

Zero Touch Provisioning Implementation and Troubleshooting Tips

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Introduction

This document describes the troubleshooting tips for first-time deployments of Zero Touch Provisioning (ZTP).

ZTP was introduced to reduce human interaction in the provision of XR devices. ZTP uses an implementation of the Preboot eXecution Environment (iPXE).

Background Information

ZTP can perform:

- Auto-Configuration update: Download and apply the XR configuration after image installation
- Script execution: Download and execute the user-defined script files. Various methods/functions can be implemented as a part of script execution: Multiple packages updateSMU installationVerificationseXR decides which of the actions to perform based on the contents of the first line in the file If the file starts with **!! IOS XR** denotes a configuration file and performs apply_config. Similarly, the files that start with **#!/bin/bash** or **#!/bin/sh** or **#!/usr/bin/python** denotes a script file, and perform script execution. Support for python is introduced from eXR 6.2.2eXR iPXE supports Trivial File Transfer Protocol (TFTP), File Transfer Protocol (FTP), and Hypertext Transfer Protocol (HTTP). Hypertext Transfer Protocol Secure (HTTPS) is not supported as it cannot predict which signature to verify.

Linux Server Configuration

iPXE is an enhancement over PXE that requires TFTP/FTP/HTTP for image/configuration download and uses Dynamic Host Configuration Protocol (DHCP) to get/provide information for the image and configuration.

DHCP Configuration

In a later example, there is a review of a packet capture to confirm the DHCP operation.

HTTP Server Requirements

HTTP server must be reachable from the Mgmt Ethernet interface.

Troubleshooting Tips

When the Linux server is set up, Perform DHCP/HTTP server reachability and functionality Check.

In this setup, a single Linux server is used as DHCP/HTTP server. If there are separate servers for these functions, verify these steps on all the servers, if needed.

```
[root@xxxxxxxxxxx]# service dhcpd status
Redirecting to /bin/systemctl status dhcpd.service
dhcpd.service - DHCPv4 Server Daemon
   Loaded: loaded (/usr/lib/systemd/system/dhcpd.service; disabled; vendor preset: disabled)
   Active: active (running) since Mon 2017-05-29 10:30:59 PDT; 15h ago
     Docs: man:dhcpd(8)
           man:dhcpd.conf(5)
  Main PID: 26913 (dhcpd)
   Status: "Dispatching packets..."
  CGroup: /system.slice/dhcpd.service
          26913 /usr/sbin/dhcpd -f -cf /etc/dhcp/dhcpd.conf -user dhcpd -group dhcpd --no-pid
<SNIP>
```

Hint: Some lines were ellipsized, use `-l` to show in full.

```
[root@xxxxxxxxxxx]# service httpd status
Redirecting to /bin/systemctl status httpd.service
httpd.service - The Apache HTTP Server
   Loaded: loaded (/usr/lib/systemd/system/httpd.service; disabled; vendor preset: disabled)
   Active: active (running) since Fri 2017-05-26 05:50:30 PDT; 3 days ago
     Docs: man:httpd(8)
           man:apachectl(8)
  Process: 28088 ExecStop=/bin/kill -WINCH ${MAINPID} (code=exited, status=0/SUCCESS)
  Process: 11036 ExecReload=/usr/sbin/httpd $OPTIONS -k graceful (code=exited, status=0/SUCCESS)
 Main PID: 28095 (httpd)
   Status: "Total requests: 0; Current requests/sec: 0; Current traffic: 0 B/sec"
  CGroup: /system.slice/httpd.service
          11037 /usr/sbin/httpd -DFOREGROUND
          11038 /usr/sbin/httpd -DFOREGROUND
          11039 /usr/sbin/httpd -DFOREGROUND
          11040 /usr/sbin/httpd -DFOREGROUND
          11041 /usr/sbin/httpd -DFOREGROUND
          26998 /usr/sbin/httpd -DFOREGROUND
          27426 /usr/sbin/httpd -DFOREGROUND
          27427 /usr/sbin/httpd -DFOREGROUND
          27428 /usr/sbin/httpd -DFOREGROUND
          27889 /usr/sbin/httpd -DFOREGROUND
```

```
28095 /usr/sbin/httpd -DFOREGROUND
```

```
May 26 05:50:30 xxxxx systemd[1]: Starting The Apache HTTP Server...
May 26 05:50:30 xxxxx systemd[1]: Started The Apache HTTP Server.
May 27 03:16:01 xxxxx systemd[1]: Reloaded The Apache HTTP Server.
May 28 03:37:01 xxxxx systemd[1]: Reloaded The Apache HTTP Server.
```

Enable Router To Get IP Address With DHCP

```
Interface MgmtEth 0/RP0/CPU0/0
Ipv4 address dhcp
Shut/no shut
```

Verify HTTP Server Is Functional

- Test that <http://<ip-servername>> is works.
- Open a browser to the IP address/server name.

If DHCP or HTTP fails to work, there can be firewall issues or reachability problems.

To check the firewall properties on the server perform these commands or add the specific protocols:

Use IP tables command to verify firewall rules:

```
Iptables -L -n
Chain IN_public_allow (1 references)
target      prot opt source                destination          udp dpt:67 ctstate NEW
ACCEPT      udp  --  0.0.0.0/0              0.0.0.0/0           tcp dpt:80 ctstate NEW
ACCEPT      tcp  --  0.0.0.0/0              0.0.0.0/0           tcp dpt:22 ctstate NEW
```

Use this firewall command to list the entries allowed:

```
[root@xxxxxxxxxx ~]# firewall-cmd --list-all
public (active)
  target: default
  icmp-block-inversion: no
  interfaces: enp2s0f0
  sources:
  services: dhcp dhcpv6-client http ssh
  ports:
  protocols:
  masquerade: no
  forward-ports:
  sourceports:
  icmp-blocks:
  rich rules:
```

Use the commands to permanently allow ports:

```
firewall-cmd --permanent --add-service=http
firewall-cmd --permanent --add-service=dhcp
```

Enable Packet capture on DHCP server:

```
tcpdump -i <interface id> port (bootpc & bootps & port http) -s 0(buffer size) -w <dest. File name>
```

```
ex: tcpdump -i enp2s0f0 port 67 or port 68 or port 80 -s 0 -w iPXEmboot.pcap
```

How To Start ZTP?

Manually Initiate ZTP

Use **ZTP initiate** exec CLI command to invoke ZTP. By default, the interface used for ZTP is MGMTEth. To initiate this process on other interfaces use this option:

```
ZTP initiate interface <type> <number> <cr>
```

OR

```
Ztp initiate <cr>
```

Boot The Router With iPXE

1. From Calvados, initiate the reload CLI command:

This command causes a router to reload, which initiates the iPXE boot.

Note: User-class information is interpreted as a **Malformed option** due to a bug in Wireshark.

2. The router initiates DHCP Discover, notice that user-class is populated with iPXE option:

```
43 2017-05-26 04:55:24.207214 172.16.58.212 172.16.58.212 DHCP 342 DHCP Offer - Transaction ID 0xf2e1f250
44 2017-05-26 04:55:24.208101 172.16.58.212 172.16.58.212 DHCP 342 DHCP ACK - Transaction ID 0xf2e1f250
45 2017-05-26 04:56:09.890179 0.0.0.0 255.255.255.255 DHCP 449 DHCP Discover - Transaction ID 0x97c7ee55
```

Instance of User Class: [0]
User Class Length: 105
[Expert Info (Error/Protocol): User Class Information: malformed option]
[User Class Information: malformed option]
[Severity level: Error]
[Group: Protocol]

Option: (55) Parameter Request List
Length: 22
Parameter Request List Item: (1) Subnet Mask
Parameter Request List Item: (3) Router
Parameter Request List Item: (6) Domain Name Server
Parameter Request List Item: (7) Log Server
Parameter Request List Item: (12) Host Name
Parameter Request List Item: (15) Domain Name
Parameter Request List Item: (17) Root Path
Parameter Request List Item: (43) Vendor-Specific Information
Parameter Request List Item: (60) Vendor class identifier
Parameter Request List Item: (66) TFTP Server Name
Parameter Request List Item: (67) Bootfile name
Parameter Request List Item: (119) Domain Search
Parameter Request List Item: (128) DOCSIS full security server IP [TODO]

00e0 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
00f0 00 00 00 00 00 00 00 00 00 00 00 00 00 00
0100 00 00 00 00 00 00 00 00 00 00 00 00 00 00
0110 00 00 00 00 00 00 63 82 53 63 35 01 01 39 02 05c.Sc5..9..
0120 c0 5d 02 00 09 5e 03 01 03 0a 4d 04 69 50 58 45 .]...^..M.iPXE
0130 37 16 01 03 06 07 0c 0f 11 2b 3c 42 43 77 80 81 7.....+<BCw..
0140 82 83 84 85 86 87 af cb af 24 b1 05 01 80 86 15\$.
0150 21 eb 03 01 00 00 17 01 01 24 01 01 13 01 01 2a !.....\$.*
0160 01 01 27 01 01 20 01 01 15 01 01 26 01 01 3d 0b&..=.
0170 46 4f 43 32 30 32 36 52 33 38 5a 3c 30 50 58 45 FOC2026R 38Z<0PXE
0180 43 6c 69 65 6e 74 3a 41 72 63 68 3a 30 30 30 30 Client:A rch:0000
0190 39 3a 55 4e 44 49 3a 30 30 33 30 31 30 3a 50 49 9:UNDI:0 03010:PI
01a0 44 3a 4e 43 53 2d 35 35 30 32 2d 53 45 61 11 00 D:NCS-55 02-SEa..
01b0 00 00 00 00 00 00 00 00 00 00 00 00 00 00
01c0 ff

3. The DHCP Offer from the server includes the boot file name in Option 67:

No.	Time	Source	Destination	Protocol	Length	Info
46	2017-05-26 04:56:09.890388	172.16.58.115	172.16.58.110	DHCP	342	DHCP Offer - Transaction ID 0x97c7ee55
47	2017-05-26 04:56:10.889556	0.0.0.0	255.255.255...	DHCP	449	DHCP Discover - Transaction ID 0x97c7ee55
48	2017-05-26 04:56:10.889765	172.16.58.115	172.16.58.110	DHCP	342	DHCP Offer - Transaction ID 0x97c7ee55

```

Hardware type: Ethernet (0x01)
Hardware address length: 6
Hops: 0
Transaction ID: 0x97c7ee55
Seconds elapsed: 4
  ▶ Bootp flags: 0x0000 (Unicast)
Client IP address: 0.0.0.0
Your (client) IP address: 172.16.58.110
Next server IP address: 0.0.0.0
Relay agent IP address: 0.0.0.0
Client MAC address: Cisco_1c:a5:1a (00:62:ec:1c:a5:1a)
Client hardware address padding: 00000000000000000000
Server host name not given
Boot file name: http://172.16.58.115/images/ncs5500-mini-x.iso-6.1.2
Magic cookie: DHCP
  ▶ Option: (53) DHCP Message Type (Offer)
  ▶ Option: (54) DHCP Server Identifier
  ▶ Option: (51) IP Address Lease Time
  ▶ Option: (1) Subnet Mask
  ▶ Option: (3) Router
  ▶ Option: (6) Domain Name Server
  ▶ Option: (57) TFTP Server Name
    0000 00 62 ec 1c a5 1a cc 46 d6 f8 8f 86 08 00 45 10 .b.....F.....E.
    0010 01 48 00 00 00 00 00 11 6c 93 ac 10 3a 73 ac 10 .H.....l...:S...
    0020 3a 6e 00 43 00 44 01 34 5d 97 02 01 06 00 97 c7 :n.C.D.4 }.....
    0030 ee 55 00 04 00 00 00 00 00 00 ac 10 3a 6e 00 00 .U.....:...n...
    0040 00 00 00 00 00 00 00 62 ec 1c a5 1a 00 00 00 00 .....b.....
    0050 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 .....
    0060 00 00 00 00 00 00 00 00 00 00 00 00 00 00 .....
    0070 00 00 00 00 00 00 00 00 00 00 00 00 00 00 .....
    0080 00 00 00 00 00 00 00 00 00 00 00 00 00 00 .....
    0090 00 00 00 00 00 68 74 74 70 3a 2f 2f 31 37 32 .....ht tp://172
    00a0 2e 31 36 2e 35 38 2e 31 31 35 2f 69 6d 61 67 65 .16.58.1 15/image
    00b0 73 2f 6e 63 73 35 35 30 30 2d 6d 69 6e 69 2d 78 s/ncs550 0-mini-x
    00c0 2e 69 73 6f 2d 36 2e 31 2e 32 00 00 00 00 00 .iso-6.1 .2.....
    00d0 00 00 00 00 00 00 00 00 00 00 00 00 00 00 .....
    00e0 00 00 00 00 00 00 00 00 00 00 00 00 00 00 .....
  
```

DHCP Server -> NCS5K

Server responds with Boot file information

4. The router initiates the image download:

No.	Time	Source	Destination	Protocol	Length	Info
46	2017-05-26 04:56:09.890388	172.16.58.115	172.16.58.110	DHCP	342	DHCP Offer - Transaction ID 0x97c7ee55
47	2017-05-26 04:56:10.889556	0.0.0.0	255.255.255...	DHCP	449	DHCP Discover - Transaction ID 0x97c7ee55
48	2017-05-26 04:56:10.889765	172.16.58.115	172.16.58.110	DHCP	342	DHCP Offer - Transaction ID 0x97c7ee55
49	2017-05-26 04:56:12.888299	0.0.0.0	255.255.255...	DHCP	461	DHCP Request - Transaction ID 0x97c7ee55
50	2017-05-26 04:56:12.888506	172.16.58.115	172.16.58.110	DHCP	342	DHCP ACK - Transaction ID 0x97c7ee55
51	2017-05-26 04:56:25.659940	172.16.58.110	172.16.58.115	TCP	74	36332 → 80 [SYN] Seq=0 Win=65532 Len=0 TSval=36...
52	2017-05-26 04:56:25.660031	172.16.58.115	172.16.58.110	TCP	74	80 → 36332 [SYN, ACK] Seq=0 Ack=1 Win=28960 Len...
53	2017-05-26 04:56:25.660153	172.16.58.110	172.16.58.115	HTTP	168	GET /images/ncs5500-mini-x.iso-6.1.2 HTTP/1.1
54	2017-05-26 04:56:25.660206	172.16.58.115	172.16.58.110	TCP	66	80 → 36332 [ACK] Seq=1 Ack=103 Win=29056 Len=0 ...
55	2017-05-26 04:56:25.661660	172.16.58.115	172.16.58.110	TCP	14546	[TCP segment of a reassembled PDU]
56	2017-05-26 04:56:25.661864	172.16.58.110	172.16.58.115	TCP	66	36332 → 80 [ACK] Seq=103 Ack=4345 Win=262144 Le...
57	2017-05-26 04:56:25.661918	172.16.58.115	172.16.58.110	TCP	8754	[TCP segment of a reassembled PDU]

```

  ▶ Frame 53: 168 bytes on wire (1344 bits), 168 bytes captured (1344 bits)
  ▶ Ethernet II, Src: Cisco_1c:a5:1a (00:62:ec:1c:a5:1a), Dst: Cisco_f8:8f:86 (cc:46:d6:f8:8f:86)
  ▶ Internet Protocol Version 4, Src: 172.16.58.110, Dst: 172.16.58.115
  ▼ Transmission Control Protocol, Src Port: 36332, Dst Port: 80, Seq: 1, Ack: 1, Len: 102
    Source Port: 36332
    Destination Port: 80
    [Stream index: 0]
    [TCP Segment Len: 102]
    Sequence number: 1 (relative sequence number)
    [Next sequence number: 103 (relative sequence number)]
    Acknowledgment number: 1 (relative ack number)
    Header Length: 32 bytes
    Flags: 0x018 (PSH, ACK)
    0000 cc 46 d6 f8 8f 86 00 62 ec 1c a5 1a 08 00 45 00 .F.....b.....E.
    0010 00 9a 09 b3 00 00 40 06 a3 a9 ac 10 3a 6e ac 10 .....@.....:n...
    0020 3a 73 8d ec 00 50 30 83 ab 5e 7a d3 a4 16 80 18 :s...P0. ^z.....
    0030 02 00 25 b4 00 00 01 01 08 0a 02 25 c3 af 94 c7 ..%.....%.....
    0040 56 00 47 45 54 20 2f 69 6d 61 67 65 73 2f 6e 63 V.GET /i mages/nc
    0050 73 35 35 30 30 2d 6d 69 6e 69 2d 78 2e 69 73 6f s5500-mi ni-x.iso
    0060 2d 36 2e 31 2e 32 20 48 54 54 50 2f 31 2e 31 0d -6.1.2 H TTP/1.1
    0070 0a 55 73 65 72 2d 41 67 65 6e 74 3a 20 69 50 58 .User-Ag ent: iPX
    0080 45 2f 31 2e 30 2e 30 2b 20 28 65 32 39 31 29 0d E/1.0.0+ (e291).
    0090 0a 48 6f 73 74 3a 20 31 37 32 2e 31 36 2e 35 38 .Host: 1 72.16.58
    00a0 2e 31 31 35 0d 0a 0d 0a .115....
  
```

NCS5K initiates download of ISO image

5. Once the image is successfully downloaded, the installation of the images on the device begins.

6. Once the router successfully boots with the downloaded image, it initiates another DHCP request:

No.	Time	Source	Destination	Protocol	Length	Info
418654	2017-05-26 05:04:12.051436	172.16.58.115	172.16.58.212	DHCP	342	DHCP Offer - Transaction ID 0xd...
418655	2017-05-26 05:04:12.052378	172.16.58.115	172.16.58.212	DHCP	342	DHCP ACK - Transaction ID 0xd...
418656	2017-05-26 05:06:52.778102	0.0.0.0	255.255.255...	DHCP	367	DHCP Discover - Transaction ID 0x5...
418657	2017-05-26 05:06:52.778327	172.16.58.115	172.16.58.110	DHCP	342	DHCP Offer - Transaction ID 0x5...
418658	2017-05-26 05:06:52.778626	0.0.0.0	255.255.255...	DHCP	379	DHCP Request - Transaction ID 0x5...

```

Your (client) IP address: 0.0.0.0
Next server IP address: 0.0.0.0
Relay agent IP address: 0.0.0.0
Client MAC address: Cisco1c:a5:1a (00:62:ec:1c:a5:1a)
Client hardware address padding: 000000000000000000
Server host name not given
Boot file name not given
Magic cookie: DHCP
  > Option: (53) DHCP Message Type (Discover)
  > Option: (55) Parameter Request List
  > Option: (60) Vendor class identifier
      Length: 45
      Vendor class identifier: PXEClient:Arch:00009:UNDI:003010:PID:NCS-5500
  > Option: (61) Client identifier
  > Option: (77) User Class Information
      Length: 10
      > Instance of User Class: [0]
  > Option: (255) End
      Option End: 255
0080 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 .....
0090 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 .....
00a0 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 .....
00b0 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 .....
00c0 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 .....
00d0 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 .....
00e0 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 .....
00f0 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 .....
0100 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 .....
0110 00 00 00 00 00 00 63 82 53 63 35 01 01 37 07 01 .....C. Sc5..7..
0120 1c 02 03 0f 06 0c 3c 2d 50 58 45 43 6c 69 65 6e .....<- PXEClie
0130 74 3a 41 72 63 68 3a 30 30 30 30 39 3a 55 4e 44 t:Arch:0 0009:UND
0140 49 3a 30 30 33 30 31 30 3a 50 49 44 3a 4e 43 53 I:003010 :PID:NCS
0150 2d 35 35 30 30 3d 0b 46 4f 43 32 30 32 36 52 33 -5500=F OC2026R3
0160 38 5a 4d 0a 65 78 72 2d 63 6f 6e 66 69 67 ff 82M.exr- config.
  
```

In this Discover, notice that user-class info includes ***.exr-config**. Since the DHCP is configured to either return **Config file** or **Script** (ie. Else statement in `etc/dhcp/dhcpd.conf`).

7. DHCP server returns the required file information in option 67:

Apply a display filter ... <36/>

No.	Time	Source	Destination	Protocol	Length	Info
418654	2017-05-26 05:04:12.051436	172.16.58.115	172.16.58.212	DHCP	342	DHCP Offer - Transaction ID 0xd...
418655	2017-05-26 05:04:12.052378	172.16.58.115	172.16.58.212	DHCP	342	DHCP ACK - Transaction ID 0xd...
418656	2017-05-26 05:06:52.778102	0.0.0.0	255.255.255...	DHCP	367	DHCP Discover - Transaction ID 0x5...
418657	2017-05-26 05:06:52.778327	172.16.58.115	172.16.58.110	DHCP	342	DHCP Offer - Transaction ID 0x5...
418658	2017-05-26 05:06:52.778626	0.0.0.0	255.255.255...	DHCP	379	DHCP Request - Transaction ID 0x5...

Seconds elapsed: 36

- Bootp flags: 0x0000 (Unicast)
- Client IP address: 0.0.0.0
- Your (client) IP address: 172.16.58.110
- Next server IP address: 0.0.0.0
- Relay agent IP address: 0.0.0.0
- Client MAC address: Cisco_1c:a5:1a (00:62:ec:1c:a5:1a)
- Client hardware address padding: 000000000000000000
- Server host name not given
- Boot file name: http://172.16.58.115/images/NCS-5502-A.cfg
- Magic cookie: DHCP

Option: (53) DHCP Message Type (Offer)

- Length: 1
- DHCP: Offer (2)

Option: (54) DHCP Server Identifier

- Length: 4
- DHCP Server Identifier: 172.16.58.115

Option: (51) IP Address Lease Time

- Length: 4
- IP Address Lease Time: (500s) 10 minutes

```

0070 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 .....
0080 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 .....
0090 00 00 00 00 00 00 68 74 74 70 3a 2f 2f 31 37 32 .....ht tp://172
00a0 2e 31 36 2e 35 38 2e 31 31 35 2f 69 6d 61 67 65 ..16.58.115/image
00b0 73 2f 4e 43 53 2d 35 35 30 32 2d 41 2e 63 66 67 s/NCS-5502-A.cfg
00c0 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 .....
00d0 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 .....
00e0 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 .....
00f0 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 .....
0100 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 .....
0110 00 00 00 00 00 63 82 53 63 35 01 02 36 04 ac .....C. Sc5..6..
0120 10 3a 73 33 04 00 00 02 58 01 04 ff ff ff 00 1c ..s3...X.....
0130 04 ac 10 3a ff 03 04 ac 10 3a 01 0f 09 63 69 73 .....:..cis
0140 63 6f 2e 63 6f 6d 06 04 ab 46 a8 b7 ff 00 00 00 co.com..F.....
0150 00 00 00 00 00 00

```

Server responds with config info

DHCP Server -> NCS5K

8. The router downloads the config:

Apply a display filter ... <36/>

No.	Time	Source	Destination	Protocol	Length	Info
418660	2017-05-26 05:06:56.981542	172.16.58.110	172.16.58.115	TCP	74	36775 → 80 [SYN] Seq=0 Win=42746 L...
418661	2017-05-26 05:06:56.981642	172.16.58.115	172.16.58.110	TCP	74	80 → 36775 [SYN, ACK] Seq=0 Ack=1 ...
418662	2017-05-26 05:06:56.981779	172.16.58.110	172.16.58.115	TCP	66	36775 → 80 [ACK] Seq=1 Ack=1 Win=4...
418663	2017-05-26 05:06:56.981852	172.16.58.110	172.16.58.115	HTTP	268	HEAD /images/NCS-5502-A.cfg HTTP/1...
418664	2017-05-26 05:06:56.981900	172.16.58.115	172.16.58.110	TCP	66	80 → 36775 [ACK] Seq=1 Ack=203 Win...

[Stream index: 1]

[TCP Segment Len: 202]

Sequence number: 1 (relative sequence number)

[Next sequence number: 203 (relative sequence number)]

Acknowledgment number: 1 (relative ack number)

Header Length: 32 bytes

- Flags: 0x018 (PSH, ACK)
- Window size value: 21
- [Calculated window size: 43008]
- [Window size scaling factor: 2048]
- Checksum: 0x0502 [unverified]
- [Checksum Status: Unverified]
- Urgent pointer: 0

Options: (12 bytes), No-Operation (NOP), No-Operation (NOP), Timestamps

- No-Operation (NOP)
- No-Operation (NOP)
- Timestamps: TSval 4294963862, TSecr 2496722970

[SEQ/ACK analysis]

Hypertext Transfer Protocol

```

0020 3a 73 8f a7 00 50 a9 0f 07 af 8d 06 14 b1 80 18 :S...P...
0030 00 15 05 02 00 00 01 01 08 0a ff ff f2 96 94 d0 .....
0040 f8 1a 48 45 41 44 20 2f 69 6d 61 67 65 73 2f 4e ..HEAD / images/N
0050 43 53 2d 35 35 30 32 2d 41 2e 63 66 67 20 48 54 CS-5502- A.cfg HT
0060 54 50 2f 31 2e 31 0d 0a 55 73 65 72 2d 41 67 65 TP/1.1.. User-Age
0070 6e 74 3a 20 63 75 72 6c 2f 37 2e 33 37 2e 31 0d nt: curl /7.37.1.
0080 0a 48 6f 73 74 3a 20 31 37 32 2e 31 36 2e 35 38 .Host: 172.16.58
0090 2e 31 31 35 0d 0a 41 63 63 65 70 74 3a 20 2a 2f .115..Ac cept: */
00a0 2a 0d 0a 58 2d 63 69 73 63 6f 2d 61 72 63 68 3a *.X-cis co-arch:
00b0 78 38 36 5f 36 34 0d 0a 58 2d 63 69 73 63 6f 2d x86_64.. X-cisco-
00c0 6f 70 65 72 3a 65 78 72 2d 63 6f 6e 66 69 67 0d oper:exr -config.
00d0 0a 58 2d 63 69 73 63 6f 2d 70 6c 61 74 66 6f 72 .X-cisco -platfor
00e0 6d 3a 46 72 65 74 74 61 0d 0a 20 58 2d 63 69 73 m:Fretta .. X-cis
00f0 63 6f 2d 73 65 72 69 61 6c 3a 22 46 4f 43 32 30 co-seria l:"FOC20
0100 32 36 52 33 38 5a 22 20 0d 0a 0d 0a 26R38Z" ....

```

NCS5K initiates config download using HTTP

The script can be included as a response from the DHCP server and have them copy the image/configuration. This can also be used as a post-install script like in the below example.

Post-Install Automation

Various automation can be performed post-installation on the eXR software.

In this example, this script installs all required packages and applies the Config. This is a slightly modified version of **ztp_helper.sh**. This script is invoked from xr-linux-shell:

```
RP/0/RP0/CPU0:NCS-5502-A#more disk0:/ztp/ztp_helper_file.sh
Wed May 31 00:55:54.529 UTC
#!/bin/bash
#####
# Install config and additional packages
#####

source /disk0:/ztp/ztp_helper.sh

export HTTP_SERVER=http://10.10.10.10
export RPM_PATH=images
export CONFIG_PATH=images
#Config
export INITIAL_CONFIG=NCS-5502-A.cfg
export FINAL_CONFIG=NCS-5502-A.cfg

#Packages
K9SEC_RPM=ncs5500-k9sec-2.2.0.0-r612.x86_64.rpm
MCAST_RPM=ncs5500-mcast-2.0.0.0-r612.x86_64.rpm
ISIS_RPM=ncs5500-isis-1.1.0.0-r612.x86_64.rpm
OSPF_RPM=ncs5500-ospf-1.1.0.0-r612.x86_64.rpm
MGBL_RPM=ncs5500-mgbl-3.0.0.0-r612.x86_64.rpm
MPLS_RPM=ncs5500-mpls-2.1.0.0-r612.x86_64.rpm
MPLSTE_RPM=ncs5500-mpls-te-rsvp-2.2.0.0-r612.x86_64.rpm

function download_config(){
    ip netns exec tpnns /usr/bin/wget ${HTTP_SERVER}/${CONFIG_PATH}/${FINAL_CONFIG} -O
/harddisk:/new-config 2>&1
    if [[ "$?" != 0 ]]; then
        printf "### Error downloading system configuration ###"
    else
        printf "### Downloading system configuration complete ###";
    fi
}

function apply_config(){
    # Applies initial configuration
    printf "### Applying initial system configuration ###";
    xrapply_with_reason "Initial ZTP configuration" /harddisk:/new-config 2>&1;
    printf "### Checking for errors ###";
    local config_status=$(xrcmd "show configuration failed");
    if [[ $config_status ]]; then
        echo $config_status
        printf "!!! Error encounter applying configuration file, review the log !!!!";
    fi
    printf "### Applying system configuration complete ###";
}

function install_pkg(){
    #Download packages
    printf "Downloading Packages"
    ip netns exec tpnns /usr/bin/wget ${HTTP_SERVER}/${RPM_PATH}/${K9SEC_RPM} -O
/harddisk:/${K9SEC_RPM} 2>&1
```



```

        if [[ "$?" != 0 ]]; then
            printf "### Error downloading $K9SEC_RPM ###"
        else
            printf "### Downloading $K9SEC_PKG complete ###";
        fi

    printf "Downloading Packages"
    ip netns exec tpnns /usr/bin/wget ${HTTP_SERVER}/${RPM_PATH}/${MCAST_RPM} -O
/harddisk:/$MCAST_RPM 2>&1
    if [[ "$?" != 0 ]]; then
        printf "### Error downloading $MCAST_RPM ###"
    else
        printf "### Downloading $MCAST_RPM complete ###";
    fi

    printf "Downloading Packages"
    ip netns exec tpnns /usr/bin/wget ${HTTP_SERVER}/${RPM_PATH}/${ISIS_RPM} -O
/harddisk:/$ISIS_RPM 2>&1
    if [[ "$?" != 0 ]]; then
        printf "### Error downloading $ISIS_RPM ###"
    else
        printf "### Downloading $ISIS_RPM complete ###";
    fi

    printf "Downloading Packages"
    ip netns exec tpnns /usr/bin/wget ${HTTP_SERVER}/${RPM_PATH}/${OSPF_RPM} -O
/harddisk:/$OSPF_RPM 2>&1
    if [[ "$?" != 0 ]]; then
        printf "### Error downloading $OSPF_RPM ###"
    else
        printf "### Downloading $OSPF_RPM complete ###";
    fi

    printf "Downloading Packages"
    ip netns exec tpnns /usr/bin/wget ${HTTP_SERVER}/${RPM_PATH}/${MGBL_RPM} -O
/harddisk:/$MGBL_RPM 2>&1
    if [[ "$?" != 0 ]]; then
        printf "### Error downloading $MGBL_RPM ###"
    else
        printf "### Downloading $MGBL_RPM complete ###";
    fi

    printf "Downloading Packages"
    ip netns exec tpnns /usr/bin/wget ${HTTP_SERVER}/${RPM_PATH}/${MPLS_RPM} -O
/harddisk:/$MPLS_RPM 2>&1
    if [[ "$?" != 0 ]]; then
        printf "### Error downloading $MPLS_RPM ###"
    else
        printf "### Downloading $MPLS_RPM complete ###";
    fi

    printf "Downloading Packages"
    ip netns exec tpnns /usr/bin/wget ${HTTP_SERVER}/${RPM_PATH}/${MPLSTE_RPM} -O
/harddisk:/$MPLSTE_RPM 2>&1
    if [[ "$?" != 0 ]]; then
        printf "### Error downloading $MPLSTE_RPM ###"
    else
        printf "### Downloading $MPLSTE_RPM complete ###";
    fi

    xrcmd "install update source /harddisk:/ $K9SEC_RPM $MCAST_RPM $ISIS_RPM $OSPF_RPM $MGBL_RPM
$MPLS_RPM $MPLSTE_RPM" 2>&1
    local complete=0
    while [ "$complete" = 0 ]; do
        complete=`xrcmd "show install active" | grep k9sec | head -n1 | wc -l`
        printf "Waiting for k9sec package to be activated"
    done

```

```
    sleep 5
done
rm -f /harddisk:/$K9SEC_RPM /harddisk:/$MCAST_RPM /harddisk:/$MCAST_RPM /harddisk:/$ISIS_RPM
/harddisk:/$OSPF_RPM /harddisk:/$MGBL_RPM /harddisk:/$MPLSTE_RPM /harddisk:/$MPLS_RPM
printf "### XR PACKAGE INSTALL COMPLETE ###"
}

printf "Start Auto provision"
install_pkg;
download_config;
apply_config;
```

Related Information

- <https://xrdocs.github.io/software-management/tutorials/2016-08-26-working-with-ztp/>
- <https://xrdocs.github.io/software-management/tutorials/2016-07-27-ipxe-deep-dive/>
- <https://xrdocs.github.io/software-management/blogs/2016-10-14-ios-xr-packages-and-security/>