general network considerations and not necessarily Network Station specific.

Use Native Apps if possible

S/390 Host

3270 text session

3270 Emulator

Corporate LAN

WTSE Server

router

3270 text session

WAN Link

ICA session traffic (=10 x 3270 text session)

router

Branch Office LAN

Native 3270 Emulator

ICA Session

Network Station

Network Station

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Notes

When there is a choice of using a local native application and its equivalent on a Windows Server, careful consideration should be given to using the native application instead.

Indeed, if you look at this diagram, on the left is a Network Station running a native 3270 application with the S/390 host. The network traffic generated by this session is the traditional text based SNA LU2 data stream, which is fairly compact.

On the right is a similar Network Station but instead of using a native 3270 emulator, it uses an ICA session to a MetaFrame server and uses the 3270 emulator, for example Personal Communications 3270, on the MetaFrame server.

The real SNA LU2 data stream session is therefore taking place between the MetaFrame server and the S/390 host. The graphics information is then transmitted over the ICA session to the user's display on the Network Station but the amount of data crossing the WAN link is now probably 10 times greater than a native 3270 session would be, to accomplish the same objective.

Clearly, use of native applications, in this case, is more efficient unless of course the native applications do not support the features that the user needs to do his job.

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Proxies and Socks
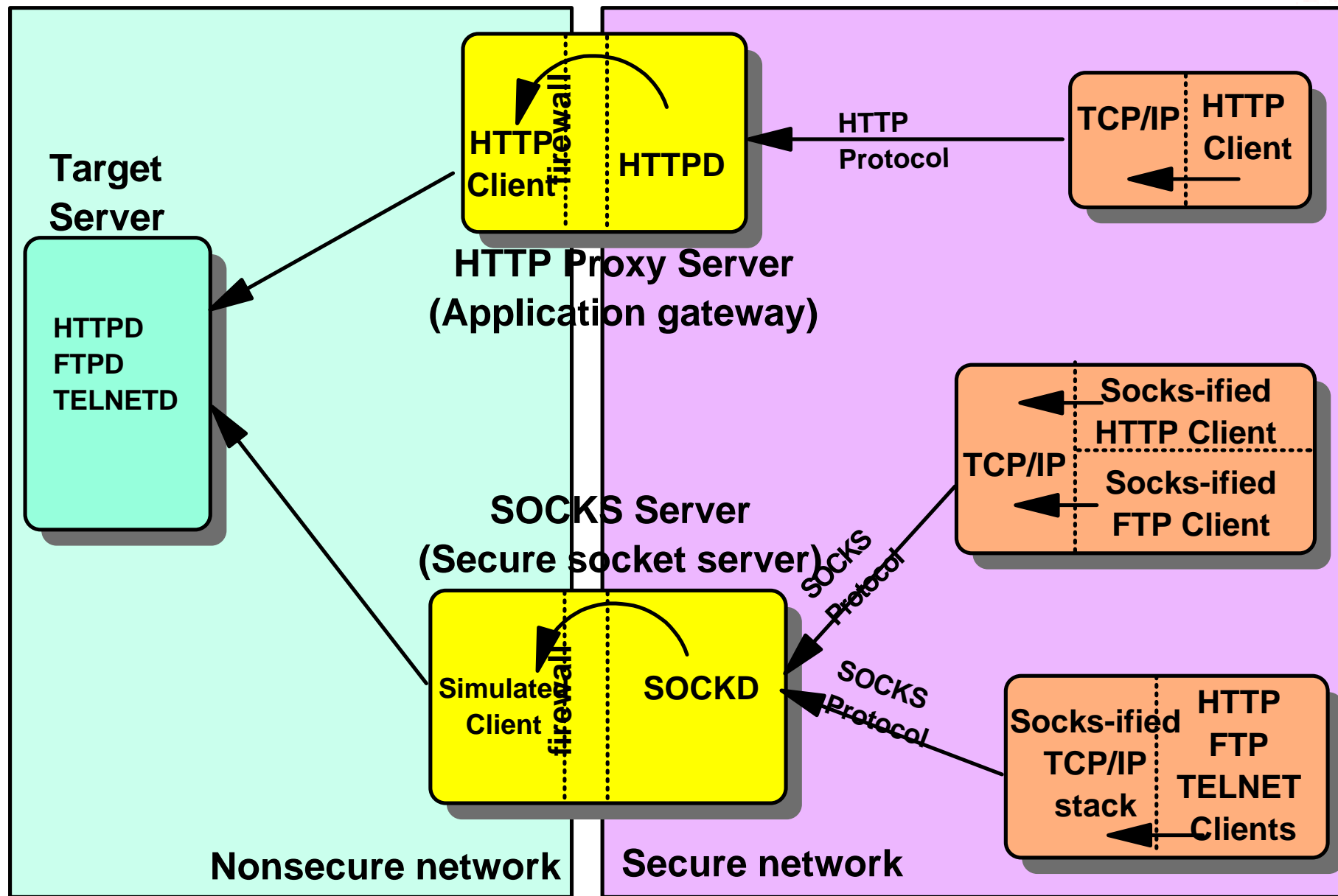
Notes

If the stations are on an Intranet and they need access to external networks by going through a firewall, there is a need to configure either proxy servers or a SOCKS server. For those who may not be familiar with this topic, here is a brief explanation.

In the top portion of the diagram, we see on the right hand side an HTTP client, such as a web browser, located in the secure network part, that needs to communicate with the HTTPD service on the target server located in the nonsecure (public) network.
The client specifies the address of an HTTP proxy server, and that server actually functions as an application gateway. An HTTPD daemon receives HTTP requests from clients on the secure side of the network , and also functions as an HTTP client on the nonsecure side of the network, effectively becoming the actual client of the target HTTP server (and acting on behalf of the real client which is on the secure side of the network).
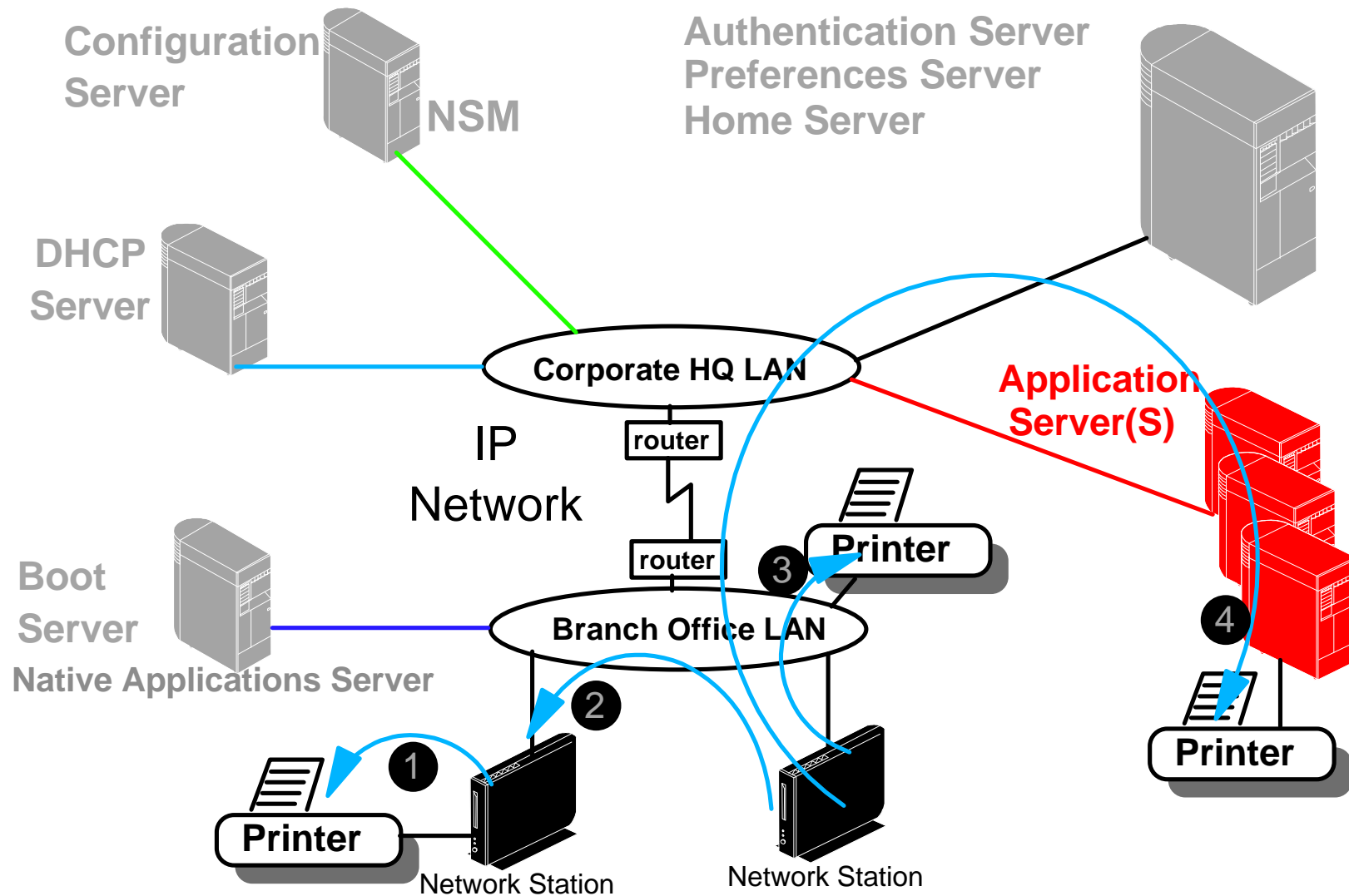Therefore, as far as the target HTTP server is concerned, it is only aware of the HTTP proxy server client and it has no knowledge of the real client where the original HTTP request actually originated.

In the bottom portion of the diagram, a SOCKS server is used instead of a proxy server. In this case, the HTTP client contains a SOCKS client, that communicates with a SOCKS server to transmit the actual HTTP request. On receipt of the request, the SOCKS server transmits the request across the firewall, in a secure manner such that the target is also unaware of the actual real client.
In a proxy server, the HTTP application actually executes on the proxy server whereas in the case of a SOCKS server, the HTTP application remains on the actual client and the SOCKS server provides a secure passthru pipe.
In the case of a SOCKS client, the client application itself can be "socksified" and communicate with the socks server or the entire TCP/IP stack can also be socksified, which then permits all applications to communicate with a SOCKS server.

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Printing - Local and Remote Printers

Configuration
Server

NSM

Authentication Server
Preferences Server
Home Server

DHCP
Server

Corporate HQ LAN

IP
Network

router

Application
Server(S)

router

Printer

3

Branch Office LAN

Boot
Server

Native Applications Server

2

Printer

4

1

Printer

Network Station
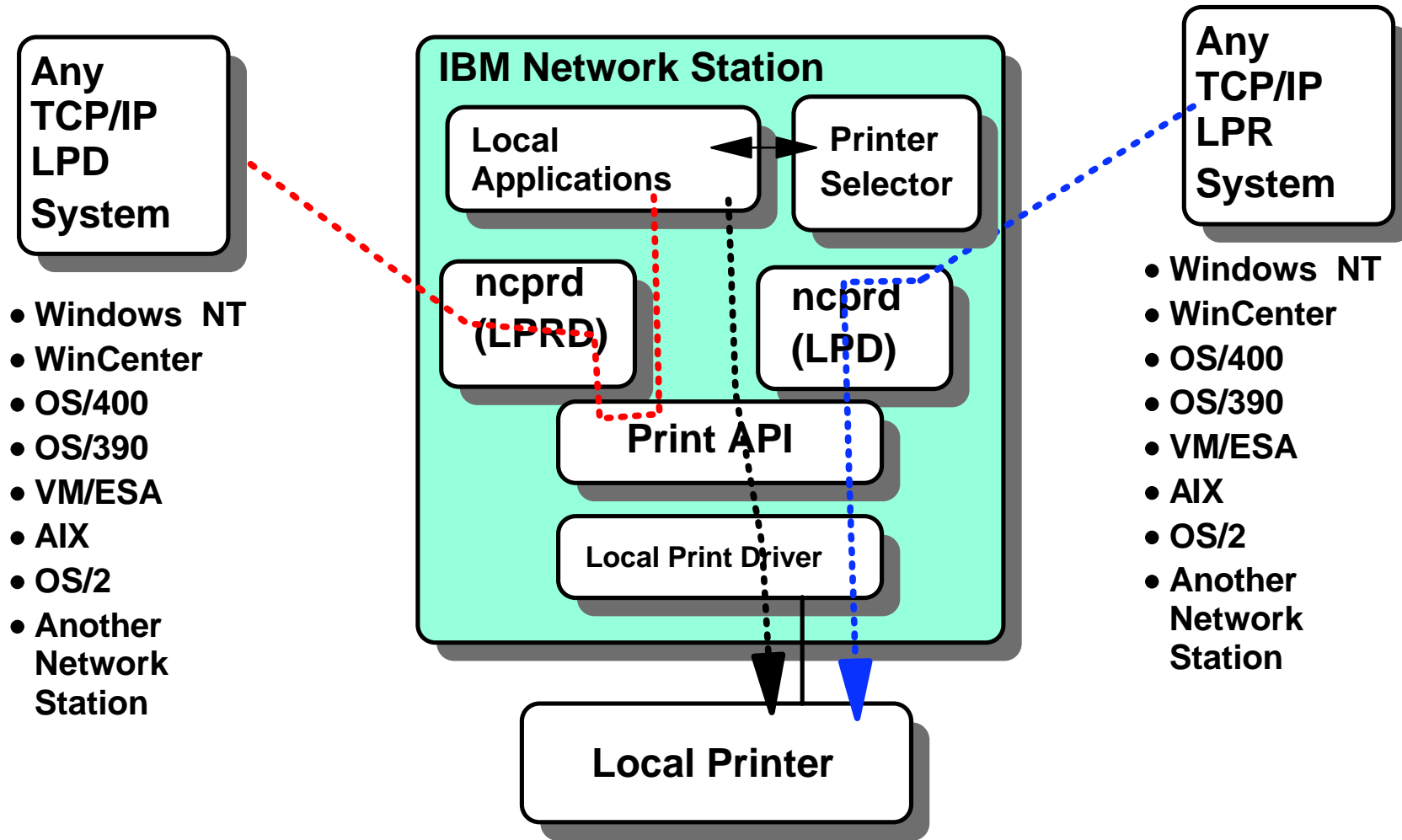
Network Station

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Notes

Applications running on the Network Station can send print output either to a Network Station attached printer (local printer) or to any other IP host that supports LPD (TCP/IP printing), including another Network Station.

A local printer can be attached to the parallel port or to the serial port of the Network Station.

The Network Station can also receive print requests from any other IP hosts that support LPR and print locally. It cannot however reroute this output received from a remote host to another remote printer because it actually does not have any local spooling capability due to the lack of local disk storage.

In this example, we see that an application on the Network Station can print to a local printer (1). Also, if a Network Station does not have its own printer attached, it can send printed output to a printer attached to a peer station (2).
Equally, it can send printed output to any remote printer such as a printer on the branch office LAN (3), or a to printer attached to a remote host(4).

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Printing Overview

Any TCP/IP LPD System

- Windows NT
- WinCenter
- OS/400
- OS/390
- VM/ESA
- AIX
- OS/2
- Another Network Station

IBM Network Station

| Local Applications | ↔ | Printer Selector |

ncprd (LPRD)

ncprd (LPD)

Print API

Local Print Driver

Any TCP/IP LPR System

- Windows NT
- WinCenter
- OS/400
- OS/390
- VM/ESA
- AIX
- OS/2
- Another Network Station

Local Printer

Notes

How does that work? This diagram summarizes the major printing components on the Network Station.
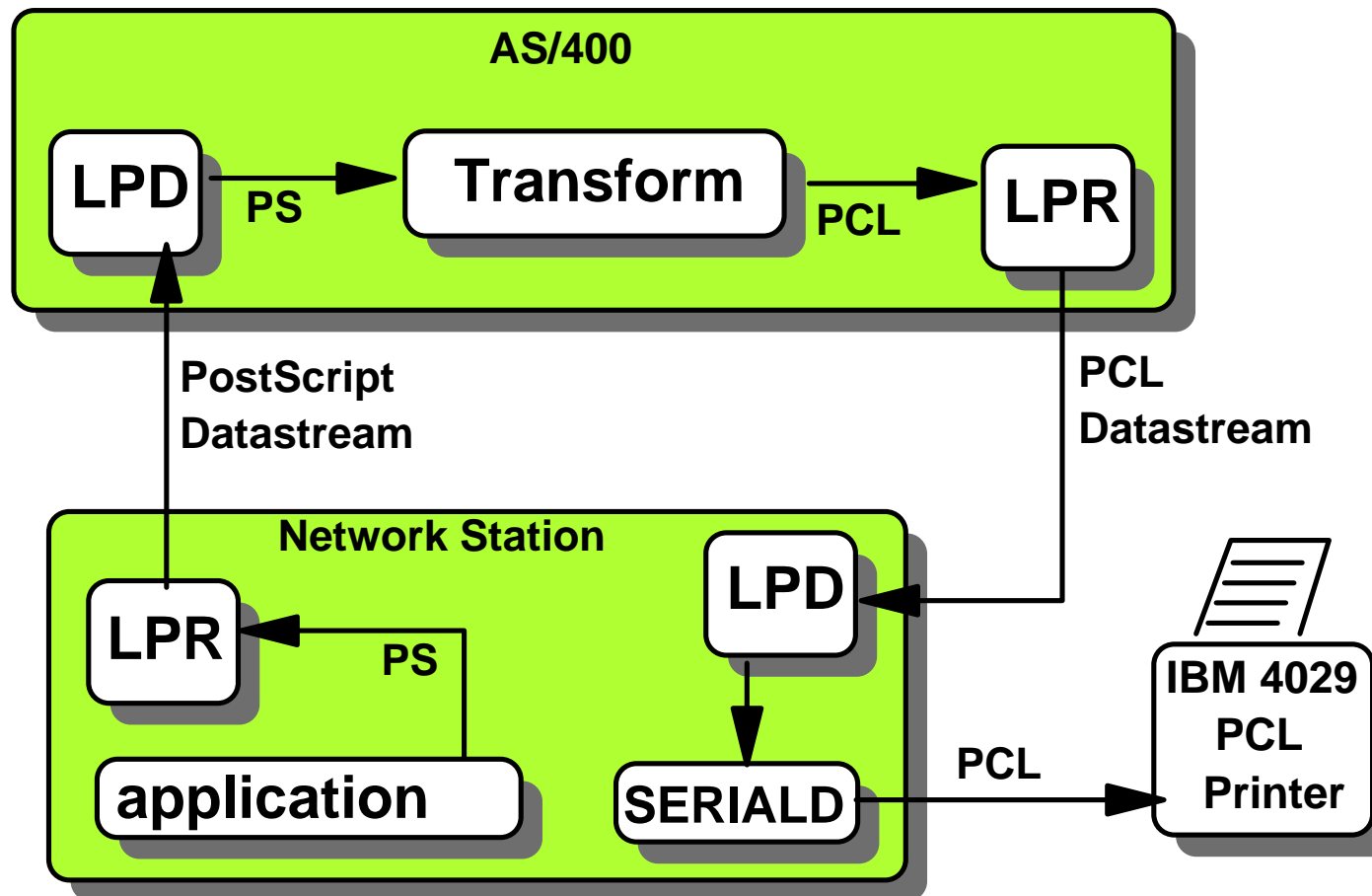
When an application makes a print request, it is presented with a printer selection panel on which appear all the printers that have been defined as accessible to this station (as configured in Network Station Manager).

If a local printer is chosen, the output is sent to the local Print API.

If a remote printer is chosen, the request is sent to the LPR daemon (LPRD) which routes the request to the selected remote printer or print server.

Finally, a print request coming from another IP host, such as another Network Station for example, is received by the LPD daemon which routes the request to the local printer.

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Print Transform

AS/400

LPD → PS → Transform → PCL → LPR

PostScript Datastream

PCL Datastream

Network Station

LPR ← PS ← application

LPD → SERIALD → PCL → IBM 4029 PCL Printer

Notes

Most local applications on the Network Stations support Postscript output but only the 3270 and 5250 emulators support PCL or ASCII as well.

If you have mainly PCL capable printers and you still want to be able to use these with the browser for example, you can use a Print Transform utility on a host such as an AS/400.

This is illustrated in this chart where an application generates Postscrip output, sends it to a specific print queue on the AS/400 host, where it is directed to be transformed to PCL output, which is then rerouted to an output queue that redirects the PCL output to the Network Station, effectively allowing a PostScript generated output to be sent to a PCL printer.

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Where to go for more information?

- **Main Web Site**
  - www.ibm.com/nc

- **Current Network Station Redbook**
  - SG24-5844 Network Station Manager V2R1 Guide

- **Previous Network Station Redbooks**
  - SG24-5187 AS/400 - Techniques for Deployment in a WAN
  - SG24-5221 Windows NT - NSM Release 3
  - SG24-5212 Printing
  - SG24-2127 Windows NT/WinCenter
  - SG24-4954 S/390, SG24-2016 RS/6000, SG24-2153 AS/400

- **Product Publications**
  - SC41-0684 Installing NSM for AS/400
  - SC41-0685 Installing NSM for RS/6000
  - SC41-0688 Installing NSM for Windows NT
  - SC41-0690 Using NSM
  - IBM Network Station Advanced Information (On the Web Site)

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Notes

These are the web site, redbooks and product publications where you can find additional information on all the subjects that we have discussed in this topic.

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