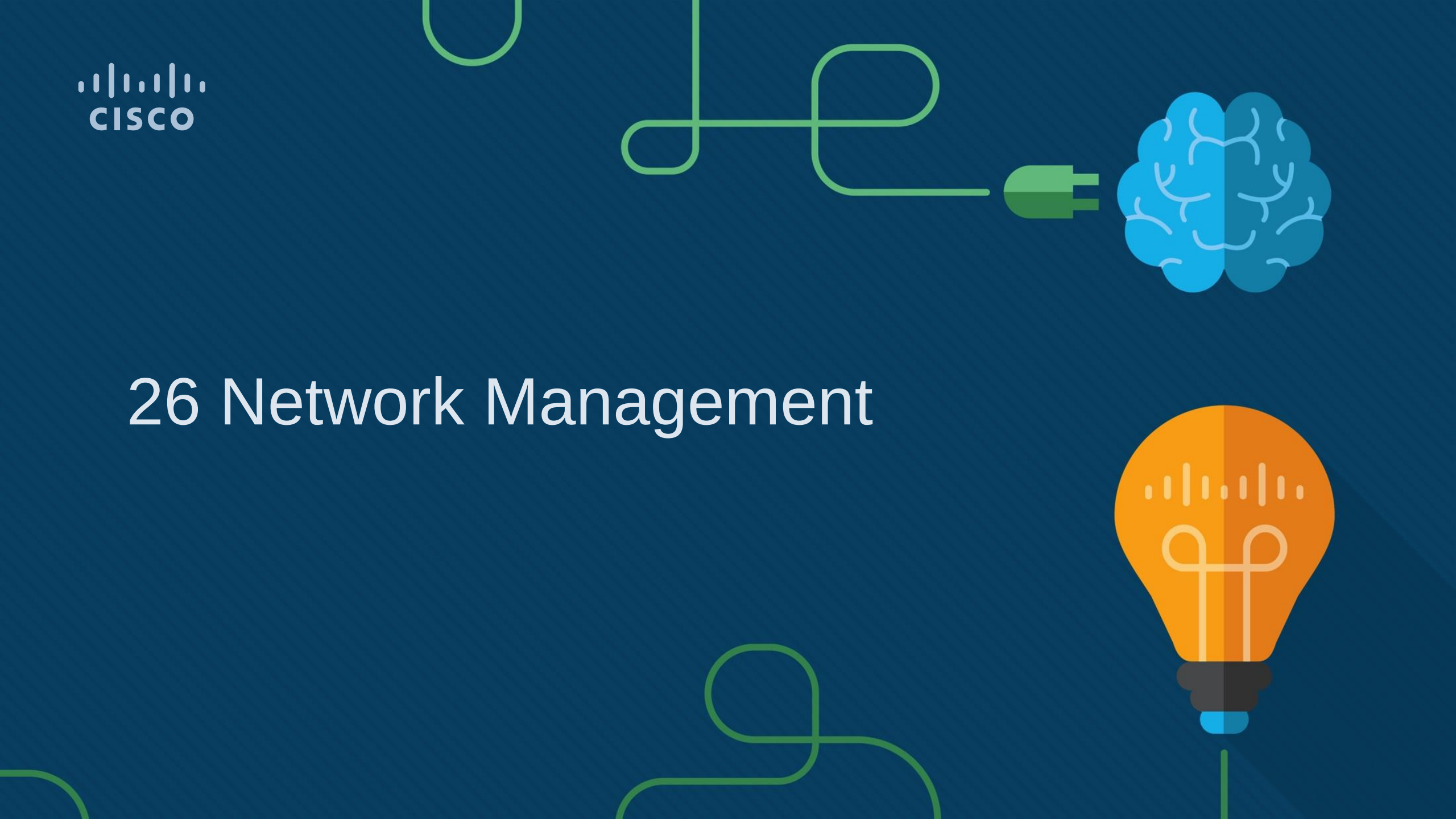


26 Network Management

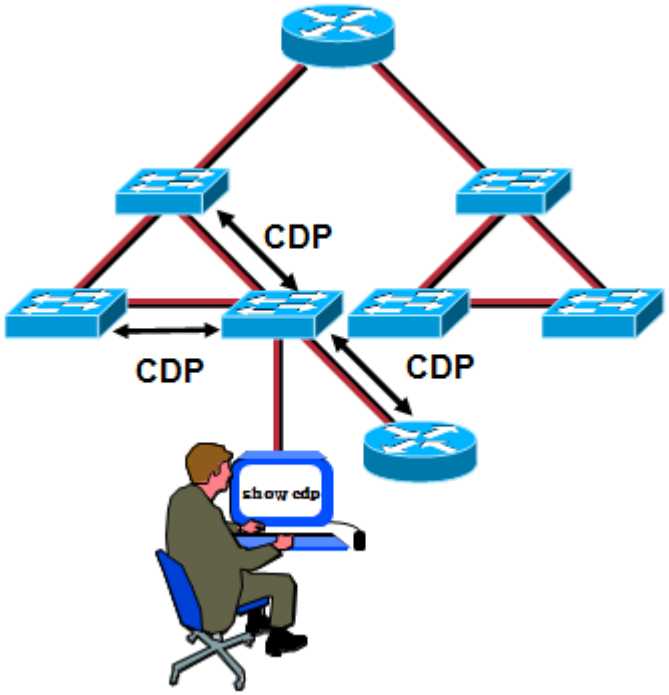
26.1 Device Discovery with CDP

CDP特征

- Cisco提供的专有的命令
- 获得直接连接的设备的信息摘要
- 运行在数据链路层
- CDP默认自动启动
- CDP默认更新周期60秒
- CDP默认过期周期180秒

CDP概述

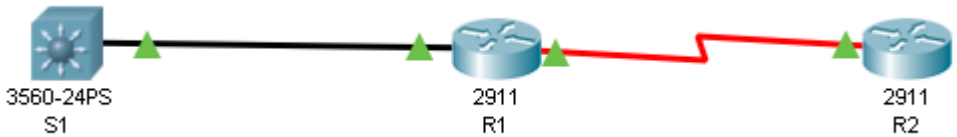
- 用CDP发现邻居信息摘要包括：
  - 设备ID（Device ID）
  - 本地接口（Local Interface ）
  - 保持时间（Holdtime ）
  - 功能（Capability ）
  - 平台（Platform ）
  - 端口ID（Port ID ）
  - VTP域名（VTP Management Domain Name (CDPv2 only) ）
  - 本征VLAN（Native VLAN (CDPv2 only) ）
  - 全双工/半双工（Full/Half-Duplex (CDPv2 only) ）



配置和验证 CDP

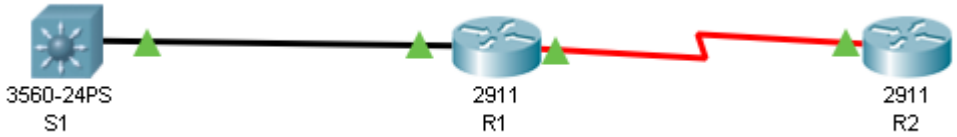

```
R1#show cdp
Global CDP information:
    Sending CDP packets every 60 seconds
    Sending a holdtime value of 180 seconds
    Sending CDPv2 advertisements is enabled

R1#show cdp neighbors
Capability Codes: R - Router, T - Trans Bridge, B - Source Route Bridge
                  S - Switch, H - Host, I - IGMP, r - Repeater, P - Phone
Device ID    Local Intrfce   Holdtme    Capability   Platform    Port ID
R2           Ser 0/0/0        171           R       C2900       Ser 0/0/0
S1           Gig 0/0          124                   3560        Fas 0/1

R1#show cdp interface
Vlan1 is administratively down, line protocol is down
  Sending CDP packets every 60 seconds
  Holdtime is 180 seconds
GigabitEthernet0/0 is up, line protocol is up
  Sending CDP packets every 60 seconds
  Holdtime is 180 seconds
GigabitEthernet0/1 is administratively down, line protocol is down
  Sending CDP packets every 60 seconds
  Holdtime is 180 seconds
GigabitEthernet0/2 is administratively down, line protocol is down
  Sending CDP packets every 60 seconds
  Holdtime is 180 seconds
Serial0/0/0 is up, line protocol is up
  Sending CDP packets every 60 seconds
  Holdtime is 180 seconds
Serial0/0/1 is administratively down, line protocol is down
  Sending CDP packets every 60 seconds
  Holdtime is 180 seconds
```

配置和验证 CDP




```
R1#show cdp neighbors detail

Device ID: R2
Entry address(es):
  IP address : 172.16.12.2
Platform: cisco C2900, Capabilities: Router
Interface: Serial0/0/0, Port ID (outgoing port): Serial0/0/0
Holdtime: 155

Version :
Cisco IOS Software, C2900 Software (C2900-UNIVERSALK9-M), Version 15.1(4)M4, RELEASE SOFTWARE (fc2)
Technical Support: http://www.cisco.com/techsupport
Copyright (c) 1986-2012 by Cisco Systems, Inc.
Compiled Thurs 5-Jan-12 15:41 by pt_team

advertisement version: 2
Duplex: full
---------------------------

Device ID: S1
Entry address(es):
  IP address : 172.16.1.100
Platform: cisco 3560, Capabilities: Router
Interface: GigabitEthernet0/0, Port ID (outgoing port): FastEthernet0/1
Holdtime: 169

Version :
Cisco IOS Software, C3560 Software (C3560-ADVIPSERVICESK9-M), Version 12.2(37)SE1, RELEASE SOFTWARE
(fc1)
Copyright (c) 1986-2007 by Cisco Systems, Inc.
Compiled Thu 05-Jul-07 22:22 by pt_team

advertisement version: 2
Duplex: full
```

配置和验证 CDP



1. 在全局配置模式下使用(no)cdp run 命令开启或关闭所由接口的CDP功能。默认情况下，CDP被全局开启。

```
R1(config)#cdp run
R1(config)#no cdp run
```

2.在接口模式下使用(no) cdp enable 命令可以开启或关闭某个特定接口的CDP功能。

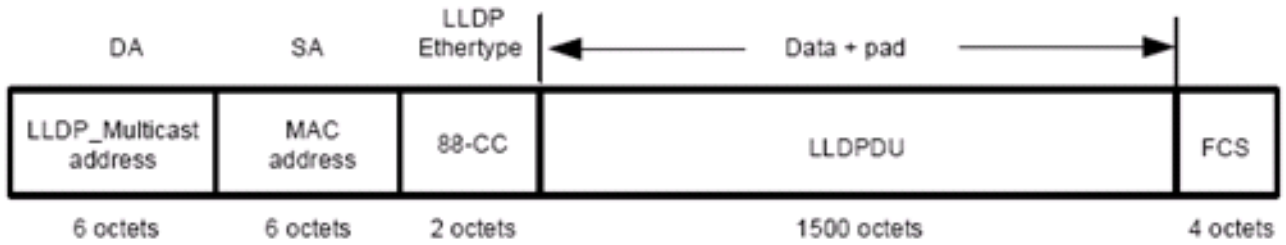
```
R1(config)#interface serial 0/0/0
R1(config-if)#no cdp enable
R1(config-if)#cdp enable
```

26.2 Device Discovery with LLDP

LLDP

供应商中立的第 2 层邻居发现协议，类似于 CDP

- 拓扑信息
- 设备的主要能力
- 管理地址
- 设备标识
- 接口标识



- DA：LLDP帧的目的地址，组播地址其值:01-80-C2-00-00-0E
- SA：与设备相邻连接设备的桥MAC
- LLDP Ethertype：帧类型，它的值为0x88CC
- LLDPDU：LLDP Data Unit，LLDP数据单元，它是LLDP信息交换的主体。
- FCS：帧校验

配置和验证 LLDP

```
Switch# conf t
Enter configuration commands, one per line. End with CNTL/Z.
Switch(config)# lldp run
Switch(config)# interface gigabitethernet 0/1
Switch(config-if)# lldp transmit
Switch(config-if)# lldp receive
Switch(config-if)# end
Switch# show lldp
Global LLDP Information:
   Status: ACTIVE
   LLDP advertisements are sent every 30 seconds
   LLDP hold time advertised is 120 seconds
   LLDP interface reinitialisation delay is 2 seconds
```

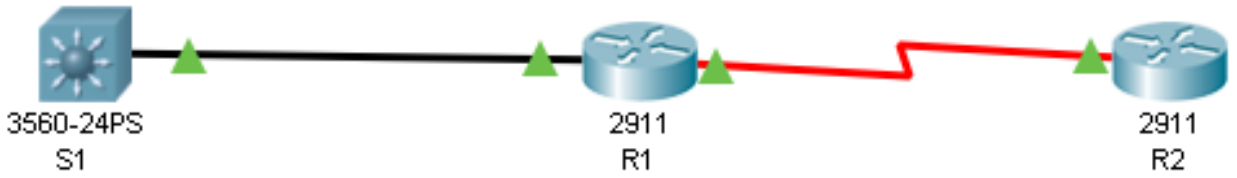
```
S1# show lldp neighbors
Capability codes:
    (R) Router, (B) Bridge, (T) Telephone, (C) DOCSIS Cable Device
    (W) WLAN Access Point, (P) Repeater, (S) Station, (O) Other
Device ID           Local Intf         Hold-time          Capability          Port ID
R1                  Fa0/5              117                          R
                    Gi0/0/1
S2                  Fa0/1              112                          B
                    Fa0/1
Total entries displayed: 2
```

配置和验证 LLDP


```
R1#show lldp

Global LLDP Information:
    Status: ACTIVE
    LLDP advertisements are sent every 30 seconds
    LLDP hold time advertised is 120 seconds
    LLDP interface reinitialisation delay is 2 seconds
```

```
S1#show lldp neighbors
Capability codes:
    (R) Router, (B) Bridge, (T) Telephone, (C) DOCSIS Cable Device
    (W) WLAN Access Point, (P) Repeater, (S) Station, (O) Other
Device ID           Local Intf     Hold-time  Capability      Port ID
R1                  Fa0/1          120        R               Gig0/0
```

配置和验证 LLDP

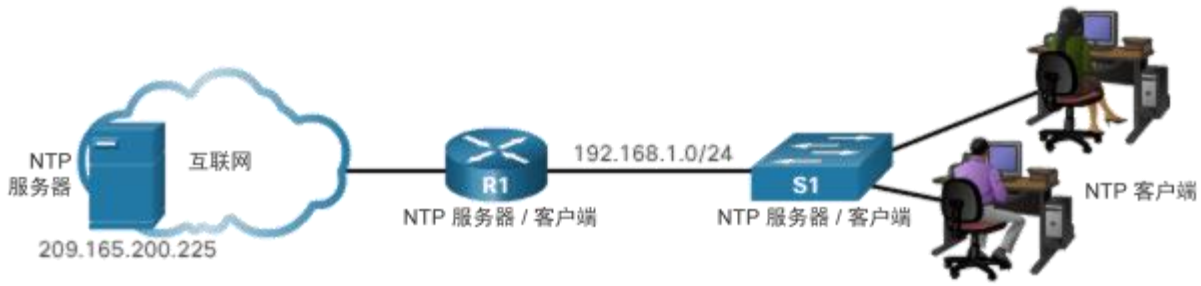



```
S1#show lldp neighbors detail
------------------------------------------------
Chassis id: 00D0.972D.B101
Port id: Gig0/0
Port Description: GigabitEthernet0/0
System Name: R1
System Description:
Cisco IOS Software, C2900 Software (C2900-UNIVERSALK9-M), Version 15.1(4)M4, RELEASE SOFTWARE (fc2)
Technical Support: http://www.cisco.com/techsupport
Copyright (c) 1986-2012 by Cisco Systems, Inc.
Compiled Thurs 5-Jan-12 15:41 by pt_team
Time remaining: 90 seconds
System Capabilities: R
Enabled Capabilities: R
Management Addresses - not advertised
Auto Negotiation - supported, enabled
Physical media capabilities:
    100baseT(FD)
    1000baseT(HD)
    1baseT(FD)
Media Attachment Unit type: 10
Vlan ID: 1

Total entries displayed: 1
```

26.3 NTP

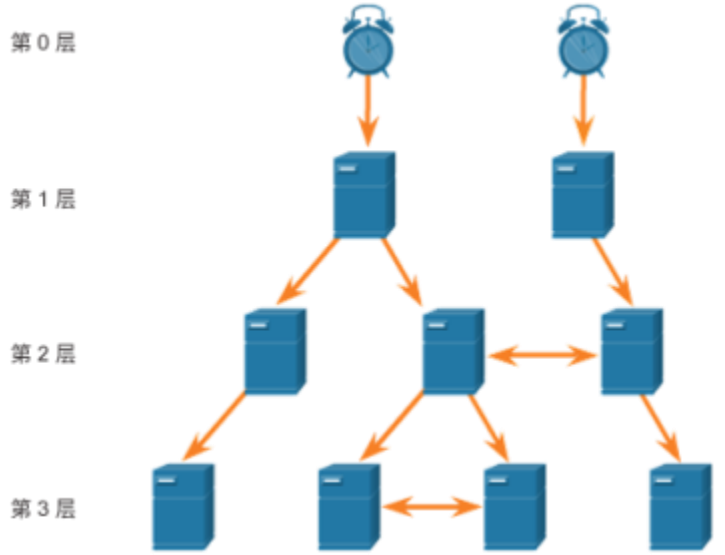
NTP功能

- NTP 是一种用于同步计算机系统数据网络时钟的协议
- NTP 可以从内部或外部时间来源获得正确的时间
- 时间来源可以是：
  - 本地主时钟
  - 网络上的主时钟
  - GPS 或原子钟
- 可将网络设备配置为 NTP 服务器或 NTP 客户端



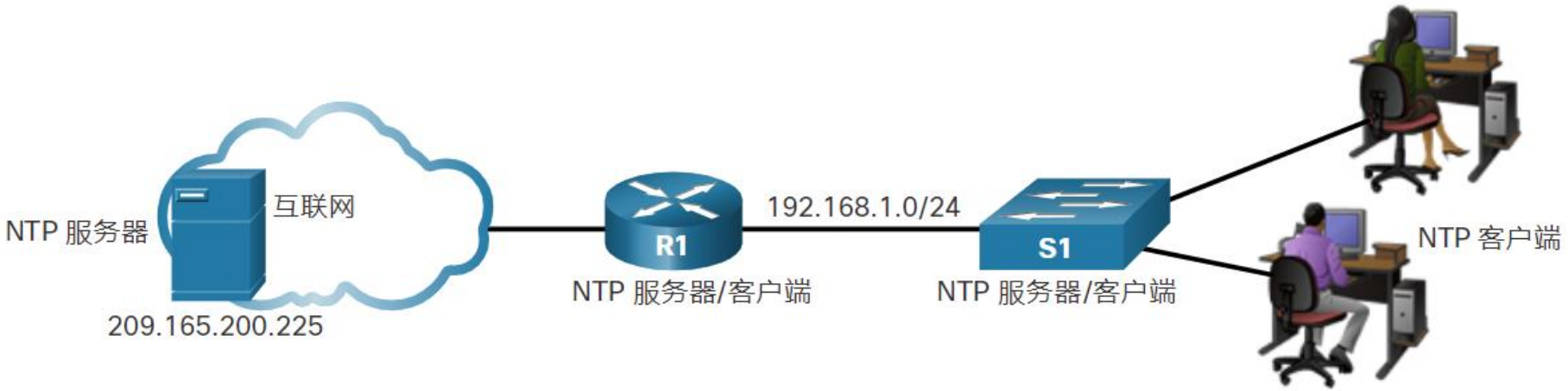
实施 NTP

- 设置系统时钟
  - 手动配置日期和时间
  - 配置网络时间协议 (NTP)
- NTP 操作
  - 时间源分层系统（stratum）
  - 第 0 层 - 权威时间源
  - 第 16 层（最低层级）表示设备不同步
  - 层数表示服务器距离时间源的远近
- 配置和验证 NTP
  - **ntp server** *ip-address*
  - **show ntp associations**
  - **show ntp status**
  - **show clock**



NTP简介

配置网络时间协议 (NTP)




```
R1# show clock detail
20:55:10.207 UTC Fri Nov 15 2019
Time source is user configuration
```

```
R1(config)# ntp server 209.165.200.225
R1(config)# end
R1# show clock detail
21:01:34.563 UTC Fri Nov 15 2019
Time source is NTP
```

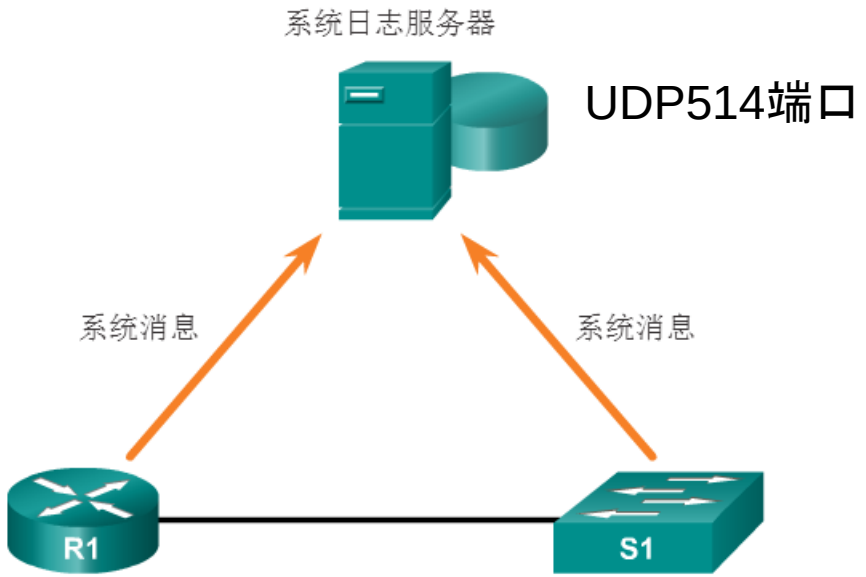
验证网络时间协议 (NTP)

```
R1# show ntp associations
  address         ref clock       st   when   poll reach  delay  offset   disp
*~209.165.200.225 .GPS.           1     61     64   377  0.481   7.480  4.261
 * sys.peer, # selected, + candidate, - outlyer, x falseticker, ~ configured

R1# show ntp status
Clock is synchronized, stratum 2, reference is 209.165.200.225
nominal freq is 250.0000 Hz, actual freq is 249.9995 Hz, precision is 2**19
ntp uptime is 589900 (1/100 of seconds), resolution is 4016
reference time is DA088DD3.C4E659D3 (13:21:23.769 PST Fri Nov 15 2019)
clock offset is 7.0883 msec, root delay is 99.77 msec
root dispersion is 13.43 msec, peer dispersion is 2.48 msec
loopfilter state is 'CTRL' (Normal Controlled Loop), drift is 0.000001803 s/s
system poll interval is 64, last update was 169 sec ago.
```

26.4 Syslog

系统日志功能

- **系统日志的日志记录服务提供了以下三个主要功能：**
  - **能够收集日志记录信息来用于监控和故障排除**
  - **能够选择捕获的日志记录信息的类型**
  - **能够指定捕获的系统日志消息发送目的地**

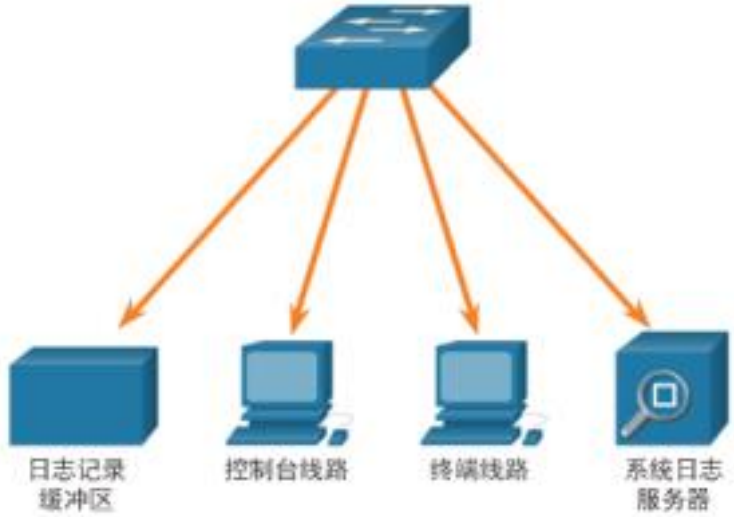


系统日志操作

- 支持设备发送消息至系统日志服务器
- 大部分网络设备都可支持
- 系统消息的常见目的地如下：
  - ✓ 日志记录缓冲区（路由器或交换机内部的 RAM）
  - ✓ 控制台线路
  - ✓ 终端线路
  - ✓ 系统日志服务器系统（Syslog服务器）
- 日志消息格式
- 严重性级别 0-7 级
- 设备 - 服务标识符

- 服务时间戳
  - 增强了实时调试和管理。
  - **service timestamps log datetime**

严重名称	严重级别	说明
紧急	第 0 级	系统不可用
提醒	第 1 级	需要立即采取操作
重要	第 2 级	关键条件
错误	第 3 级	错误条件
警告	第 4 级	警告条件
通知	第 5 级	正常、但比较重要的情况
信息性	第 6 级	信息性消息
调试	第 7 级	调试消息



系统消息格式

```
*Dec 18 17:10:15.079: %LINEPROTO-5-UPDOWN: Line
protocol on Interface FastEthernet0/0, changed state
to down
```

- 时间戳：*Dec 18 17:10:15.079
- 路由器上生成消息的设施：%LINEPROTO
- 严重性级别：5
- 消息的助记符：UPDOWN
- 消息说明：Line protocol on Interface FastEthernet0/0, changed state to down

修改系统消息

```
R1(config)# no service timestamps
R1(config)# service sequence-numbers
R1(config)# end
R1#
000011: %SYS-5-CONFIG_I: Configured from console by
console
```

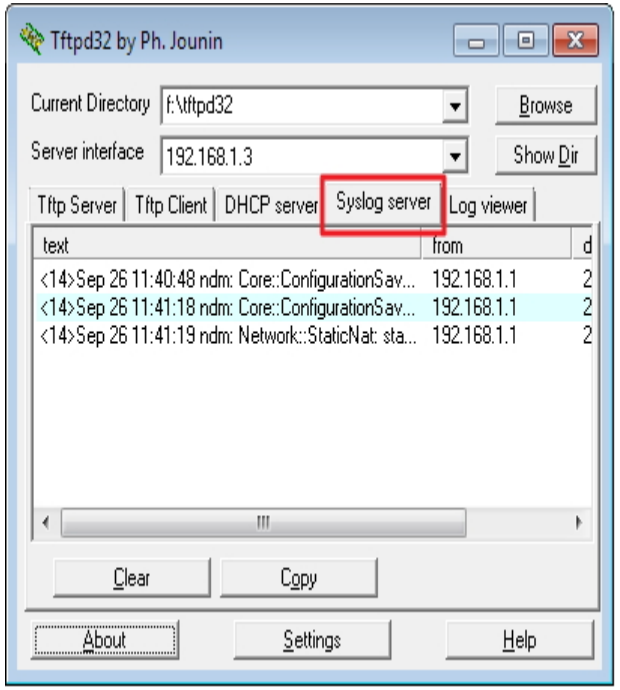
配置和检验 Syslog

- R1(config)#logging 192.168.1.101
- R1(config)#logging trap 4
- 默认情况下，思科路由器和交换机会向控制台发送所有严重性级别的日志消息。在某些 IOS 版本中，默认情况下设备还会缓冲这些 syslog 消息
  - R1(config)# logging console
  - R1(config)# logging buffered
- R1# show logging

系统日志简介

路由器和交换机作为syslog客户端配置命令

```
R1(config)# logging 192.168.1.3
R1(config)# logging trap 4
R1(config)# logging source-interface g0/0
R1(config)# interface loopback 0
R1(config-if)#
*Jun 12 22:06:02.902: %LINK-3-UPDOWN: Interface Loopback0,
changed state to up
*Jun 12 22:06:03.902: %LINEPROTO-5-UPDOWN: Line protocol on
Interface Loopback0, changed state to up
*Jun 12 22:06:03.902: %SYS-6-LOGGINGHOST_STARTSTOP: Logging to
host 192.168.1.3 port 514 started - CLI initiated
R1(config-if)# shutdown
R1(config-if)#
*Jun 12 22:06:49.642: %LINK-5-CHANGED: Interface Loopback0,
changed state to administratively down
*Jun 12 22:06:50.642: %LINEPROTO-5-UPDOWN: Line protocol on
Interface Loopback0, changed state to down
R1(config-if)# no shutdown
R1(config-if)#
*Jun 12 22:09:18.210: %LINK-3-UPDOWN: Interface Loopback0,
changed state to up
*Jun 12 22:09:19.210: %LINEPROTO-5-UPDOWN: Line protocol on
Interface Loopback0, changed state to up
R1(config-if)#
```



系统日志简介

检验Syslog

```
R1# show logging | include changed state to up
*Jun 12 17:46:26.143: %LINK-3-UPDOWN: Interface
GigabitEthernet0/1, changed state to up
*Jun 12 17:46:26.143: %LINK-3-UPDOWN: Interface Serial0/0/1,
changed state to up
*Jun 12 17:46:27.263: %LINEPROTO-5-UPDOWN: Line protocol on
Interface GigabitEthernet0/1, changed state to up
*Jun 12 17:46:27.263: %LINEPROTO-5-UPDOWN: Line protocol on
Interface Serial0/0/1, changed state to up
*Jun 12 20:28:43.427: %LINK-3-UPDOWN: Interface
GigabitEthernet0/0, changed state to up
*Jun 12 20:28:44.427: %LINEPROTO-5-UPDOWN: Line protocol on
Interface GigabitEthernet0/0, changed state to up
*Jun 12 22:04:11.862: %LINEPROTO-5-UPDOWN: Line protocol on
Interface Loopback0, changed state to up
*Jun 12 22:06:02.902: %LINK-3-UPDOWN: Interface Loopback0,
changed state to up
*Jun 12 22:06:03.902: %LINEPROTO-5-UPDOWN: Line protocol on
Interface Loopback0, changed state to up
*Jun 12 22:09:18.210: %LINK-3-UPDOWN: Interface Loopback0,
changed state to up
```

```
R1# show logging | begin Jun 12 22:35
*Jun 12 22:35:46.206: %LINK-5-CHANGED: Interface Loopback0,
changed state to administratively down
*Jun 12 22:35:47.206: %LINEPROTO-5-UPDOWN: Line protocol on
Interface Loopback0, changed state to down
*Jun 12 22:35:55.926: %LINK-3-UPDOWN: Interface Loopback0,
changed state to up
*Jun 12 22:35:56.926: %LINEPROTO-5-UPDOWN: Line protocol on
Interface Loopback0, changed state to up
*Jun 12 22:49:52.122: %SYS-5-CONFIG_I: Configured from console by
console
*Jun 12 23:15:48.418: %SYS-5-CONFIG_I: Configured from console by
console
R1#
```

26.5 Router and Switch File Maintenance
路由器和交换机文件维护

路由器文件系统

- 路由器文件系统
  - **show file systems - 列出所有可用的文件系统**
  - **dir - 列出文件系统的内容**
  - **pwd - 检验当前工作目录**
  - **cd - 更改当前目录**

可以看到总内存和空闲内存、文件系统的类型及其权限。权限包括只读 (ro)、只写 (wo) 和读写 (rw)。命令输出的 Flags（标志）列中显示的就是权限。
闪存文件系统前面还标有一个星号。这表示闪存是当前默认文件系统。
可启动的 IOS 位于闪存中；因此闪存列表附加的井号 (#) 表示它是可启动磁盘。

```
Router# show file systems
File Systems:
      Size(b)       Free(b)      Type  Flags  Prefixes
            -             -    opaque     rw   system:
            -             -    opaque     rw   tmpsys:
*   7194652672    6294822912      disk     rw   bootflash: flash:#
    256589824     256573440      disk     rw   usb0:
    1804468224    1723789312      disk     ro   webui:
            -             -    opaque     rw   null:
            -             -    opaque     ro   tar:
            -             -   network     rw   tftp:
            -             -    opaque     wo   syslog:
     33554432      33539983     nvram     rw   nvram:
            -             -   network     rw   rcp:
            -             -   network     rw   ftp:
            -             -   network     rw   http:
            -             -   network     rw   scp:
            -             -   network     rw   sftp:
            -             -   network     rw   https:
            -             -    opaque     ro   cns:
```

路由器文件系统

- 路由器文件系统
  - **dir - 列出文件系统的内容**

```
Router# dir
Directory of bootflash:/
   11  drwx            16384   Aug 2 2019 04:15:13 +00:00  lost+found
370945  drwx             4096   Oct 3 2019 15:12:10 +00:00  .installer
338689  drwx             4096   Aug 2 2019 04:15:55 +00:00  .ssh
217729  drwx             4096   Aug 2 2019 04:17:59 +00:00  core
379009  drwx             4096  Sep 26 2019 15:54:10 +00:00  .prst_sync
80641  drwx              4096   Aug 2 2019 04:16:09 +00:00  .rollback_timer
161281  drwx             4096   Aug 2 2019 04:16:11 +00:00  gs_script
112897  drwx            102400   Oct 3 2019 15:23:07 +00:00  tracelogs
362881  drwx             4096  Aug 23 2019 17:19:54 +00:00  .dbpersist
298369  drwx             4096   Aug 2 2019 04:16:41 +00:00  virtual-instance
   12  -rw-               30   Oct 3 2019 15:14:11 +00:00  throughput_monitor_params
 8065  drwx             4096   Aug 2 2019 04:17:55 +00:00  onep
   13  -rw-               34   Oct 3 2019 15:19:30 +00:00  pnp-tech-time
249985  drwx             4096  Aug 20 2019 17:40:11 +00:00  Archives
   14  -rw-            65037   Oct 3 2019 15:19:42 +00:00  pnp-tech-discovery-summary
   17  -rw-          5032908  Sep 19 2019 14:16:23 +00:00
isr4200_4300_rommon_1612_1r_SPA.pkg
   18  -rw-        517153193  Sep 21 2019 04:24:04 +00:00  isr4200-
universalk9_ias.16.09.04.SPA.bin
7194652672 bytes total (6294822912 bytes free)
Router#
```

路由器文件系统

- 路由器文件系统
  - **dir - 列出文件系统的内容**
  - **pwd - 检验当前工作目录**
  - **cd - 更改当前目录**

```
Router#
Router# cd nvram:
Router# pwd
nvram:/
Router# dir
Directory of nvram:/
32769  -rw-             1024                    startup-config
32770  ----               61                    private-config
32771  -rw-             1024                    underlying-config
    1  ----                4                    private-KS1
    2  -rw-             2945                    cwmp_inventory
    5  ----              447                    persistent-data
    6  -rw-             1237                    ISR4221-2x1GE_0_0_0
    8  -rw-               17                    ecfm_ieee_mib
    9  -rw-                0                    ifIndex-table
   10  -rw-             1431                    NIM-2T_0_1_0
   12  -rw-              820                    IOS-Self-Sig#1.cer
   13  -rw-              820                    IOS-Self-Sig#2.cer
33554432 bytes total (33539983 bytes free)
Router#
```

交换机文件系统

```
Switch# show file systems
File Systems:
      Size(b)     Free(b)      Type  Flags  Prefixes
*    32514048    20887552     flash     rw    flash:#
           -           -    opaque     rw       vb:
           -           -    opaque     ro       bs:
           -           -    opaque     rw   system:
           -           -    opaque     rw   tmpsys:
       65536       48897     nvram     rw    nvram:
           -           -    opaque     ro   xmodem:
           -           -    opaque     ro   ymodem:
           -           -    opaque     rw     null:
           -           -    opaque     ro      tar:
           -           -   network     rw     tftp:
           -           -   network     rw      rcp:
           -           -   network     rw     http:
           -           -   network     rw      ftp:
           -           -   network     rw      scp:
           -           -   network     rw    https:
           -           -    opaque     ro      cns:
```

使用文本文件备份配置

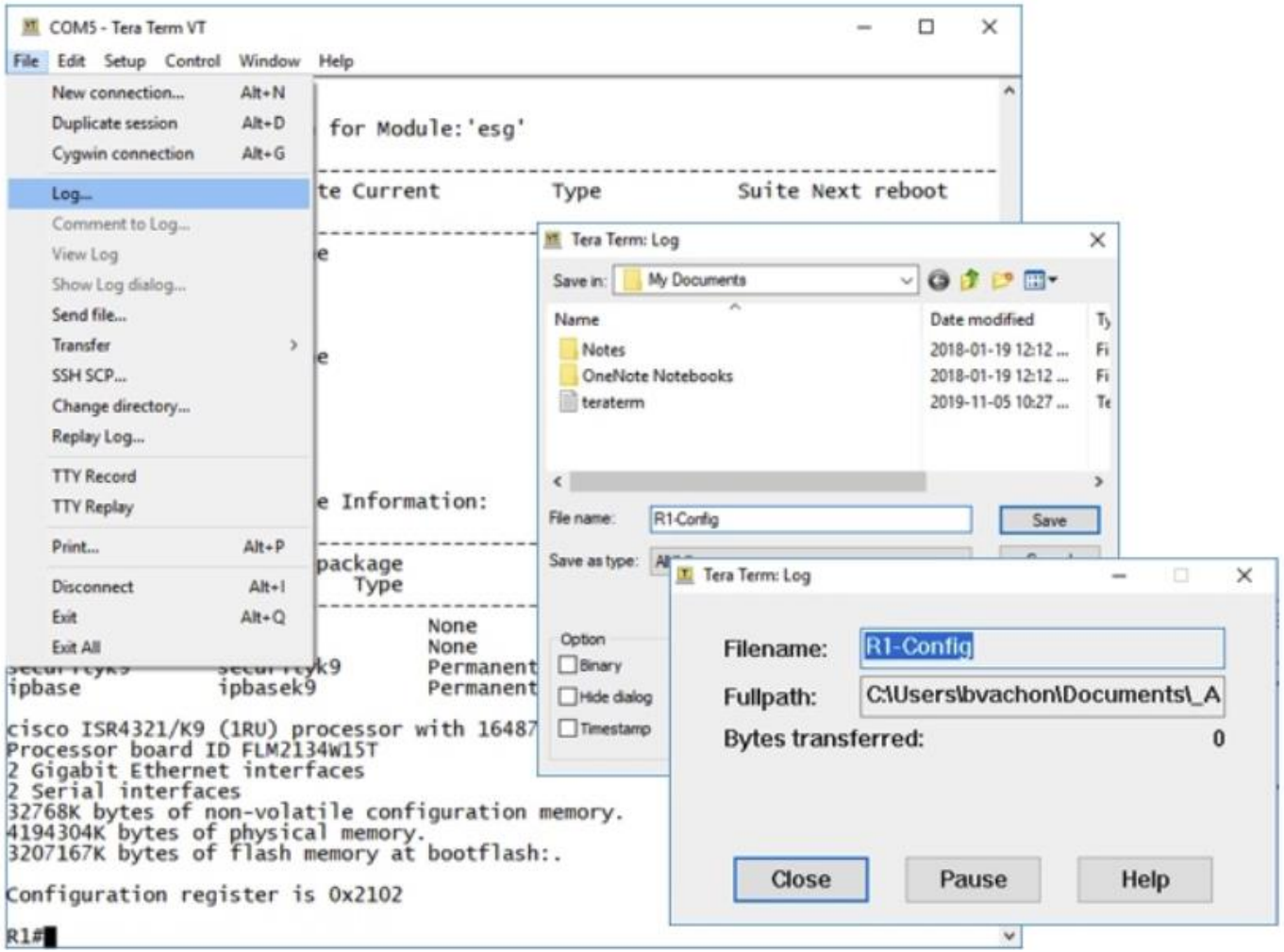
步骤 1. 在File（文件）菜单中点击 Log。

步骤 2. 选择保存文件的位置。Tera Term 将开始捕获文本。

步骤 3. 在开始捕获后，在特权 EXEC模式下使用 show running-config 或 show startup-config 命令。在终端窗口中显示的文本将指向选定文件。

步骤 4. 当捕获完成后，在终端日志窗口选择 关闭。

步骤 5. 查看文件验证其未损坏。



路由器和交换机文件备份

- 使用 TFTP 进行备份和恢复
  - **copy running-config tftp**
  - **copy startup-config tftp**
  - **步骤 1. 输入 copy running-config tftp 命令。**
  - **步骤 2. 输入要存储配置文件的主机的 IP 地址。**
  - **步骤 3. 输入要为配置文件指定的名称。**
  - **步骤 4. 按 Enter 确认每次选择。**

```
R1# copy running-config tftp
Remote host []?192.168.10.254
Name of the configuration file to write[R1-config]? R1-Jan-2019
Write file R1-Jan-2019 to 192.168.10.254? [confirm]
Writing R1-Jan-2019 !!!!!! [OK]
```

路由器和交换机文件备份

- 使用 USB 端口进行备份和恢复
  - **show file systems**
  - **dir usbflash0:**
  - **copy run usbflash0:/**

```
R1# dir usbflash0:/
Directory of usbflash0:/
    1  drw-      0  Oct 15 2010 16:28:30 +00:00  Cisco
   16  -rw-   5024   Jan 7 2013 20:26:50 +00:00  R1-Config
4050042880 bytes total (3774144512 bytes free)
R1#
R1# more usbflash0:/R1-Config
!
! Last configuration change at 20:19:54 UTC Mon Jan 7 2013 by
admin version 15.2
service timestamps debug datetime msec
service timestamps log datetime msec
no service password-encryption
!
hostname R1
!
boot-start-marker
boot-end-marker
!
logging buffered 51200 warnings
!
no aaa new-model
!
no ipv6 cef
R1#
```

路由器密码恢复

路由器冷启动，1分钟内按住【Ctrl】+【Break】

步骤 1. 进入 ROMMON 模式。

步骤 2. 更改配置寄存器值。

步骤 3. 把启动配置复制到运行配置。

步骤 4. 更改密码。

步骤 5. 把运行配置保存为新的启动配置。

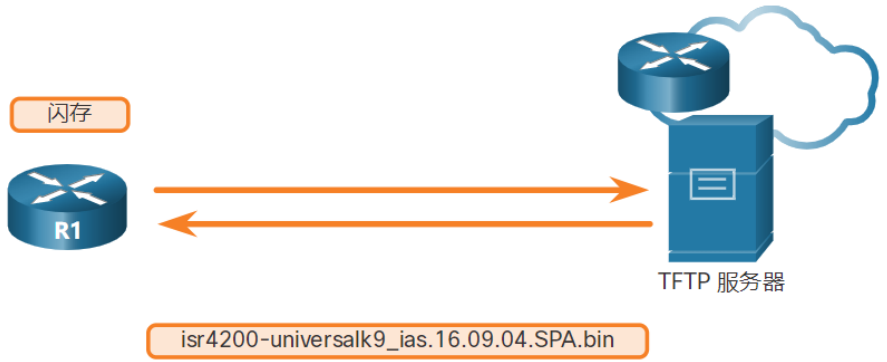
步骤 6. 重启设备。

```
rommon 1 > confreg 0x2142
rommon 2 > reset
Router# copy startup-config running-config
R1(config)# enable secret cisco
R1(config)# config-register 0x2102
R1(config)# end
R1# copy running-config startup-config
```

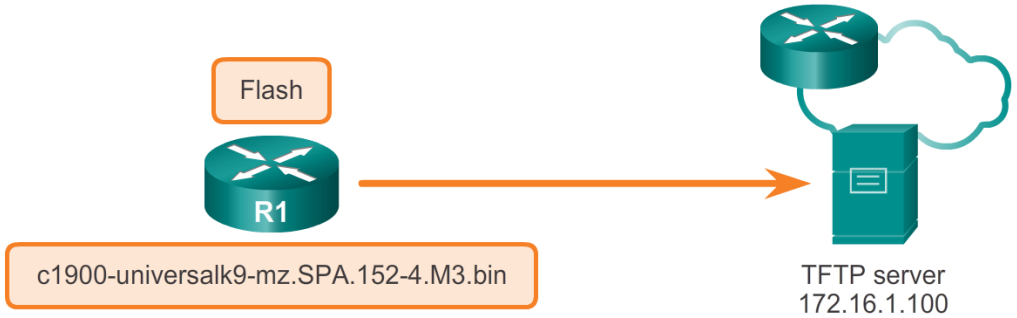
26.6 IOS Image Management
IOS 映像管理

IOS 备份

- TFTP 服务器作为备份位置
  - IOS 映像和配置文件的备份位置
- 将 IOS 映像备份到 TFTP 服务器的步骤
  - 验证 TFTP 服务器的访问权
  - 确认有足够的磁盘空间
  - 将 IOS 映像复制到 TFTP 服务器
    - **copy** *source-url* **tftp:**
- 将 IOS 映像复制到设备的步骤
  - 从 Cisco.com 下载 IOS 映像并将其传输到 TFTP 服务器
  - 验证设备到 TFTP 服务器的访问权
  - 确认设备上有足够的磁盘空间
  - 从 TFTP 服务器上复制映像
    - **copy tftp:** *destination-url*
- **boot system** 命令
  - 在启动过程中，使用命令加载新映像
  - **boot system** *file-url*



创建Cisco IOS映像文件备份




```
R1# ping 172.16.1.100
Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 172.16.1.100, timeout is 2
seconds:
!!!!!
Success rate is 100 percent (5/5),
round-trip min/avg/max = 56/56/56 ms
```

```
R1# show flash0:
-# - --length-- -----date/time------ path
8   68831808   Apr 2 2013 21:29:58  +00:00
                          c1900-universalk9-mz.SPA.152-4.M3.bin
<output omitted>
```

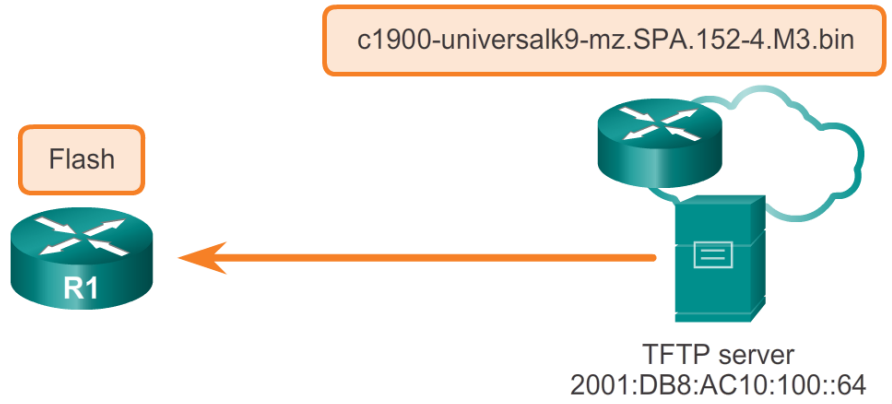
备份IOS 映像到TFTP 服务器, 需要以下几个步骤：

- **步骤1**. 确保本地能够**访问到**TFTP服务器
- **步骤2**. 检查TFTP服务器是否有充分的**磁盘空间**来存放IOS映像文件
- **步骤3**. 使用 **copy *source-url destination-url*** 命令复制IOS文件到TFTP服务器。

```
R1# copy flash0: tftp:
Source filename []? c1900-universalk9-mz.SPA.152-4.M3.bin
Address or name of remote host []? 172.16.1.100
Destination filename []?
c1900-universalk9-mz.SPA.152-4.M3.bin
!!!!!!!!!!!!!!!!!!!
<output omitted>
68831808 bytes copied in 363.468 secs (269058 bytes/sec)
```

IOS 映像管理

复制一个 IOS 映像文件




```
R1# ping 2001:DB8:CAFE:100::99
Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 2001:DB8:CAFE:100::99,
timeout is 2 seconds:
!!!!!
Success rate is 100 percent (5/5),
round-trip min/avg/max = 56/56/56 ms
```

```
R1# show flash0:
-# - --length-- -----date/time------ path
 <output omitted>

182394880 bytes available (74092544 bytes used)

R1#
```

```
R1# copy tftp: flash0:
Address or name of remote host []? 2001:DB8:CAFE:100::99
Source filename []? c1900-universalk9-mz.SPA.152-4.M3.bin
Destination filename []?
c1900-universalk9-mz.SPA.152-4.M3.bin
Accessing tftp://2001:DB8:CAFE:100::99/c1900-universalk9-
mz.SPA.152-4.M3.bin...
Loading c1900-universalk9-mz.SPA.152-4.M3.bin from
2001:DB8:CAFE:100::99 (via
GigabitEthernet0/0): !!!!!!!!!!!!!!!!!!!
 <output omitted>
[OK - 68831808 bytes]
68831808 bytes copied in 368.128 secs (265652 bytes/sec)
```

下列几个步骤可以在Cisco 路由器上**升级**IOS映像：

- **步骤 1.** 从 cisco.com下载需要的 IOS 文件并传输到 TFTP 服务器
- **步骤 2.** 验证本机到TFTP 服务器的**连接**是否正常
- **步骤 3.** 确保路由器有足够的flash**存储空间**升级到新的映像
- **步骤 4.** 使用 **copy tftp: flash0:** 命令从TFTP服务器复制 IOS 映像文件到本地路由器

系统引导

- 使用**boot system**命令指定准备加载的Cisco IOS 文件的名字和位置。

Router(config)# **boot system flash0:// flash0:isr4200-universalk9_ias.16.09.04.SPA.bin**

Router(config)# **boot system tftp://flash0:isr4200-universalk9_ias.16.09.04.SPA.bin**

Router(config)# **boot system rom**

```
R1# show version
Cisco IOS XE Software, Version 16.09.04
Cisco IOS Software [Fuji], ISR Software (X86_64_LINUX_IOSD-UNIVERSALK9_IAS-M), Version 16.9.4, RELEASE
SOFTWARE (fc2)
Technical Support: http://www.cisco.com/techsupport
Copyright (c) 1986-2019 by Cisco Systems, Inc.
Compiled Thu 22-Aug-19 18:09 by mcpre
Cisco IOS-XE software, Copyright (c) 2005-2019 by cisco Systems, Inc.
All rights reserved.  Certain components of Cisco IOS-XE software are
licensed under the GNU General Public License ("GPL") Version 2.0.  The
software code licensed under GPL Version 2.0 is free software that comes
with ABSOLUTELY NO WARRANTY.  You can redistribute and/or modify such
GPL code under the terms of GPL Version 2.0.  For more details, see the
documentation or "License Notice" file accompanying the IOS-XE software,
or the applicable URL provided on the flyer accompanying the IOS-XE
software.

ROM: IOS-XE ROMMON
Router uptime is 2 hours, 19 minutes
Uptime for this control processor is 2 hours, 22 minutes
System returned to ROM by PowerOn
System image file is "flash:isr4200-universalk9_ias.16.09.04.SPA.bin"
```


CISCO