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Pica8 Deployment Guide – AmpCon ZTP

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# **Pica8 Zero Touch Provisioning for Bare Metal Switches in Remote Branches**



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# Pica8 Zero Touch Provisioning for Bare Metal Switches in Remote Branches

This document gives an overview of Zero Touch Provisioning (ZTP), how to setup [Pica8's AmpCon Network Controller](#) for ZTP and Pica8's ZTP process sequence for a group of bare metal switches in remote branches.

## Push-Button ZTP Overview

### Business Problems Associated with Deploying New Switches in Remote Branches

The idea of zero touch provisioning (ZTP) systems in the networking world exists to address the following business problems:

- 1. Scalability:** Provision large numbers of switches in remote branches, distributed sites and enterprise campus networks
- 2. Consistency:** Ensure deployment consistency across switches and locations
- 3. Time and effort requirements:** Building and refreshing networks across the campus and distributed sites requires considerable time for mundane switch management tasks
- 4. Shortage of IT resources:** A common mantra for enterprise network operators is to "do more with less"

### AmpCon Push-Button ZTP Benefits

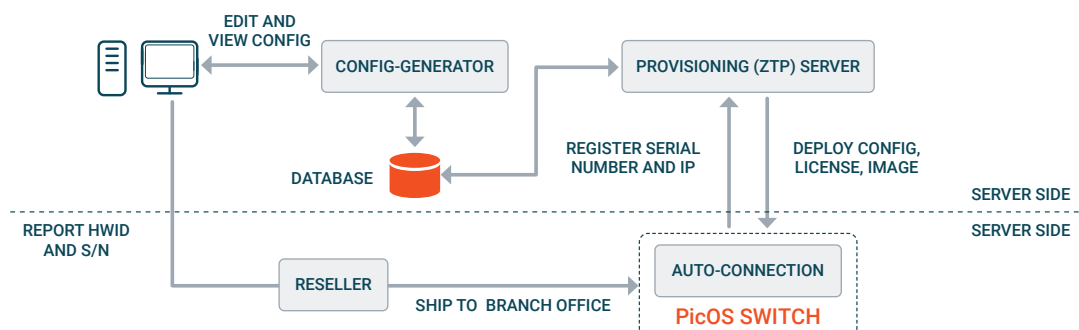
Pica8's AmpCon Network Controller is the Command Center for your enterprise network. AmpCon ZTP allows automatic provisioning of bare metal switches at remote branches without any manual intervention. You ship bare metal switches to the remote location and your IT teams only need to perform simple tasks like connecting the power and network cables to the switch.

Following are AmpCon ZTP benefits:

- **Remote secure provisioning:** Communication between the AmpCon server and remote location switches are encrypted. Secured remote provisioning is not offered by other vendor solutions.
- **Full configuration:** Switch is configured fully as part of ZTP. There is no need for iterative configuration push.
- **IT expertise not needed:** AmpCon automates the setup of network switches. Hence IT experts are not needed in the remote branch.
- **Reduce configuration errors:** Switch provisioning is automated via AmpCon in a consistent manner to reduce the chance of human errors.
- **Time savings:** AmpCon ZTP reduces remote switch provisioning time from 5 to 1.5 days for a block of 100 switches. 1.5 days to provision 100 switches is spent mostly on unboxing, racking and stacking the switches in their remote locations.

### Overview of AmpCon Push-button ZTP for Bare Metal Switches

Switch Serial Numbers are added in AmpCon Database to prepare for provisioning. When the bare metal switch is powered up, it registers its Serial Number and Management IP with the AmpCon server as shown below.



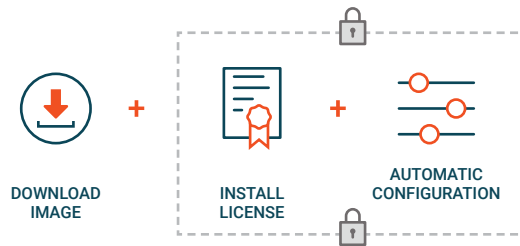
The switch Serial Number corresponds to the following items in the AmpCon server:

- hardware platform
- specific PicOS image
- switch specific license
- switch configuration

We will see the specifics of how a switch Serial Number is tied to the above items in AmpCon later in this blog.

As part of ZTP, the following are done:

1. Image is downloaded to the bare metal switch and the bare metal switch is booted with PicOS
2. AmpCon Agent running in the switch downloads and provisions the following as part of ZTP over VPN
  - a. License
  - b. Full configuration of the switch

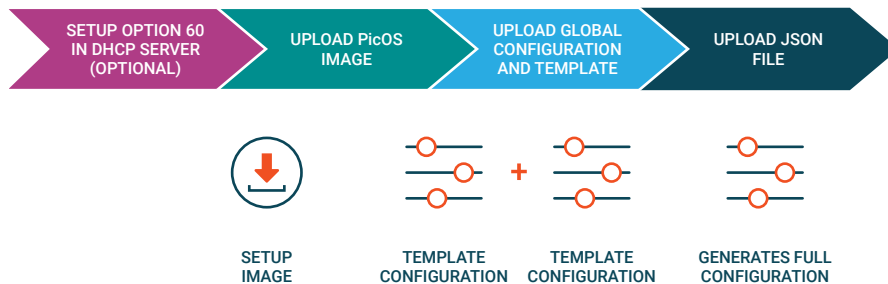


## Setup DHCP and AmpCon Server for ZTP for a Group of Bare Metal Switches

### How to Setup Staging a Group of Remote Switches in DHCP and AmpCon Server for ZTP Workflow?

We first need to setup staging a group of remote switches in AmpCon before we power-up those bare metal switches in a remote location for ZTP.

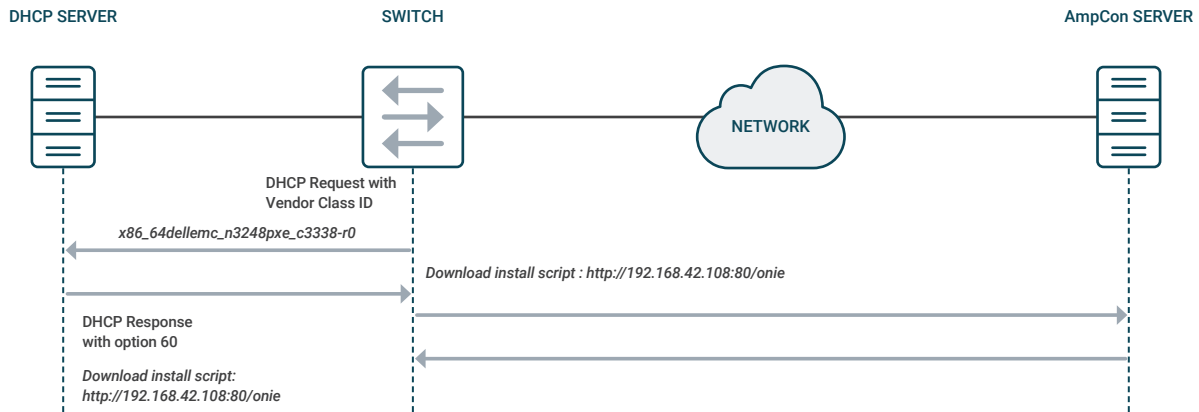
Here is the setup operation in the DHCP server and AmpCon for staging a group of remote switches:



#### STAGING GROUP OF SWITCHES FOR AUTOMATED DEPLOYMENT

1. DHCP server configuration: Configure DHCP server with the Vendor Class Identifier (Option 60). During the DHCP request process, the bare metal switch with ONIE will send the Vendor Class Identifier (hardware Platform name) to the DHCP server. In this example, the switch sends its platform name x86\_64dellemc\_n3248pxe\_c3338-r0 to the DHCP server. Based on the DHCP configuration, the DHCP server will provide a download URL for the PicOS image install script. In this example

the DHCP server sends the image install script URL <http://192.168.42.108:80/onie>. The switch will then use this URL to download the image install script from the AmpCon Server and then execute the downloaded script to download the specific PicOS image from the AmpCon Server.



For more details on configuring the DHCP Option 60, please refer to [DHCP Option 60](#).

## 2. Setup operation for staging a group of remote switches for ZTP in AmpCon

- a. **Configure License Portal info** – URL, User ID and Password. For more details please refer to [Setup System Configuration Parameters in AmpCon](#). The AmpCon Agent running in the PicOS switch uses this License Portal access info to get the license using REST APIs and then installs the license on the switch.
- b. **Upload and setup the PicOS image for a specific switch model** - For more details refer to [Setup PicOS image for specific switch model](#). The switch Serial Number is tied to the specific switch hardware model. For more details on how the switch model is tied to the specific switch Serial Number, please refer to section 2e below. AmpCon has info on the switch Serial Number, and it uses it to identify the corresponding switch model. AmpCon uses the switch model to select the PicOS image and downloads this image to the bare metal switch when the bare metal switch registers its Serial Number with the AmpCon Server.
- c. **Upload Global and Security configurations** - You need to upload two files containing the set of CLI commands that are common between all switches you are planning to deploy. For more details refer to [Setting up Global and Security Configurations](#). The switch Serial Number is tied to a specific Global configuration file. For more details on how the switch serial number is tied to specific a Global configuration file, please refer to section 2e below. AmpCon provisions the switch with the contents of the Global configuration file tied to the Serial Number of the switch.
- d. **Upload model-specific switch template** - Example template files are provided by Pica8. Template files are easy to use and easy to modify to customize your configuration. Templates generate two kinds of configurations: (1) switch specific configurations like Hostname and (2) interface specific configuration. It is easy to generate the interface specific configuration using templates. For more details refer to [How to upload a Switch Model Specific Template in AmpCon](#). The switch Serial Number is tied to a configuration generated by a specific Template file. For more details on how the switch Serial Number is tied to a configuration generated by a specific Template file, please refer to section 2e below. AmpCon provisions the configuration generated by a specific Template file tied to the Serial Number of the switch.
- e. **Upload JSON file** - JSON file adds Serial Numbers of a group of bare metal switches to the AmpCon database.

The switch Serial Number corresponds to the following items in the AmpCon server:

- specific hardware platform
- specific PicOS image
- switch specific license
- switch configuration

Here is an example JSON file. This file stages two switches in AmpCon with Serial Numbers: [TW000WH7DNT000490090](#)

and **PICA8\_TEST**.

```
{
  "sn": [ "TW000WH7DNT000490090", "PICA8_TEST" ],
  "hardware_model": "N3248PXE-ON",
  "location": "Palo Alto",
  "global_config_name": "2020-11-24-glob-N3248PXE-ON-V1",
  "site_template_name": "N3248PXE-ON-Nov20",
  "agent_config": {
  },
  "default_config_param": {
    "Default_gateway": "192.168.42.1",
    "Data_VLAN_id": "10",
    "Voice_VLAN_id": "800"
  },
  "unique_config_param": {
    "TW000WH7DNT000490090": {
      "Hostname": "P8-Access-BR-1-SW-1",
      "Management_IP_Address_Mask": "192.168.42.169/24",
      "Data_VLAN_IP_Address_Mask": "192.168.43.169/24"
    },
    "PICA8_TEST": {
      "Hostname": "P8-Access-BR-1-SW-2",
      "Management_IP_Address_Mask": "192.168.42.170/24",
      "Data_VLAN_IP_Address_Mask": "192.168.43.170/24"
    }
  }
}
```

When you upload the above JSON file to AmpCon, the switch Serial Numbers listed in green are automatically added to the AmpCon database. AmpCon stages the above two switches with Serial Numbers: **TW000WH7DNT000490090** and **PICA8\_TEST**. These two switches are now ready for ZTP. Log into the AmpCon UI and select the Deployment->Switch List menu to check whether these two switches are staged for ZTP. You will see two switches with the above Serial Numbers already staged. If these two switches are powered up and connected to the network cable in the remote location, these two switches will be provisioned via AmpCon's ZTP mechanism.

Switch Name	Serial Number	Hardware Model	IP Address	Status	Management IP	Actions
P8-ACCESS-BR-1-SW-2	TW000WH7DNT000490090	N3248P-ON	4.1.2.2/53781C75FE	IMPORTED	10.8.0.26	Display, Clone, Log, Remove, Address
EVPN-ACC4	EC1815000432	AS4610_30P	4.1.3/AAD3336D85	SUCCESS	10.8.0.54	Display, Clone, Log, Address, SSH
EVPN-ACC3	463054PE2138020	AS4630-54PE	4.1.3/AAD3336D85	SUCCESS	10.8.0.42	Display, Clone, Log, Address, SSH
EVPN-ACC2	TW0PDDVDGNT000660004	N3224P-ON	4.1.3/AAD3336D85	IMPORTED	10.8.0.30	Display, Clone, Log, Remove, Address
EVPN-ACC1	TW0F94Y7DNT0006J0003	N3224F-ON	4.1.3/AAD3336D85	SUCCESS	10.8.0.58	Display, Clone, Log, Address, SSH
DATAROOM-SW1	TW026NOK282987C10014	S4128T-ON	4.1.2.2/BE9F68BB2	IMPORTED	10.8.0.50	Display, Clone, Log, Remove, Address
UNDEFINED	TW000WH7DNT000490090	N3248PXE-ON		STAGED	UNDEFINED	Display, Clone, Log, Un-Stage, Remove
UNDEFINED	PICA8_TEST	N3248PXE-ON		STAGED	UNDEFINED	Display, Clone, Log, Un-Stage, Remove

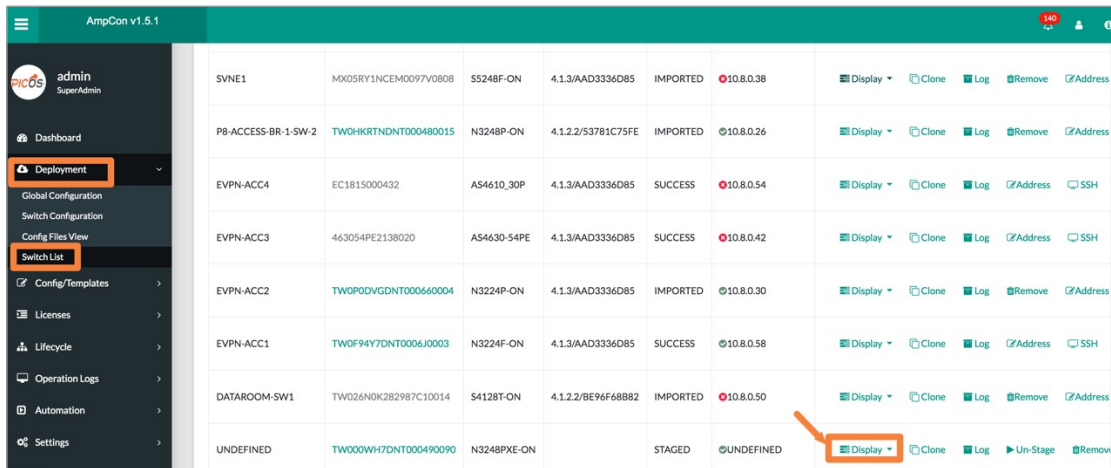
For the above two switches:

- a. AmpCon knows the corresponding hardware model (marked in blue color in the JSON file) so that it downloads the corresponding PicOS image during ZTP.
- b. AmpCon generates the switch specific configuration from the Global Configuration file and Template files (marked in blue along with the switch specific configuration parameters marked in purple in the JSON file) and provisions the generated configuration during ZTP.

For more details please refer to [Building Configuration Automatically for a Group of Switches](#).

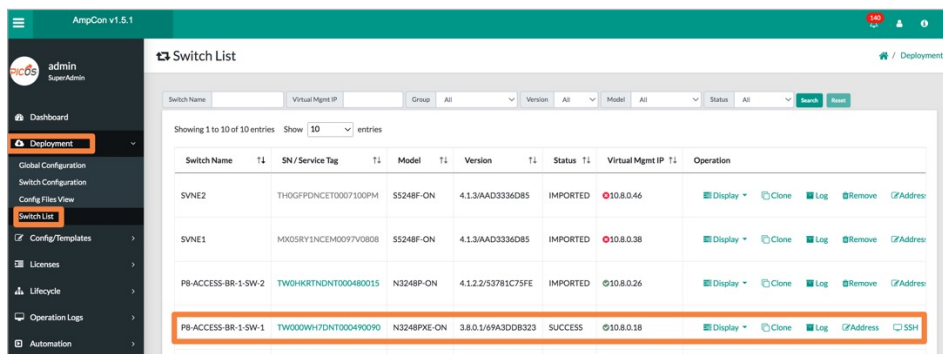
- f. **Verify the generated switch config** – Do this manually one time for each switch hardware model. It is possible there may be errors in CLIs listed in the global configuration file or Template file. In order to verify there are no configuration errors in the configuration commands generated by AmpCon do the following:

From the AmpCon UI, select Deployment->Switch List, select one of the staged switches (Example: Switch with Serial Number **TW000WH7DNT000490090**), select Display->Init Deploy Config menu, copy the generated configuration lines and paste it to a PicOS-V switch or another PicOS switch with same hardware model (N3248PXE-ON) and validate the configuration syntax.



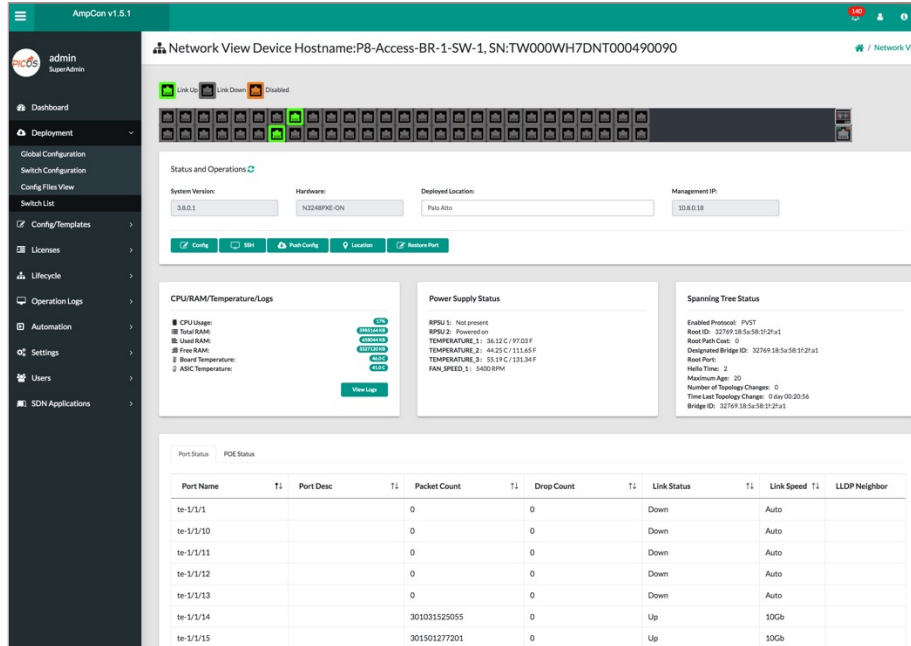
- g. Verify whether the bare metal switch is successfully deployed by ZTP mechanism using AmpCon UI

To check whether the bare metal switch is successfully deployed by the AmpCon ZTP mechanism, log into the AmpCon UI and do the following: Select Deployment-Switch List menu. Check the deployment Status for the switch with Serial Number **TW000WH7DNT000490090** and it is displayed as SUCCESS as shown below.



In the above Switch List click the Serial Number of a specific switch (for example: **TW000WH7DNT000490090**) to view the

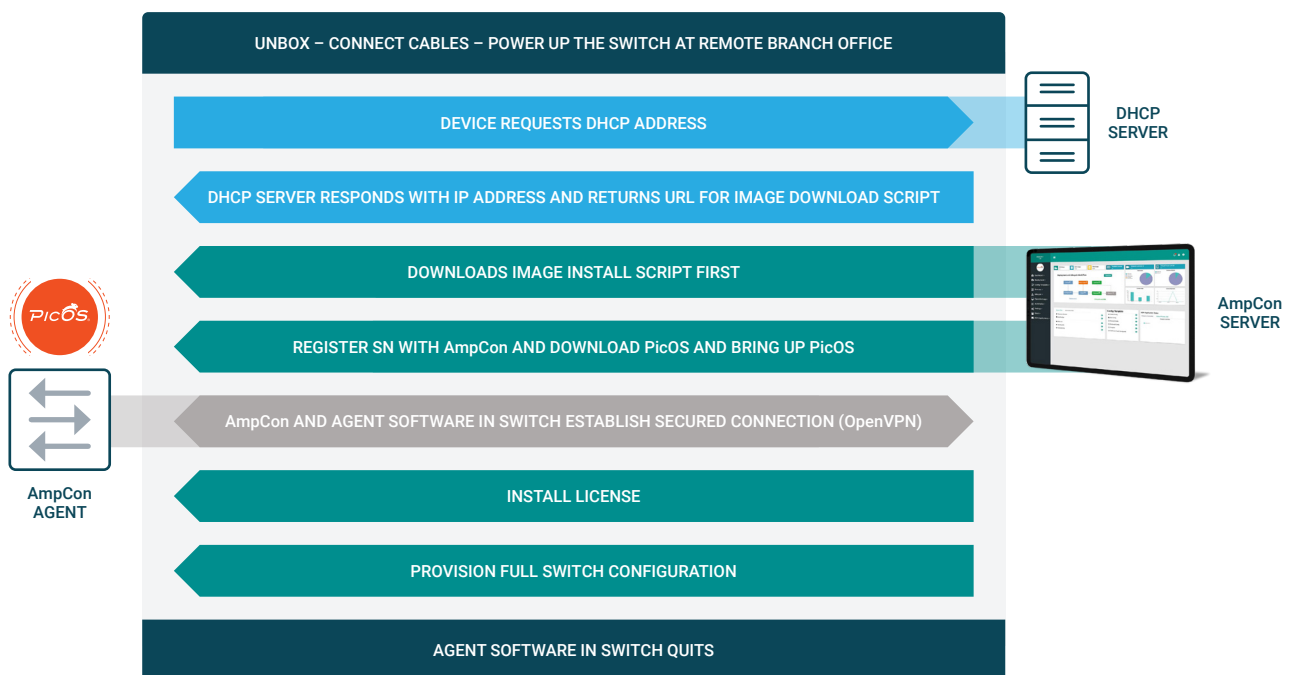
high-level health status of the switch, link status of switch ports and snapshot of port traffic statistics at that specific time as shown below.



## ZTP Process Sequence on Bare Metal Switches

### ZTP Process on Bare Metal Switches

When a switch is connected to the network and powered up in a remote location, the ZTP process on the switch downloads the PicOS image, license and full configuration. The following figure shows the ZTP process on the bare metal switch.





Version 2.19.1266. Copyright (C) 2019 American Megatrends, Inc.  
 BIOS Date: 10/17/2019 02:10:40 Ver: 0ACHI040  
 Press <DEL> or <F2> to enter setup.Welcome to GRUB!

### GNU GRUB version 2.02

```

+-----+
| *ONIE:  Install 05
|   ONIE:  Resuce
|   ONIE:  Uninstall OS
|   ONIE:  Update ONIE
|   ONIE:  Embed ONIE
|   EDA-DIAG
+-----+
    
```

Use the ^ and v keys to select which entry is highlighted.  
 Press enter to boot the selected OS, `e` to edit the commands  
 before booting or `c` for a command-line.  
 The highlighted entry will be executed automatically in 0s.  
 Booting `ONIE: Install OS`

```

ONIE: OS Install Mode ...
Platform  : x86_64-dellemc_n2200_n3200_c3338-r0
Version   : 3.45.1.9-4
Build Date: 2019-06-19T19:10-07:00
Info: Mounting kernel filesystems... done.
Info: Mounting ONIE-BOOT on /mnt/onie-boot ...
ERROR: fsck corrected errors.
Info: Mounting EFI System on /boot/efi ...
Info: BIOS mode: UEFI

Info: Making NOS install boot mode persistent.
Info: Using eth0 MAC address: 18:5a:58:1f:2f:a0
Info: eth0: Checking link... up.
Info: Trying DHCPv4 on interface: eth0
ONIE: Using DHCPv4 addr: eth0: 192.168.42.27 / 255.255.255.0
Starting: klogd... done.
Starting: dropbear ssh daemon... done.
Starting: telnetd... done.
discover: installer mode detected. Running installer.
Starting: discover... done.

Please press Enter to activate this console. Info: eth0: Checking link... up.
Info: Trying DHCPv4 on interface: eth0
ONIE: Using DHCPv4 addr: eth0: 192.168.42.27 / 255.255.255.0
ONIE: Starting ONIE Service Discovery
FAT-fs (mmcblk0p1): Volume was not properly unmounted. Some data may be corrupt. Please run
fsck.
Info: Attempting file://dev/mmcblk0p1/onie-installer-x86_64-dellemc_n3248pxe_c3338-r0 ...
Info: Attempting file://dev/mmcblk0p1/onie-installer-x86_64-dellemc_n3248pxe_c3338-r0.bin ...
Info: Attempting file://dev/mmcblk0p1/onie-installer-x86_64-dellemc_n3248pxe_c3338 ...
    
```

```

Info: Attempting file://dev/mmcbk0p1/onie-installer-x86_64-dellemc_n3248pxe_c3338.bin ...
Info: Attempting file://dev/mmcbk0p1/onie-installer-dellemc_n3248pxe_c3338 ...
Info: Attempting file://dev/mmcbk0p1/onie-installer-dellemc_n3248pxe_c3338.bin ...
Info: Attempting file://dev/mmcbk0p1/onie-installer-x86_64-bcm ...
Info: Attempting file://dev/mmcbk0p1/onie-installer-x86_64-bcm.bin ...
Info: Attempting file://dev/mmcbk0p1/onie-installer-x86_64 ...
Info: Attempting file://dev/mmcbk0p1/onie-installer-x86_64.bin ...
Info: Attempting file://dev/mmcbk0p1/onie-installer ...
Info: Attempting file://dev/mmcbk0p1/onie-installer.bin ...
Info: Attempting http://192.168.42.108:80/onie ...
ONIE: Executing installer: http://192.168.42.108:80/onie
Connecting to 192.168.42.108:80 (192.168.42.108:80)
picos.bin          52% |*****| 111M 0:00:00 ETA
picos.bin          100% |*****| 213M 0:00:00 ETA

Connecting to 192.168.42.108:80 (192.168.42.108:80)
auto-deploy.conf  100% |*****| 378  0:00:00 ETA

Connecting to 192.168.42.108:80 (192.168.42.108:80)
picos_patch.sh    100% |*****| 202  0:00:00 ETA

discover: installer mode detected.
Stopping: discover... done.
ONIE: Executing installer: picos.bin
Verifying image checksum ... OK.
Preparing image archive ... OK.
  [1] PICOS L2/L3 (default)
  [2] PICOS Open vSwitch/OpenFlow
1
PICOS L2/L3 is selected.
<output suppressed>

BIOS initializations...

CPGC Memtest Channel 0 ..... PASS

POST:
  RTC Battery OK at last cold boot
  RTC date 2/10/2022 3:03:57

POST SPD test ..... PASS

POST Lower DRAM Memory test .....
POST ECC Test ..... PASS

.... Perf cnt (curr, fixed): 0x17A82C4F8, 0x2C5B531BA

POST Lower DRAM Memory test ..... PASS
POST Lower DRAM ECC check ..... PASS
Reset Cause = 41

Current BOOT from Primary BIOS
DxE POST
POST Upper DRAM Memory test

```

Short memory cell test

```
POST Upper DRAM Memory test ..... PASS
HDD Access ..... PASS
POST PCI test ..... PASS
POST Critical Device test ..... PASS
POST NVRAM check ..... PASS
POST overall test results ..... PASS
```

```
NVRAM: 00 DF 04 E6 03 03 00 EA
Version 2.19.1266. Copyright (C) 2019 American Megatrends, Inc.
BIOS Date: 10/17/2019 02:10:40 Ver: 0ACHI040
Press <DEL> or <F2> to enter setup.Welcome to GRUB!
```

**GNU GRUB version 2.02**

```
+-----+
| *PICOS-3.8.0.1 |
| ONIE           |
+-----+
```

Use the ^ and v keys to select which entry is highlighted.  
 Press enter to boot the selected OS, `e` to edit the commands  
 before booting or `c` for a command-line.  
 The highlighted entry will be executed automatically in 0s.  
 Booting `PICOS-3.8.0.1`

Loading, please wait...

```
[ 2.612019] systemd-fsck[373]: User-Data: 11/201600 files (0.0% non-contiguous), 30245/804913
blocks
[ 19.200983] picos-pre.sh[588]: ssh-keygen: generating new host keys: RSA1 RSA DSA ECDSA
ED25519
[ 19.320205] picos-pre.sh[588]: Auto Provisioning Tool - checking updates ....
[ 19.503333] picos-pre.sh[588]: No tftp server address found, exit now
[ 19.518692] picos_monitor[784]: Starting monitor
[ 20.461880] system-diag[783]: ***** System Diagnosis Start *****
[ 20.472254] system-diag[783]: Date: Thu Feb 10 03:04:39 UTC 2022
[ 20.480172] system-diag[783]: Version:
[ 20.486118] system-diag[783]: Copyright (C) 2009-2021 Pica8, Inc.
[ 20.494120] system-diag[783]: =====
[ 20.502150] system-diag[783]: Hardware Model : N3248PXE-ON
[ 20.510150] system-diag[783]: Linux System Version/Revision : 3.8.0.1/69a3ddb323
[ 20.520148] system-diag[783]: Linux System Released Date : 04/12/2021
[ 20.528147] system-diag[783]: L2/L3 Version/Revision : 3.8.0.1/69a3ddb323
[ 20.538157] system-diag[783]: L2/L3 Released Date : 04/12/2021
[ 20.546149] system-diag[783]: OVS/OF Version/Revision : 3.8.0.1/69a3ddb323
```

```
[ 20.556150] system-diag[783]: OVS/OF Released Date      : 04/12/2021
[ 20.565648] system-diag[783]: ONIE version           : 3.45.1.9-4
[ 20.572154] system-diag[783]: CPLD1 version          : 0.6
[ 20.579168] system-diag[783]: CPLD2 version          : 1.6
[ 20.586151] system-diag[783]: Hardware information:
[ 20.593152] system-diag[783]: MAC address           : 18:5A:58:1F:2F:A1
[ 20.601151] system-diag[783]: Serial number        : TW000WH7DNT000490090
[ 20.609158] system-diag[783]: Product name         : N3248PXE-ON
<output suppressed>
2022-02-10 03:05:47,746 Auto-deploy WARNING : Auto-deploy Agent Start
<output suppressed>
2022-02-09 19:14:36,248 Auto-deploy WARNING : This switch has been already deployed, agent will
quit
admin@P8-Access-BR-1-SW-1 login:
```

## Conclusion

In summary AmpCon ZTP allows automatic provisioning of bare metal switches securely at remote branches without any manual intervention or need for IT expertise. You do not have to worry about countless mundane switch provisioning tasks for large numbers of switches. AmpCon automates mundane switch management tasks, allowing you to focus on your important projects.

[Contact us today](#) to learn more about our push-button approach to ZTP for your bare metal switches.