南京大学 软件学院
NANJING UNIVERSITY · SOFTWARE INSTITUTE

OSI Layer 5-7: Application Layers

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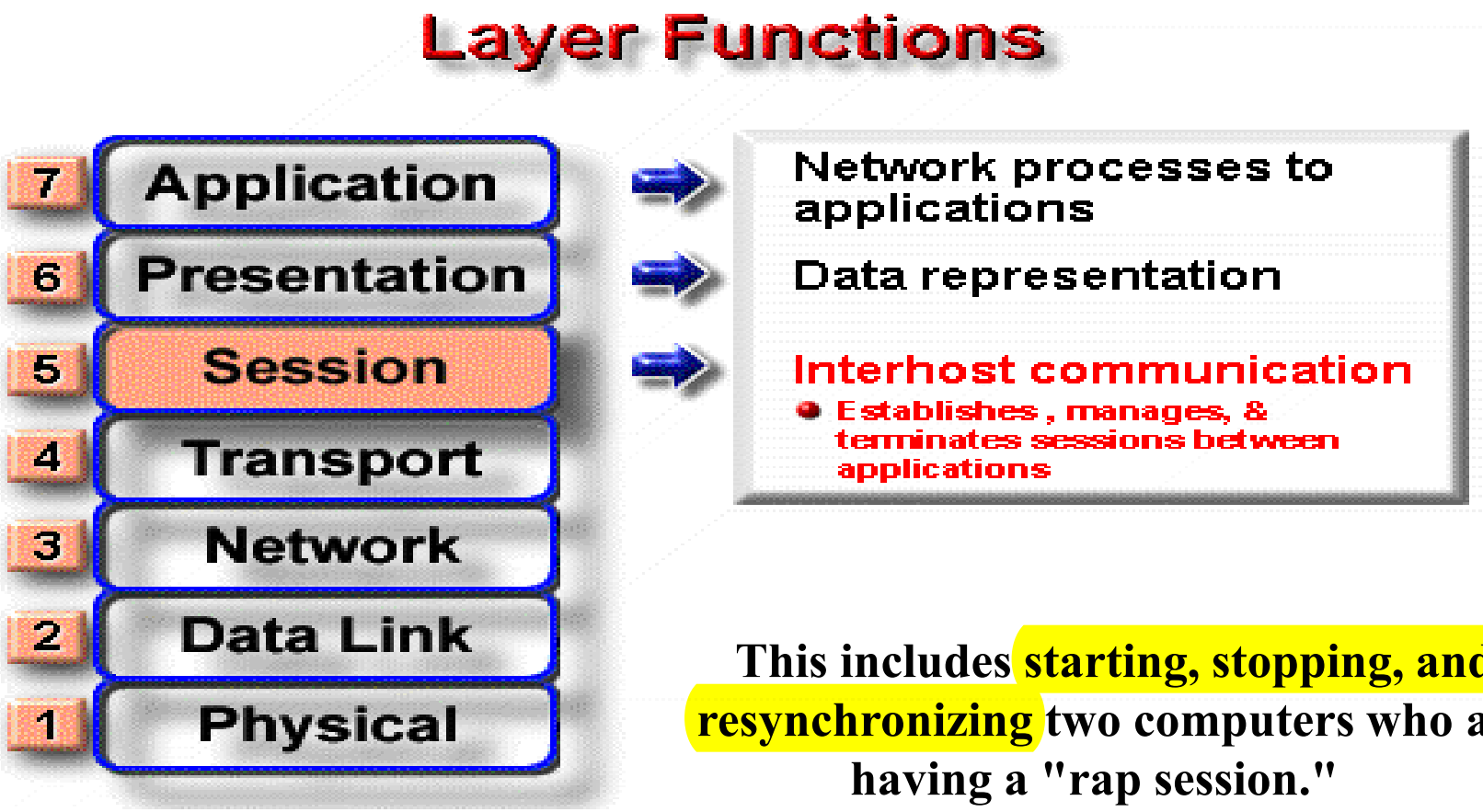
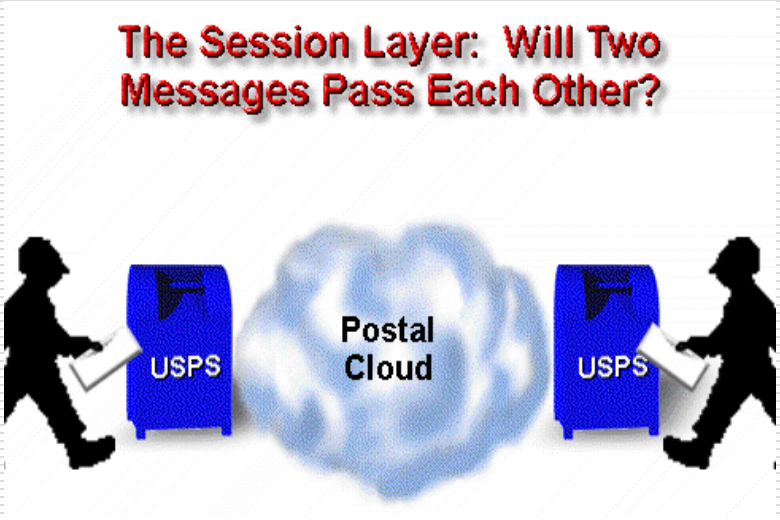
- The Session Layer
- The Presentation Layer
- The Application Layer

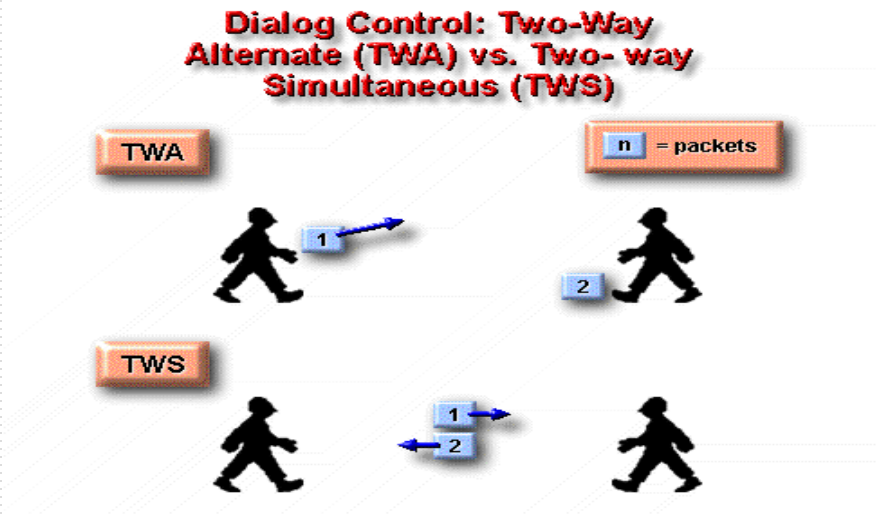
Layer 5: The Session Layer



This includes starting, stopping, and resynchronizing two computers who are having a "rap session."

The Session Layer

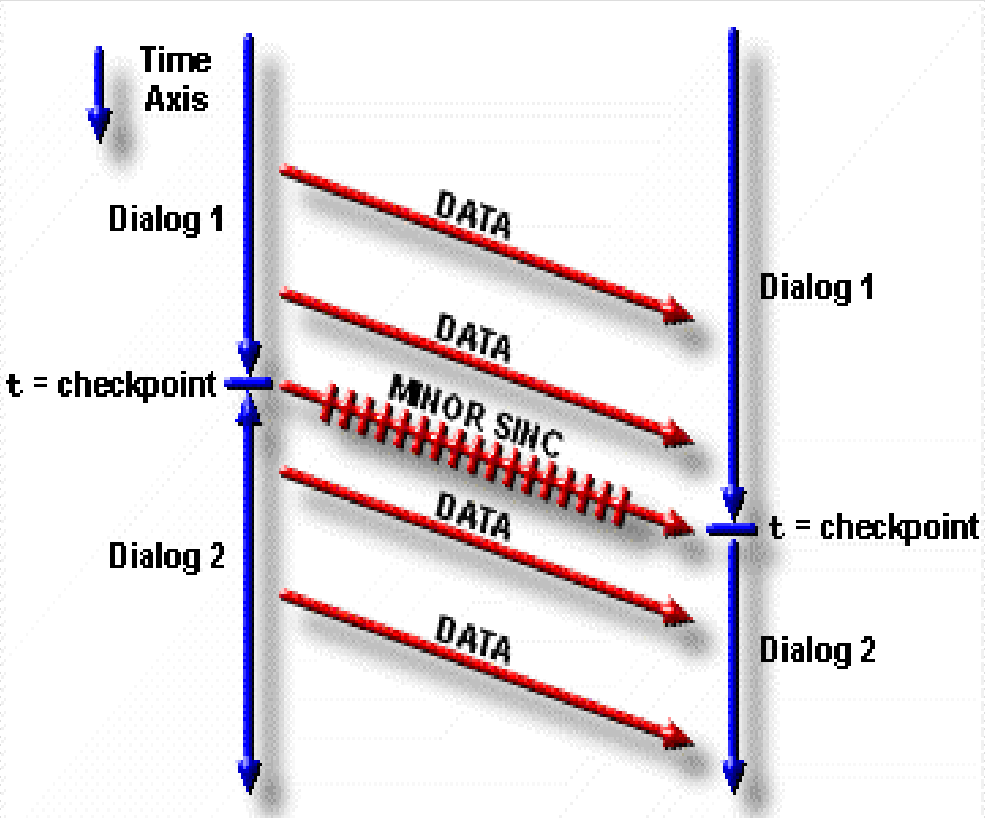




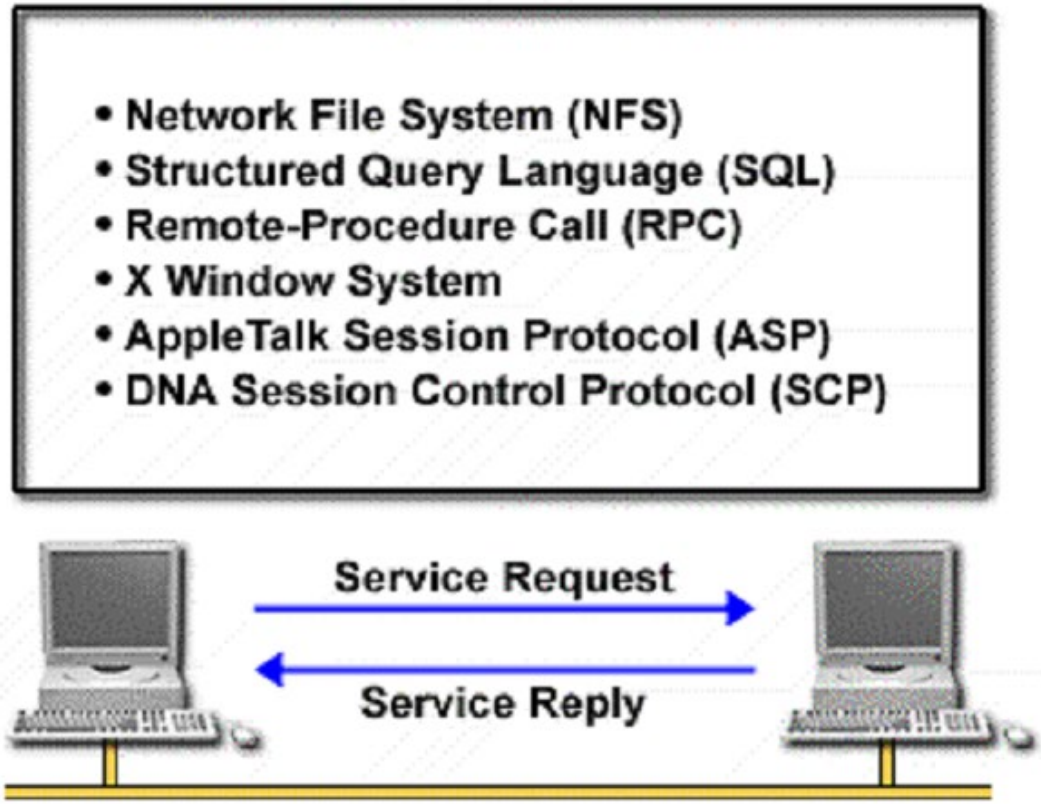
- *two-way simultaneous communication?*
- *two-way alternate control?*
- **have synchronized the subjects of your conversations?**

The Session Layer

- *Checkpoint* is used to separate parts of a session, previously referred to as dialogues
- Dialogue separation is the orderly initiation, termination, and managing of communication.



Some Applications of Layer 5



- Coordinates applications as they interact on different hosts

The Application Layers

- The Session Layer
- The Presentation Layer
- The Application Layer

Layer 6 - The Presentation Layer

- The presentation layer is responsible for presenting data in a form that the receiving device can understand.
- The presentation layer has 3 main functions:
  - Data formatting
  - Data compression
  - Data encryption

Data Formatting

- Imagine two dissimilar systems.
  - One uses Extended Binary Coded Decimal Interchange Code (EBCDIC) to format text
  - The other uses American Standard Code for Information Interchange (ASCII) to format text
- Layer 6 provides the translation between these two different types of codes

Graphic File Formats

- The Internet often uses two binary file formats to display images:
  - Graphic Interchange Format (GIF)
  - Joint Photographic Experts Group (JPEG).
- Any computer with a reader for the GIF and JPEG file formats can read these file types, regardless of the type of computer.

Multimedia File Format

- The multimedia file format is another type of binary file, which stores sounds, music, and video.
  - These files may be completely downloaded, and then played, or they may download while they are playing.
  - The latter method is referred to as streaming audio.

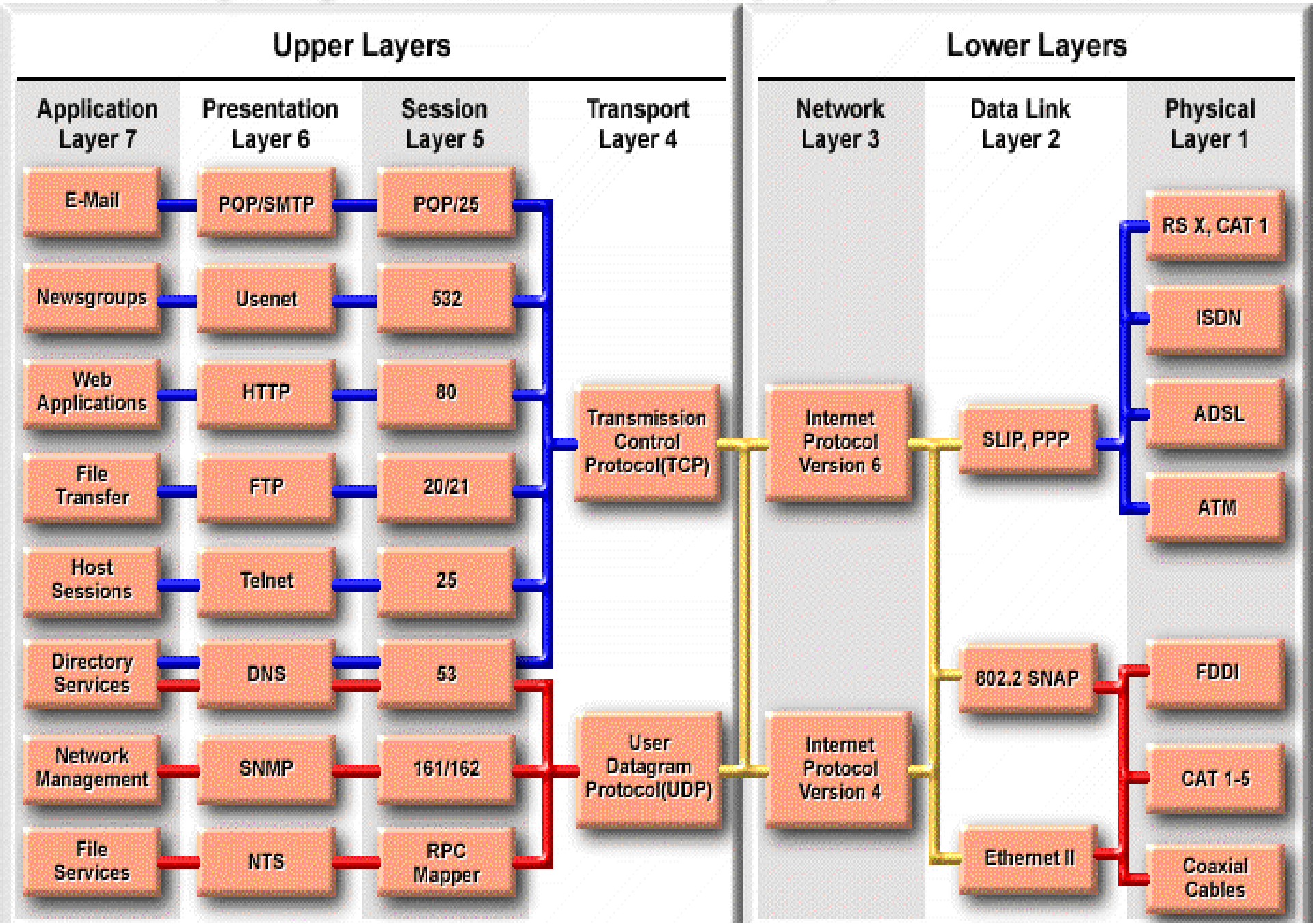
Encryption & Compression

- Layer 6 is responsible for data encryption.
  - Data encryption protects information during its transmission.
- The presentation layer is also responsible for the compression of files.

The Application Layers

- The Session Layer
- The Presentation Layer
- The Application Layer

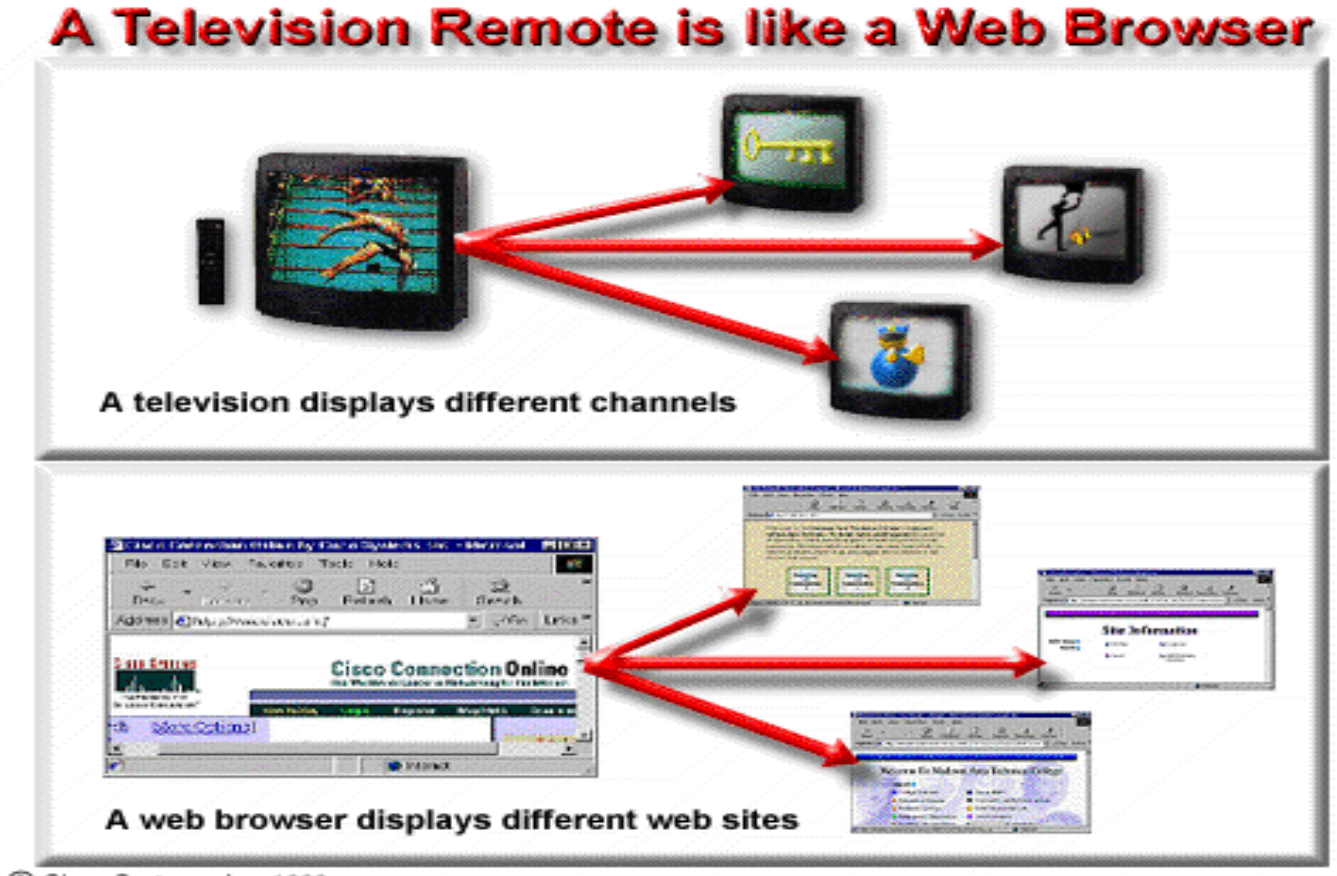
Open Systems Interconnection (OSI) Reference Model



Layer 7: Application Layer

- The application layer (closest to the user) supports the *communicating component* of an application.
- The application layer:
  - Identifies and establishes the availability of intended communication partners
  - Synchronizes cooperating applications
  - Establishes agreement on procedures for error recovery
  - Control of data integrity

HTTP


A Television Remote is like a Web Browser
A television displays different channels
Cisco Connection Online
A web browser displays different web sites
© Cisco Systems, Inc. 1999

统一资源定位符 URL

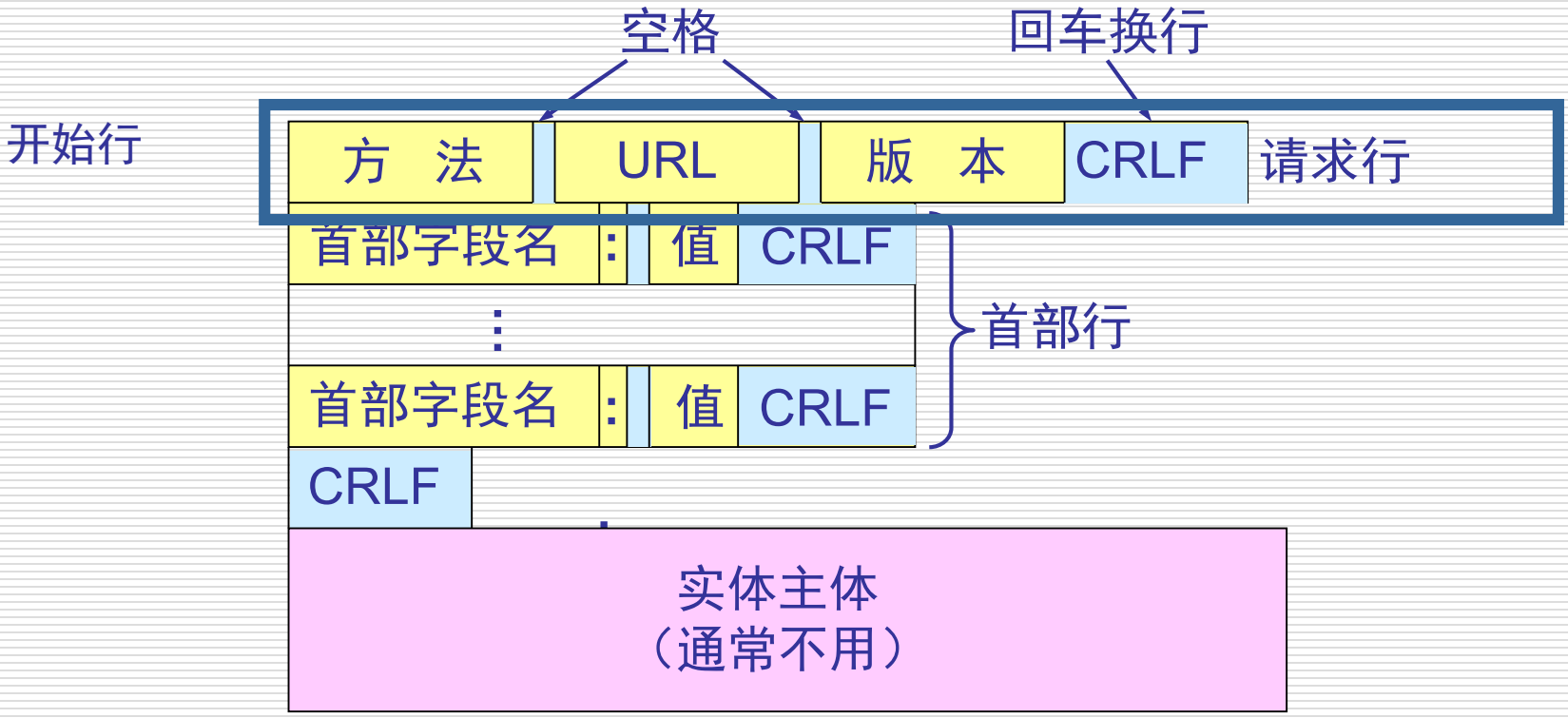
- 统一资源定位符 URL 是对可以从因特网上得到的资源的位置和访问方法的一种简洁的表示。
- URL 给资源的位置提供一种抽象的识别方法，并用这种方法给资源定位。
- 只要能够对资源定位，系统就可以对资源进行各种操作，如存取、更新、替换和查找其属性。
- URL 相当于一个文件名在网络范围的扩展。因此 URL 是与因特网相连的机器上的任何可访问对象的一个指针。

<URL的访问方式>://<主机>:<端口>/<路径>

HTTP

- HTTP 是面向事务的客户服务器协议。
- HTTP 1.0 协议是无状态的(stateless)。
- HTTP 协议本身也是无连接的，虽然它使用了面向连接的 TCP 向上提供的服务。
- 万维网浏览器就是一个 HTTP 客户，而在万维网服务器等待 HTTP 请求的进程常称为 HTTP daemon，有的文献将它缩写为 HTTPD。
- HTTP daemon 在收到 HTTP 客户的请求后，把所需的文件返回给 HTTP 客户。

HTTP 的报文结构（请求报文）



报文由三个部分组成，即开始行、首部行和实体主体。
在请求报文中，开始行就是请求行。

HTTP 请求报文的一些方法

方法（操作）	意义
OPTION	请求一些选项的信息
GET	请求读取由URL所标志的信息
HEAD	请求读取由URL所标志的信息的首部
POST	给服务器添加信息（例如，注释）
PUT	在指明的URL下存储一个文档
DELETE	删除指明的URL所标志的资源
TRACE	用来进行环回测试的请求报文
CONNECT	用于代理服务器

HyperText Markup Language

- 定义了许多用于排版的命令（标签）。
- HTML 文档是一种可以用任何文本编辑器创建的 ASCII 码文件。
- 仅当 HTML 文档是以.html 或 .htm 为后缀时，浏览器才对此 文档的各种标签进行解释。
- 当浏览器从服务器读取 HTML 文档，针对HTML 文档中的各种标签，根据浏览器所使用的显示器的尺寸和分辨率大小，重新进行排版并恢复出所读取的页面。
- HTML 用一对标签（一个开始标签和一个结束标签）或几对标签来标识一个元素。

FTP and TFTP

- FTP is a reliable, connection-oriented service that uses TCP to transfer files.
  - FTP first establishes a control connection between the client and the server(port 21)
  - Then a second connection is established, which is a link between the computers through which the data is transferred. (port 20)
- TFTP is a connectionless service that uses UDP
  - Small and easy to implement.
  - E.g. TFTP is used on routers to transfer configuration files and Cisco IOS images.

主进程工作步骤

- 打开熟知端口（端口号为 21），使客户进程能够连接上。
- 等待客户进程发出连接请求。
- 启动从属进程来处理客户进程发来的请求。从属进程对客户进程的请求处理完毕后即终止，但从属进程在运行期间根据需要还可能创建其他一些子进程。
- 回到等待状态，继续接受其他客户进程发来的请求。主进程与从属进程的处理是并发地进行。

FTP 的屏幕信息举例

```
[01] ftp nic.ddn.mil
[02] connected to nic.ddn.mil
[03] 220 nic FTP server (Sunos 4.1)ready.
[04] Name: anonymous
[05] 331 Guest login ok, send ident as password.
[06] Password: abc@xyz.math.yale.edu
[07] 230 Guest login ok, access restrictions apply.
[08] ftp
[09] 250                    successful.
[
[
[
     (128.36.12.27,1401) (4318 bytes).
[13] 226 ASCII Transfer complete.
     local: nicinfo remote: rfc1261.txt
     4488 bytes received in 15 seconds (0.3 Kbytes/s).
[14] ftp> quit
[15] 221 Goodbye.
```

[01] 用户要用 FTP 和远地主机(网络信息中心 NIC 上的主机)建立连接。

FTP 的屏幕信息举例

```
[01] ftp nic.ddn.mil
[02] connected to nic.ddn.mil
[03] 220 nic FTP server (Sunos 4.1)ready.
[04] ame: anonymous
[05]      Guest login ok, send ident as password.
[06]  rd: abc@xyz.math.yale.edu
[07] 2    t login ok, access restrictions apply.
[08] ft   s
[09] 25   nd successful
[10]
[11]
[12] 150 ASCII data connection for rfc1261.txt
     (128.36.12.27,1401) (4318 bytes).
[13] 226 ASCII Transfer complete.
     local: nicinfo remote: rfc1261.txt
     4488 bytes received in 15 seconds (0.3 Kbytes/s).
[14] ftp> quit
[15] 221 Goodbye.
```

[02] 本地 FTP 发出的连接成功信息。

FTP 的屏幕信息举例

```
[01] ftp nic.ddn.mil
[02] connected to nic.ddn.mil
[03] 220 nic FTP server (Sunos 4.1)ready.
[04] Name: anonymous
[05] 331 Guest login ok, send ident as password.
[06] Password: abc@xyz.math.yale.edu
[07] 230 Guest login ok, access restrictions apply.
[08] ftp
[09] 250 successful.
[10] ftp> xt nicinfo
[
[
     (128.36.12.27,1401) (4318 bytes).
[13] 226 ASCII Transfer complete.
     local: nicinfo remote: rfc1261.txt
     4488 bytes received in 15 seconds (0.3 Kbytes/s).
[14] ftp> quit
[15] 221 Goodbye.
```

[03] 从远地服务器返回的信息，220 表示“服务就绪”。

FTP 的屏幕信息举例

```
[01] ftp nic.ddn.mil
[02] connected to nic.ddn.mil
[03] 220 nic FTP server (Sunos 4.1)ready.
[04] Name: anonymous
[05] 331 Guest login ok, send ident as password.
[06]  assword: abc@xyz.math.yale.edu
[07]  Guest login ok, access restrictions apply.
[08] f        rfc
[09] 25       mand successful.
[10] ftp>          61.txt nicinfo
[11] 200 P         uccessful.
[
[
     local: nicinfo remote: rfc261.txt
     4488 bytes received in 15 seconds (0.3 Kbytes/s).
[14] ftp> quit
[15] 221 Goodbye.
```

[04] 本地 FTP 提示用户键入名字。用户键入的名字表示“匿名”。用户只需键入 anonymous 即可。

FTP 的屏幕信息举例

```
[01] ftp nic.ddn.mil
[02] connected to nic.ddn.mil
[03] 220 nic FTP server (Sunos 4.1)ready.
[04] Name: anonymous
[05] 331 Guest login ok, send ident as password.
[06] Password: abc@xyz.math.yale.edu
[07] 230 Guest login ok, access restrictions apply.
[08] ftp> cd rfc
[09] 250 CWD command successful.
[10] ftp> get rfc1261.txt nicinfo
[11] 200 PORT command successful.
[12] 150 Opening connection for rfc1261.txt
[13]
     local: nicinfo remote: rfc1261.txt
     4488 bytes received in 15 seconds (0.3 Kbytes/s).
[14] ftp> quit
[15] 221 Goodbye.
```

[05] 数字 331 表示“用户名正确”，需要口令。

FTP 的屏幕信息举例

```
[01] ftp nic.ddn.mil
[02] connected to nic.ddn.mil
[03] 220 nic FTP server (Sunos 4.1)ready.
[04] Name: anonymous
[05] 331 Guest login ok, send ident as password.
[06] Password: abc@xyz.math.yale.edu
[07] 230 Guest login ok, access restrictions apply.
[08] ftp> cd rfc
[09] 250 CWD command successful.
[10] ftp> ls rfc1261.txt nicinfo
[11] 200 PORT command successful.
[12] 150 Opening connection for rfc1261.txt
     (128.                    ) (4318 bytes).
```

[06] 本地 FTP 提示用户键入口令。用户这时可键入 guest 作为匿名的口令，也可以键入自己的电子邮件地址，即耶鲁大学数学系名为 xyz 的主机上的 abc。

FTP 的屏幕信息举例

```
[01] ftp nic.ddn.mil
[02] connected to nic.ddn.mil
[03] 220 nic FTP server (Sunos 4.1)ready.
[04] Name: anonymous
[05] 331 Guest login ok, send ident as password.
[06] Password: abc@xyz.math.yale.edu
[07] 230 Guest login ok, access restrictions apply.
[08] ftp> cd rfc
[09] 250 CWD command successful.
[10]      > get rfc1261.txt nicinfo
[11]      ORT command successful.
[12] 1      I data connection for rfc1261.txt
     (1      27,1401) (4318 bytes).
[13] 22(      nsfer complete.
                                          Kbytes/s).
[
[15] 221 Goodbye.
```

[07] 数字 230 表示用户已经注册完毕。

FTP 的屏幕信息举例

```
[01] ftp nic.ddn.mil
[02] connected to nic.ddn.mil
[03] 220 nic FTP server (Sunos 4.1)ready.
[04] Name: anonymous
[05] 331 Guest login ok, send ident as password.
[06] Password: abc@xyz.math.yale.edu
[07] 230 Guest login ok, access restrictions apply.
[08] ftp> cd rfc
[09] 250 CWD command successful.
[10] ftp> get rfc1261.txt nicinfo
[11] PORT command successful.
[12] BII data connection for rfc1261.txt
     (8.27,1401) (4318 bytes).
[13] 22( ansfer complete.
     loc  remote: rfc1261.txt
                                                    tes/s).
[
[
```

"ftp>"是 FTP 的提示信息。用户键入的是将目录改变为包含 RFC 文件的目录。

FTP 的屏幕信息举例

```
[01] ftp nic.ddn.mil
[02] connected to nic.ddn.mil
[03] 220 nic FTP server (Sunos 4.1)ready.
[04] Name: anonymous
[05] 331 Guest login ok, send ident as password.
[06] Password: abc@xyz.math.yale.edu
[07] 230 Guest login ok, access restrictions apply.
[08] ftp> cd rfc
[09] 250 CWD command successful.
[10] ftp> get rfc1261.txt nicinfo
[11] 200 PORT command successful.
[12]     ASCII data connection for rfc1261.txt
         36.12.27,1401) (4318 bytes).
[13] 2    II Transfer complete.
     lo    info remote: rfc1261.txt
     44    eceived in 15 seconds (0.3 Kbytes/s).
[
[
```

[09] 字符 CWD 是 FTP 的标准命令，
代表 Change Working Directory。

FTP 的屏幕信息举例

[10] 用户要求将名为 rfc1261.txt 的文件复制到
本地主机上，并改名为 nicinfo。

```
[01]
[02]
[03]
[04] Name: a
[05] 331 G          n ok, send ident as password.
[06] Pas            abc@xyz.math.yale.edu
[07] 2              st login ok, access restrictions apply.
[08] ftp> cd rfc
[09] 250 CWD command successful.
[10] ftp> get rfc1261.txt nicinfo
[11] 200 PORT command successful.
[12] 150 ASCII data connection for rfc1261.txt
     (128.36.12.27,1401) (4318 bytes).
[13] 226 ASCII Transfer complete.
     local: nicinfo remote: rfc1261.txt
     4488 bytes received in 15 seconds (0.3 Kbytes/s).
[14] ftp> quit
[15] 221 Goodbye.
```

FTP 的屏幕信息举例

[11] 字符 PORT 是 FTP 的标准命令，表示要建立数据连接。200 表示“命令正确”。

```
[01]
[02]
[03]
[04] Name: a
[05] 331 G          ok, send ident as password.
[06] Pass           c@xyz.math.yale.edu
[07] 23             login ok, access restrictions apply.
[08] f              cd rfc
[09]                CWD command successful.
[10] ftp> get rfc1261.txt nicinfo
[11] 200 PORT command successful.
[12] 150 ASCII data connection for rfc1261.txt
     (128.36.12.27,1401) (4318 bytes).
[13] 226 ASCII Transfer complete.
     local: nicinfo remote: rfc1261.txt
     4488 bytes received in 15 seconds (0.3 Kbytes/s).
[14] ftp> quit
[15] 221 Goodbye.
```

FTP 的屏幕信息举例

[12] 数字 150 表示“文件状态正确，即将建立数据连接”。

```
[01]
[02]
[03]
[04] Name:                    as
[05] 331                      ogin ok, send ident as password.
[06] Pas                      abc@xyz.math.yale.edu
[07] 23                       st login ok, access restrictions apply.
[08] f                        cd rfc
[09]                          CWD command successful.
[10] ftp> get rfc1261.txt nicinfo
[11] 200 PORT command successful.
[12] 150 ASCII data connection for rfc1261.txt
     (128.36.12.27,1401) (4318 bytes).
[13] 226 ASCII Transfer complete.
     local: nicinfo remote: rfc1261.txt
     4488 bytes received in 15 seconds (0.3 Kbytes/s).
[14] ftp> quit
[15] 221 Goodbye.
```

FTP 的屏幕信息举例

[13] 数字 226 是“释放数据连接”。
现在一个新的本地文件已产生。

```
[01]
[02]
[03]
[04] Name:                    s
[05] 331                      gin ok, send ident as password.
[06] Pas                      abc@xyz.math.yale.edu
[07] 23(                      t login ok, access restrictions apply.
[08] f                        rfc
[09] 2                    WD command successful.
[10]                  > get rfc1261.txt nicinfo
[11]                  00 PORT command successful.
[12]                  150 ASCII data connection for rfc1261.txt
     (128.36.12.27,1401) (4318 bytes).
[13] 226 ASCII Transfer complete.
     local: nicinfo remote: rfc1261.txt
     4488 bytes received in 15 seconds (0.3 Kbytes/s).
[14] ftp> quit
[15] 221 Goodbye.
```

FTP 的屏幕信息举例

```
[01] ftp nic.ddn.mil
[02] connected to nic.ddn.mil
[03] 220 nic FTP server (Sunos 4.1)ready.
[04] Name: anonymous
[05] 331 Guest login ok, send ident as password.
[06] Password: abc@xyz.math.yale.edu
[07] 230 Guest login ok, access restrictions apply.
[08] ftp
[09] 25
[10] ftp> c          c1261.txt nicinfo
[11] 200          command successful.
[12] 150          II data connection for rfc1261.txt
     (1          36.12.27,1401) (4318 bytes).
[13]          ASCII Transfer complete.
     local: nicinfo remote: rfc1261.txt
     4488 bytes received in 15 seconds (0.3 Kbytes/s).
[14] ftp> quit
[15] 221 Goodbye.
```

[14] 用户键入退出命令。

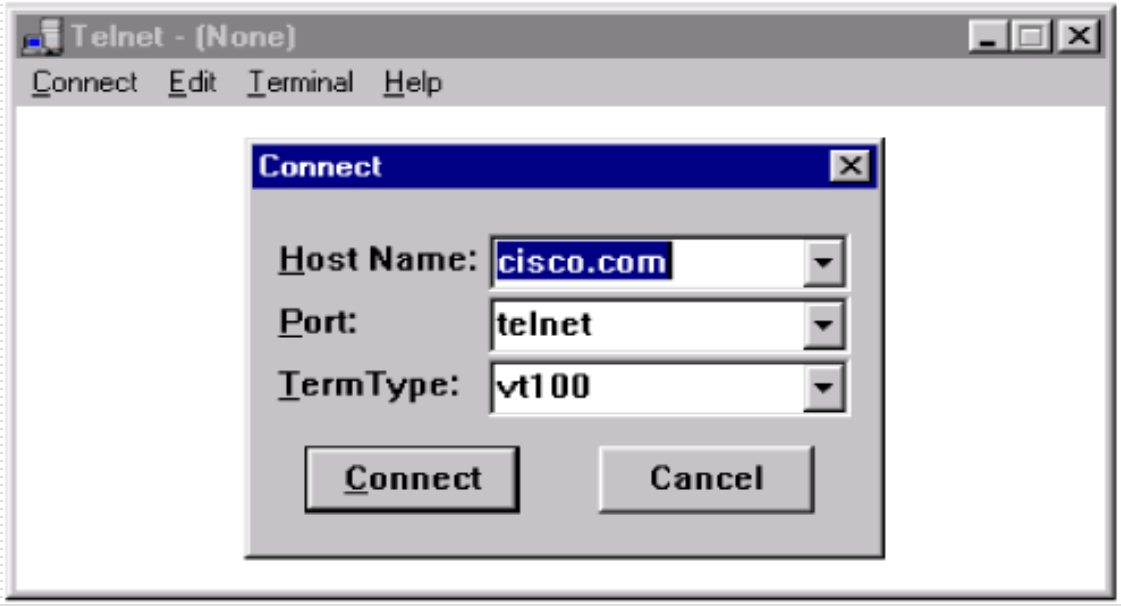
FTP 的屏幕信息举例

```
[01] ftp nic.ddn.mil
[02] connected to nic.ddn.mil
[03] 220 nic FTP server (Sunos 4.1)ready.
[04] Name: anonymous
[05] 331 Guest login ok, send ident as password.
[06] Password: abc@xyz.math.yale.edu
[07] 230 Guest login ok, access restrictions apply.
[08] ftp>
[09] 2
[10] ftp> get rfc1261.txt nicinfo
[11] 200 PORT command successful.
[12] 150 Opening data connection for rfc1261.txt
     (128.6.12.27,1401) (4318 bytes).
[13] 226 ASCII Transfer complete.
     local: nicinfo remote: rfc1261.txt
     4488 bytes received in 15 seconds (0.3 Kbytes/s).
[14] ftp> quit
[15] 221 Goodbye.
```

[15] 表明 FTP 工作结束。

Telnet

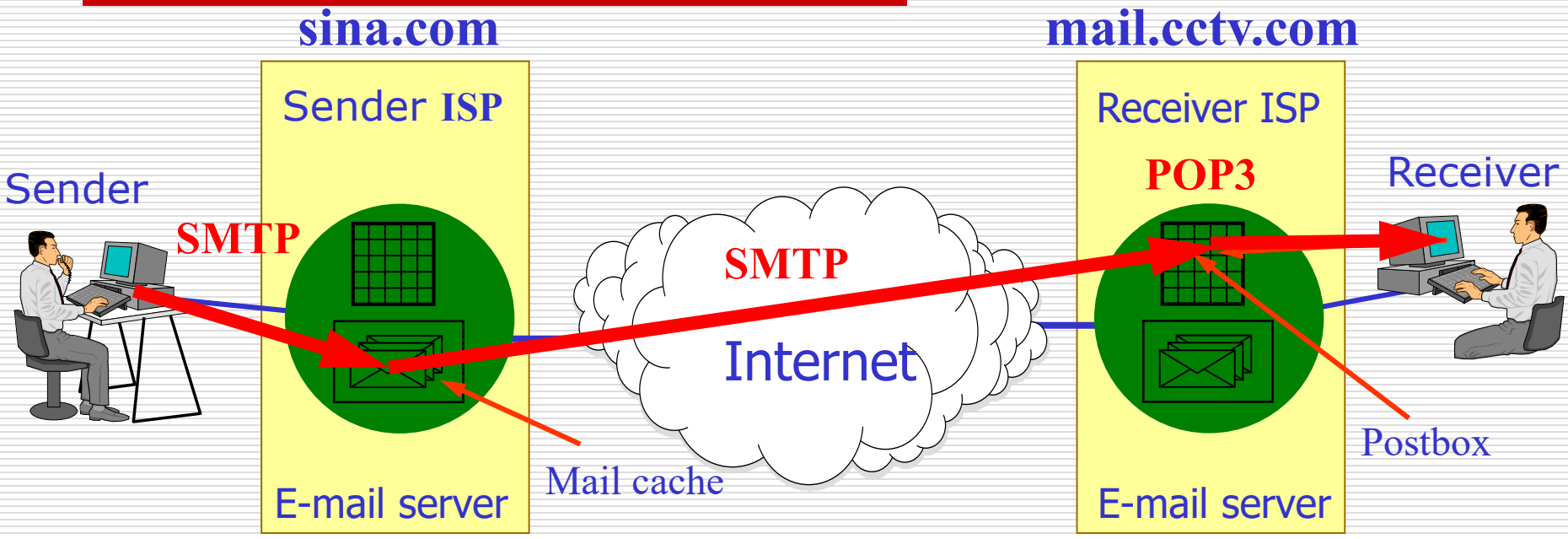
- Telnet client software provides the ability to log in to a remote Internet host that is running a Telnet server application and then to execute commands from the command line.



SMTP and POP

- E-mail servers communicate with each other using the SMTP to send and POP to receive mail.
  - **SMTP (Simple Mail Transfer Protocol)**
  - **POP3 (Post Office Protocol version 3)**

SMTP and POP



Sender: **xyz5678@sina.com**

Receiver : **ab30@mail.cctv.com**

User name

Domain name of e-mail server

IP and TCP are transferring protocols of e-mail

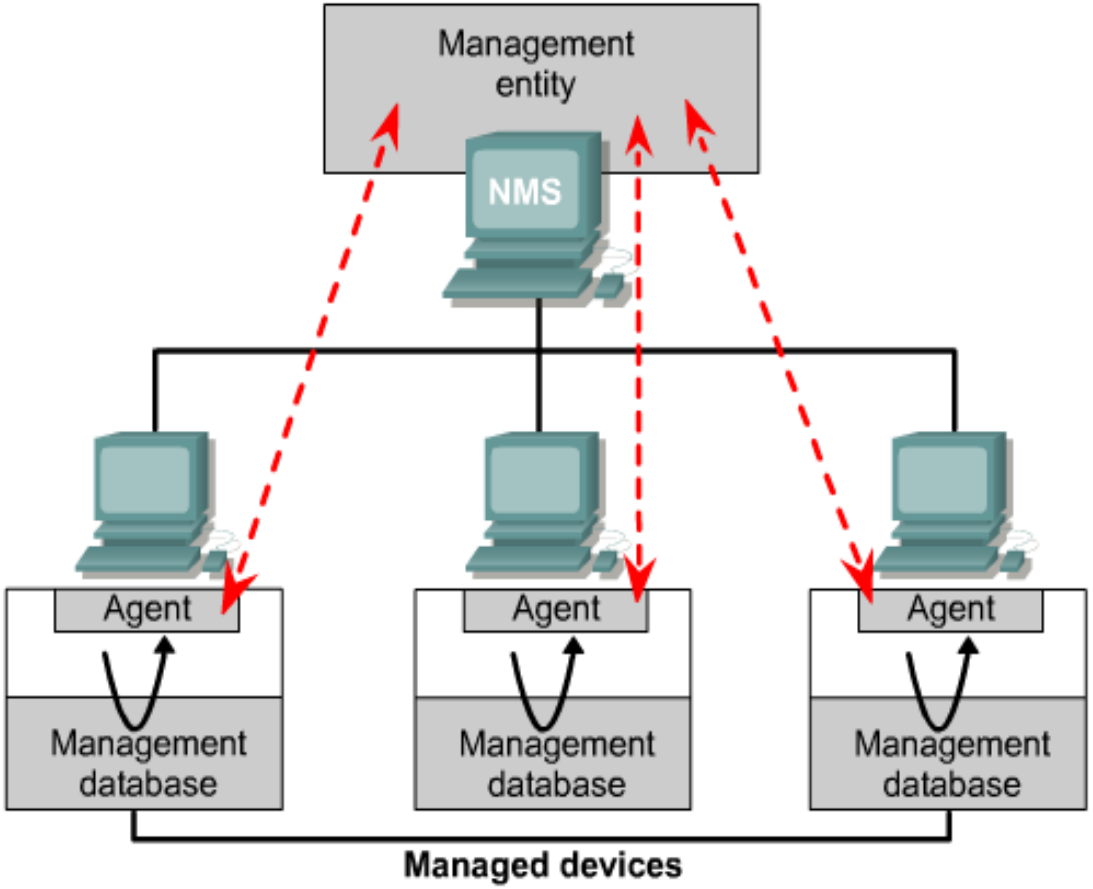
MIME 和 SMTP 的关系

MIME 增加 5 个新的邮件首部

- MIME-Version: 标志 MIME 的版本。现在的版本号是 1.0。若无此行，则为英文文本。
- Content-Description: 这是可读字符串，说明此邮件主体是否是图像、音频或视频。
- Content-Id: 邮件的惟一标识符。
- Content-Transfer-Encoding: 在传送时邮件的主体是如何编码的。
- Content-Type:说明邮件主体的数据类型和子类型。

SNMP

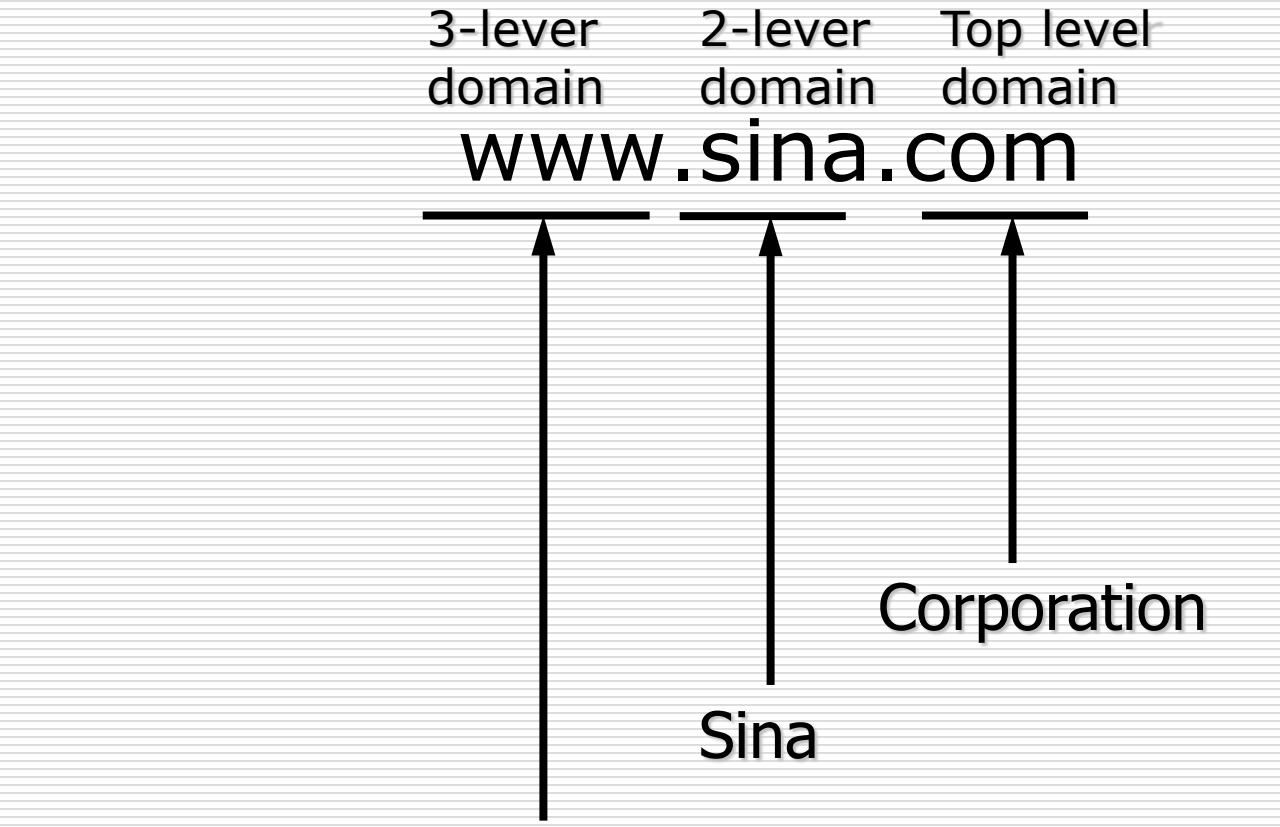
- The Simple Network Management Protocol (SNMP) is an application layer protocol that facilitates the exchange of management information between network devices.



Domain Name System (DNS)

- The Domain Name System (DNS) is a service on a network that manages domain names and responds to requests from clients to translate a domain name into the associated IP address.

Domain Name


3-lever domain
2-lever domain
Top level domain
www.sina.com
Corporation
Sina
Computer name to provide the www services

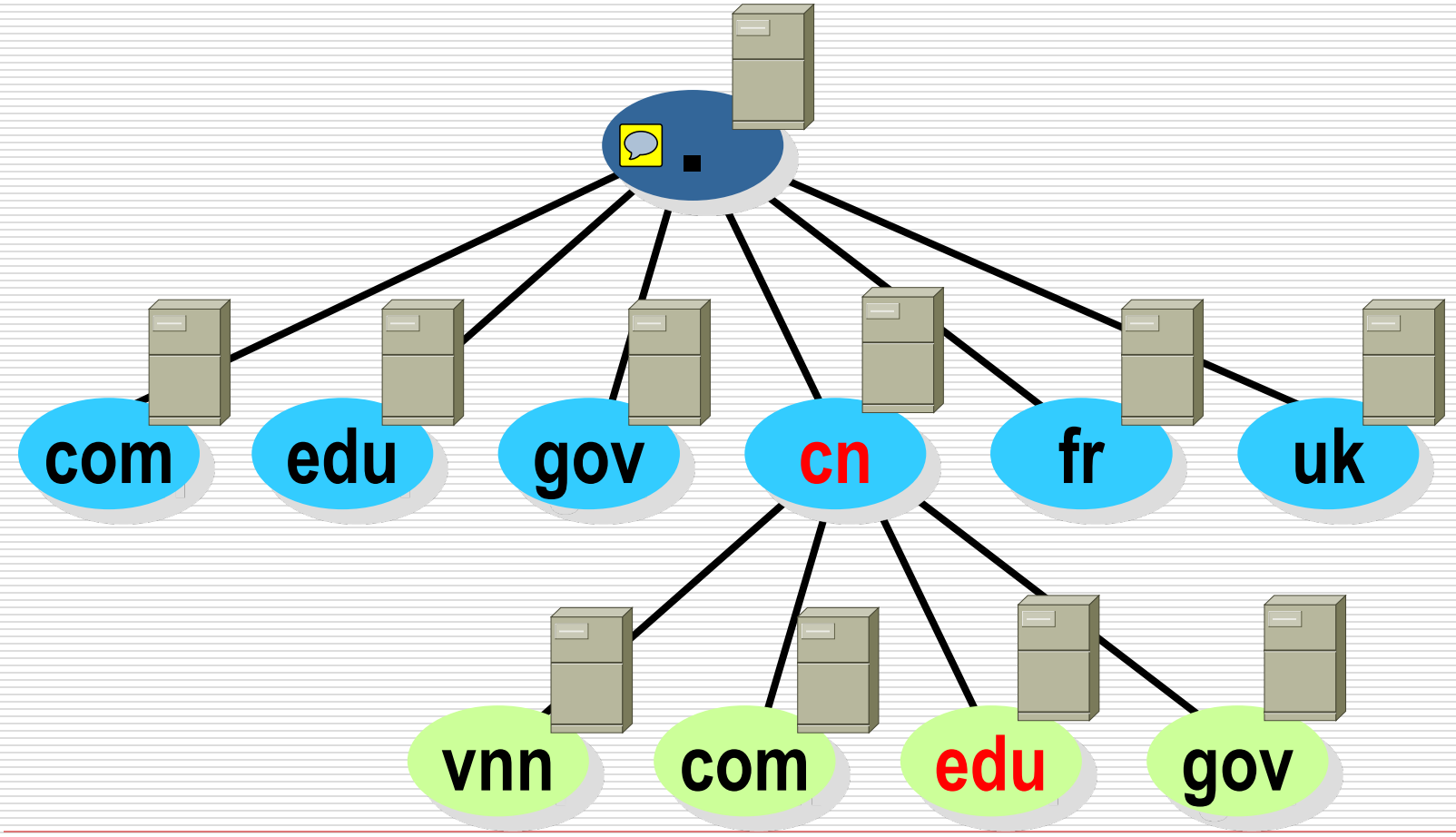
TLD (Top Level Domain)

- Nation TLD(nTLD)
  - .cn(CHINA), .us (United States), .uk (United kingdom), etc.
- Generic TLD(gTLD), the earliest domains include:
  - .com Enterprises and companies
  - .net Network services providers
  - .org Nonprofit organizations
  - .edu Educational facilities
  - .gov Governments (only for U.S.A)
  - .mil Military facilities (only for U.S.A)
  - .int International organizations

TLD (Top Level Domain)

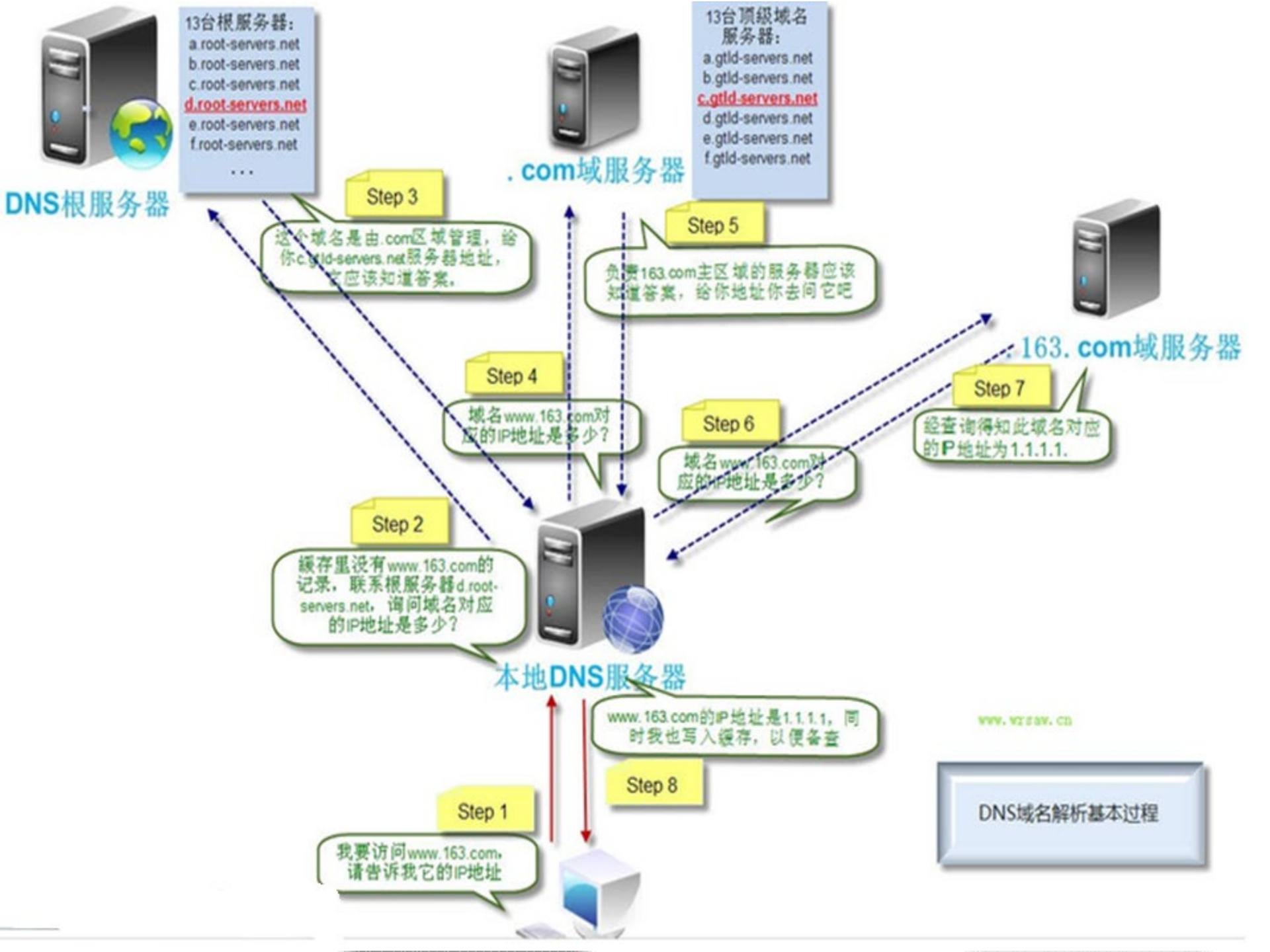
- Infrastructure domain
  - Only one: arpa, for resolving domain names reversely
- Recently, new TLD domain added:
  - .aero （航空运输企业）
  - .biz （公司和企业）
  - .cat （加泰隆人的语言和文化团体）
  - .coop （合作团体）
  - .info （各种资讯）
  - .jobs （人力资源管理者）
  - .mobi （移动产品与服务的用户和提供者）
  - .museum （博物馆）
  - .name （个人）
  - .pro （经过认证的专业人员）
  - .travel （旅游业）

Domain Name Server (DNS)



Domain Name Server (DNS)

- **The *DNS* system is set up in a hierarchy that creates different levels of *DNS* servers.**
- **The *DNS* server at this level judges if itself is able to translate the domain name into an associated IP address:**
  - **If it can do that, it does so and returns the result to the client**
  - **If not, it sends the request to the higher level.**


13台根服务器：
a.root-servers.net
b.root-servers.net
c.root-servers.net
d.root-servers.net
e.root-servers.net
f.root-servers.net
...
DNS根服务器
13台顶级域名服务器：
a.gtld-servers.net
b.gtld-servers.net
c.gtld-servers.net
d.gtld-servers.net
e.gtld-servers.net
f.gtld-servers.net
.com域服务器
.163.com域服务器
Step 1
我要访问www.163.com，请告诉我它的IP地址
Step 2
缓存里没有www.163.com的记录，联系根服务器d.root-servers.net，询问域名对应的IP地址是多少？
Step 3
这个域名是由.com区域管理，给你c.gtld-servers.net服务器地址，它应该知道答案。
Step 4
域名www.163.com对应的IP地址是多少？
Step 5
负责163.com主区域的服务器应该知道答案，给你地址你去问它吧
Step 6
域名www.163.com对应的IP地址是多少？
Step 7
经查询得知此域名对应的IP地址为1.1.1.1.
Step 8
www.163.com的IP地址是1.1.1.1，同时我也写入缓存，以便备查
本地DNS服务器
DNS域名解析基本过程

Application Layer: Communication Ways

- One way that communication processing takes place:
  - When a browser opens, it is connected to the default page and the files of the page are transferred to the client.
  - After the processing is completed, the connection is broken
- The second way:
  - As Telnet and FTP, establish a connection to the server and maintain that connection until all processing is performed.
  - The client terminates the connection when the user determines that he/she has finished.
- All communication activity falls into one of these two categories.

谢 谢！