Link-OS

PrintSecure

Printer Administration Guide

P1099957-12EN

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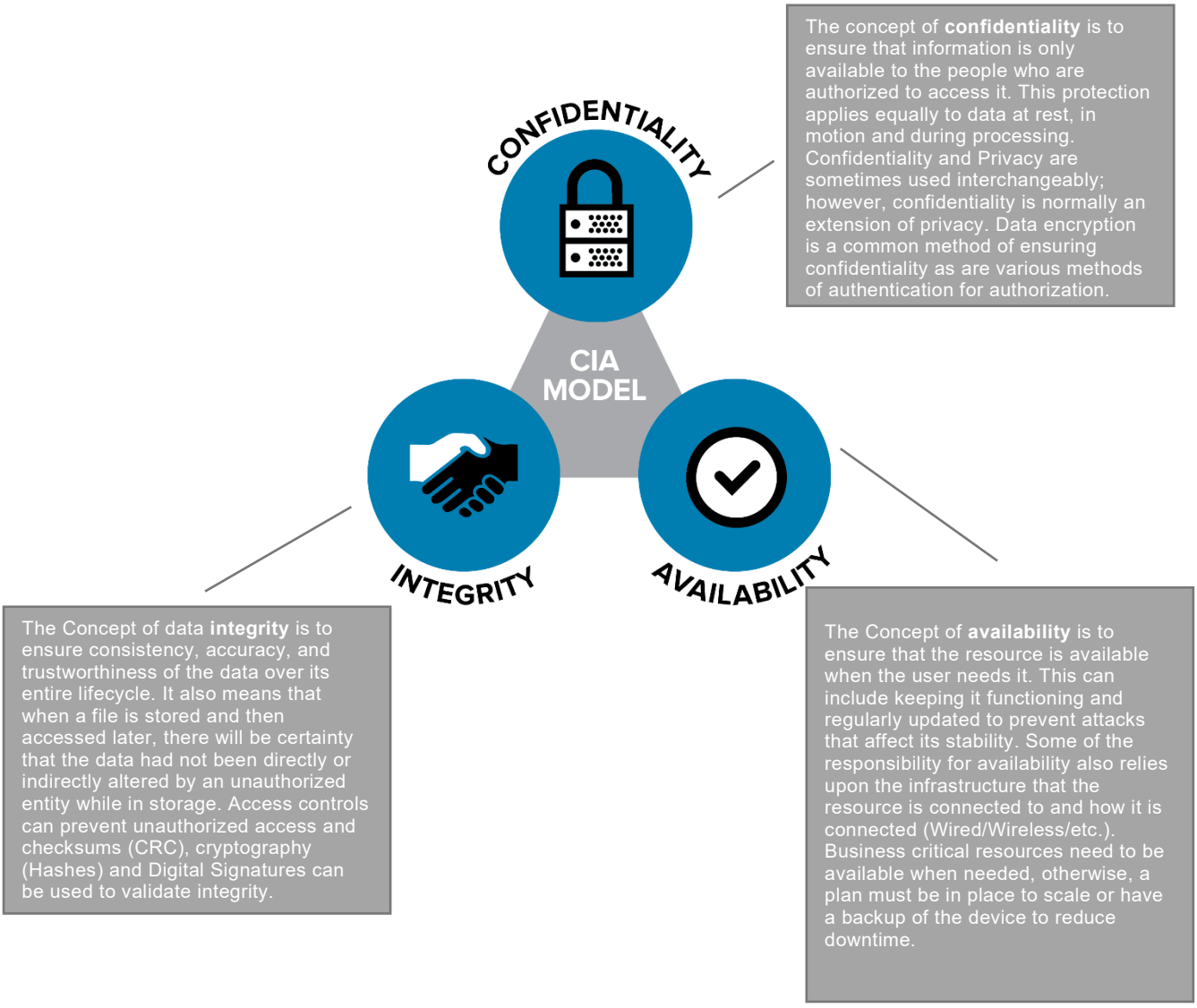
Introduction

This document details how to perform Administrator-level functions on a Zebra Label or Receipt printer. The content in this document covers both Link-OS and ZebraLink printers, though the degree to which the two types of printers can be Administered is different. To make it easy to see where a given Administrative feature is available, the document will display the Link-OS or ZebraLink icon to indicate if the feature is available on the printer being configured.

Overview

Administering Zebra printers might, at first, appear to be a very different task than managing other devices, such as computers or smartphones. Fortunately, there is a well-established, reliable model and a set of best practices that can be easily applied to minimize risks and make the task straightforward.

The "CIA Model" provides a guiding framework when considering how to reasonably and effectively raise the bar on risk mitigation. The model can be applied to all devices that utilize the data protected by enterprise information systems, from the more traditional connected solutions to other players in the connected environment, such as intelligent thermal barcode printers. This model includes three components:



Common Sense Best Practices

There are a set of Best Practices you can put in place to align your printer Administration with the CIA concepts. By applying these common-sense Best Practices, you can reduce risk, while still optimizing your use of thermal barcode printers.

1. •Start early. Plan for incoming devices, and how they will be protected.
2. •Use encrypted and authenticated connections. Avoid connecting devices directly to the Internet and instead use internal networks or a firewall.
3. •Plan to rotate access passwords, access keys and authentication credentials.
4. •Defaults settings represent well-known methods to access a device. Make use of User Interface Passwords, and admin authentication. Turn off unused services to reduce a device's attack surface.
5. •Leverage a remote management system to easily update settings across a fleet of devices. The longer devices are using out dated settings, the longer they represent an *easier target*.
6. •Limit informaiton disclosure, and only inform those who must know when planned updates are scheduled.
7. •Continuously monitor your system for *lost* devices. If a device has potentially been taken out of the enterprise environment, withdraw its credentials until the device status is determined.
8. •Choose devices that can be regularly updated across their long service lives to stay current with security best practices. Verify that the update system uses a method to ensure integrity of any updates to prevent tampering.
9. •Plan for device retirement by having a decommission process to remove sensitive enterprise data, and delete device user Accounts/Credentials.
10. •Consider Confidentiality, Integrity, and Availability during all stages of the device's lifecycle.

Steps to Take:

Applying these Best Practices is straightforward. The process involves four steps:

1. **Census** – which devices do you have?
2. **Consider** – which Admin capabilities do your printers have?
3. **Configure** – send commands to alter Admin settings
4. **Confirm** – validate the new settings

Census: Which Devices Do You Have?

Zebra has been making printers for more than 40 years. In that time, the scope of Administrator-level settings has grown. It is important to know which printer models you are working with to know which Administrator controls are available. The chart below will help you place your printer model into one of three categories:

Legacy Models (no admin features)	**Zebra Link™** (or limited admin features)	**Link-OS** (most admin features)
Desktop Printers A100 series A300 series Bravo series Companion Encore series LP/TLP series Tiger Writer 2746 series HT146 DA402 R402 T300/T402	**Desktop Printers** LP/TLP-Z series LP/TLP Plus series S300 S400 S500 S600 G series HC100 ZD200 series ZD800 series	**Desktop Printers** ZD400 series ZD500 series ZD600 series
Mobile Printers Cameo series MP series QL series PA400 series PT400 series PS2000-PS400 series TR220 ZQ110 ZR100 series	**Mobile Printers** QLPlus series P4T series RW Series ZQ200 series	**Mobile Printers** iMZ series (up to Link-OS 5.2) QLn series (up to Link-OS 5.2) ZQ300 series ZQ500 series ZQ600 series ZR300 series ZR600 series
Industrial Printers Z60 series Z90 series Z100 series Z140 series Z200 series 105Se	**Industrial Printers** Z4000/Z6000 Z4M/Z6M ZM400/600 series 105SL series 105SL Plus series XiII through Xi4 series	**Industrial Printers** ZT100 series ZT200 series ZT400 series ZT500 series ZT600 series
Others TTP Kiosk printer series	**Others** PAX 2 through PAX5 series ZE500 series KR403	**Others** ZE501 series

Consider: Which Admin Capabilities Does Your Printer Have?

Link-OS printers support a wide range of administrative commands and features.

	Zebra Link™	
Security		
Protected Mode		✓
OS Download Blocking		✓
Decommissioning Mode		✓
Services		
HTTP	✓	✓
HTTPS		✓
FTP	✓	✓
LPD	✓	✓
UDP		✓
SMTP	✓	✓
SNMP	✓	✓
Raw Telnet	✓	✓
POP3	✓	✓
NTP		✓
IPP/IPPS		✓
Communications		
Auto-WLAN Cert Management		✓
Bluetooth Mode		✓
Bluetooth Discoverability		✓
Bluetooth Enable		✓
BTLE		✓
USB Host		✓
Ethernet		✓
WLAN		✓
ESSID		✓
802.11x		✓
RTS/CTS Protection		✓
IP Address Allow list		✓
IP Port		✓
IP Alternate port		✓
JSON port		✓
Single connection port		✓
TLS IP Port		✓
TLS JSON Port		✓
TLS Enable		✓
Web sockets port		✓
Asset Visibility Agent		✓
MQTT		✓
Applications		
Data Capture		✓
XML Printing	✓	✓
USB Mirror		✓
FTP Mirror	✓	✓
SFTP Mirror		✓
Zebra Basic Interpreter		✓
APL Emulations		✓
User Interface		
Password	✓	✓

Premade Administration Files

Zebra has created several sets of premade files that you can send to your printer to quickly enable some of the most common security settings. These premade Admin Files were designed and built using the commands documented in this guide. However, because different user's networks operate in different ways, there is no one configuration file that could address every user's needs.

To obtain the premade Admin Files, go to: https://www.zebra.com/printsecure

You should edit the files to adapt to your unique needs. As you work with the Printer Administration Guide, you will quickly discover which commands and settings that are appropriate for your use case. For example, if you are communicating over a wireless connection do not disable the SGD "card.enable" as that will disable the wireless card. This example demonstrates why it is important to consider the following pages below before sending the files.

Sending the Administration files is simple. You can send the files to any port on the printer using our Printer Setup Utility or the legacy Z-Downloader utility.

The Printer Setup Utility can be downloaded from: www.zebra.com/setup

The legacy Z-Downloader app can be downloaded from:

https://www.zebra.com/us/en/support-downloads/printer-software/zdownloader.html

The Premade Administration files come in four groups:

- **Applications** – Three files, which can be used to set, check settings, or default the application settings on the printer.
- **Communications** – Three files, which can be used to set, check settings, or default the communication settings on the printer.
- **Services** – Three files, which can be used to set, check settings, or default the services settings on the printer.
- **User interface** – Two files, which can be used to set or default the user interface settings on the printer. (**IMPORTANT:** Zebra recommends not to use the sample password shown in this file. Please change it.)

Configure:

Send Commands to alter Admin settings

Confirm:

Validate the New Settings

This can be the most time-consuming portion of the process. Each Administrative capability used will have consequences for how the printer works, what it can do, and how it will work with other devices. Time should be taken to carefully consider which administrative features are used, and how they may impact the use of the printer.

Commands:

In this section, each Admin capability will be detailed, along with its defaults, its range of settings, how to activate/deactivate it, along with some notes to help you carefully consider the use of the capability.

NOTE: Many of the Administrative capabilities are controlled using the Set-Get-Do command language. If you are not familiar with this language, consult the Zebra Programming Guide, SGD Chapter for help with syntax and how to use this printer feature.

Protected Mode Commands

PROTECTED MODE STATE	Supported Printer Types	
Description: This command returns the current state of Protected Mode.		
Considerations: By default, Protected Mode is off. It is recommended to place the printer into Protected Mode to prevent unintentional or unauthorized setting changes.		
Control Commands: Protected Mode is controlled by JSON commands. This SGD command will report if Protected Mode is on or off. More detail can be found in the Best Practices - Protected Mode section of this guide. Example: `! U1 getvar "device.protected_mode"` The printer responds with the current setting value: "on" or "off". Return to Command List		

Protected Mode Commands

PROTECTED MODE ALLOWED	Supported Printer Types	
Description: This command returns the state of Protected Mode Allowed. This is used in conjunction with setting the password.		
Considerations: It is recommended to place the printer into Protected Mode to prevent unintentional or unauthorized setting changes.		
Control Commands: Protected mode is controlled by JSON commands and this SGD command will report if protected mode is allowed. More detail can be found in the Best Practices - Protected Mode section of this guide. Example: `! U1 getvar "device.protected_mode_allowed"` The printer responds with the current setting value: "yes" or "no". Return to Command List		

Protected Mode Commands

PRINTER OS DOWNLOAD CONTROL	Supported Printer Types	
Description: This command controls the device firmware download capability.		
Considerations: The default for this setting is "yes". It is recommended that Printer OS Download control be enabled to prevent unplanned Printer OS updates. Protected Mode should also be enabled to protect this setting and prevent it from being altered.		

Control Commands: The Printer OS Download Control capability is controlled by the `device.allow_firmware_downloads` command. More detail can be found in the Best Practices - Firmware Protection section of this guide.
 	
To set the command:
 	
`! U1 setvar "device.allow_firmware_downloads" "yes"`
`! U1 setvar "device.allow_firmware_downloads" "no"`
 	
To confirm the command is set:
 	
`! U1 getvar "device.allow_firmware_downloads"`
 	
The printer responds with the current setting value: "yes" or "no".
 	
Return to Command List		

NOTE: If this setting is set to "no", Printer OS downloads will not be possible. In this case the allow-next-firmware-download operation can be used to allow the next firmware file to be accepted. Refer to Best Practices – Printer OS Download Protection for details.

HTTP SERVICE	Supported Printer Types	
Description: This service is used to provide HTTP access to the printer	Zebra Link™	
Considerations: The HTTP service runs on port 80 and provides support for the printer's internal web pages. It is important to note that any POST to URL capability is disabled when this service is not enabled. The printer can still be managed by the Printer Profile Manager Enterprise app or via direct commands when this is disabled. To limit unauthorized access, the printer should not be accessible on the public internet. Instead, consider accessing it through a firewall or on an internal private network only. **NOTE:** Alerts with this destination will not work when this service is disabled.		

Control Commands: The HTTP capability is controlled by the `ip.http.enable` command.
 	
To set the command:
 	
`! U1 setvar "ip.http.enable" "on"`
`! U1 setvar "ip.http.enable" "off"`
 	
To confirm the command is set:
 	
`! U1 getvar "ip.http.enable"`
 	
The printer responds with the current setting value, or "?" if not supported.
 	
Return to Command List		

HTTPS SERVICE	Supported Printer Types	
Description: This service is used to provide HTTPS access to the printer		
Considerations: The HTTPS service runs on port 443 and provides support for the printer's internal web pages utilizing a secure connection. While HTTPS provides encrypted communication, one should still limit unauthorized access by not allowing the printer to be accessible on the public Internet. Instead, consider accessing it through a firewall or on an internal private network only.		

Control Commands: The HTTPS capability is controlled by the `ip.https.enable` command.
 	
To set the command:
 	
`! U1 setvar "ip.https.enable" "on"`
`! U1 setvar "ip.https.enable" "off"`
 	
To confirm the command is set:
 	
`! U1 getvar "ip.https.enable"`
 	
The printer responds with the current setting value, or "?" if not supported.
 	
Return to Command List		

NOTE: New in Link-OS 7.4.2 The printer generates a self-signed certificate that will be used if a user cert is not placed on the printer. Older versions require that a valid certificate is present on the printer.

The certificate and private key can be deployed to the device as a single file, or separate files. If using a single file, the name of the file must be:

HTTPS_CERT.NRD

If using multiple files:

HTTPS_CERT.NRD – certificate file

HTTPS_KEY.NRD – private key file

Once TLS communication is verified and operational, it is a security best practice to disable unencrypted forms of communicating with the printer over a network.

FTP SERVICE	Supported Printer Types	
Description: This service is used to send commands or files that the printer will act upon (this can include, CPCL, EPL, ZPL and Set-Get-Do commands).	Zebra Link™	
Considerations: The FTP service run on port 21 and can be used to place files on the printers file system, or for printing. It is not a service that is typically used for printing. As such, it's a good candidate to be disabled, however, it's important to first check if your organization plans to use it for file transfer, printing or device management.		

Control Commands: The FTP capability is controlled by the `ip.ftp.enable` command.

To set the command:

```
! U1 setvar "ip.ftp.enable" "on"
! U1 setvar "ip.ftp.enable" "off"
```

To confirm the command is set:

```
! U1 getvar "ip.ftp.enable"
```

The printer responds with the current setting value, or "?" if not supported.

Return to Command List

LPD SERVICE	Supported Printer Types	
Description: This service is used to send print jobs to the printer that it will act upon (this can include, CPCL, EPL, ZPL).	Zebra Link™	
Considerations: The LPD service uses port 515 and is a printing protocol typically used in Unix/Linux systems and the Mac OS environment. This can be supported on a Windows network with the addition of software features. Check which printing technology you are using and disable the appropriate port(s).		

Control Commands: The LPD capability is controlled by the `ip.lpd.enable` command.
 	
To set the command:
 	
`! U1 setvar "ip.lpd.enable" "on"`
`! U1 setvar "ip.lpd.enable" "off"`
 	
To confirm the command is set:
 	
`! U1 getvar "ip.lpd.enable"`
 	
The printer responds with the current setting value, or "?" if not supported.
 	
Return to Command List		

UDP SERVICE	Supported Printer Types	
Description: The UDP socket is only used for port defined by ip.port.		
Considerations: The User Datagram Protocol (UDP) is a connectionless protocol in contrast to Transmission Control Protocol (TCP) which requires a validated connection and an IP address. The primary purpose of this service is to communicate with the printer command language parser via UDP.		

Control Commands: The UDP capability is controlled by the `ip.udp.enable` command.
 	
To set the command:
 	
`! U1 setvar "ip.udp.enable" "on"`
`! U1 setvar "ip.udp.enable" "off"`
 	
To confirm the command is set:
 	
`! U1 getvar "ip.udp.enable"`
 	
The printer responds with the current setting value, or "?" if not supported.
 	
Return to Command List		

TCP SERVICE	Supported Printer Types	

Description: The TCP socket is used for ports defined by:
 	
`ip.port`
`ip.port_alternate`
`ip.port_json_config`
`ip.port_single_conn`
		

Considerations: The Transmission Control Protocol (TCP) provides a reliable, ordered, error-checked connection in contrast to User Datagram Protocol (UDP). The primary purpose of this service is to communicate with the printer command language parser via TCP. .		

Control Commands: The TCP capability is controlled by the `ip.tcp.enable` command.
 	
To set the command:
 	
`! U1 setvar "ip.tcp.enable" "on"`
`! U1 setvar "ip.tcp.enable" "off"`
 	
To confirm the command is set:
 	
`! U1 getvar "ip.tcp.enable"`
 	
The printer responds with the current setting value, or "?" if not supported.
 	
Return to Command List		

SMTP SERVICE	Supported Printer Types	
Description: The Simple Mail Transfer Protocol (SMTP) service (port 25) is used to receive print jobs.	Zebra Link™	
Considerations: This SMTP service is used to receive printer jobs using the Simple Mail Transfer Protocol (this can include, CPCL, EPL, ZPL). The print job is sent in the body of the email. Refer to the Zebra Programming Guide for format.		

Control Commands: The SMTP capability is controlled by the `ip.smtp.enable` command.
 	
To set the command:
 	
`! U1 setvar "ip.smtp.enable" "on"`
`! U1 setvar "ip.smtp.enable" "off"`
 	
To confirm the command is set:
 	
`! U1 getvar "ip.smtp.enable"`
 	
The printer responds with the current setting value, or "?" if not supported.
 	
Return to Command List		

NOTE: Ensure that the other dependent settings are configured correctly when using this capability

For further information on SMTP refer to the Programming Guide.

For example:

```
ip.smtp.server_addr
ip.smtp.domain
```

SNMP SERVICE	Supported Printer Types	
Description: The Simple Network Management Protocol (SNMP) service enables the manageability of the printer using this industry standard protocol.	Zebra Link™	

Considerations: The SNMP service uses UDP port 161 and allows the configuration of the printer and supports the issuance of SNMP trap messages. Some of the basic printer MIB is supported as well as a private MIB that contains Zebra specific settings and configuration. By default, this uses the public community name, if you intend to use this consider changing the community name from the default.

Some SGD commands can affect other settings Alerts with this destination will not work when this service is disabled.

Control Commands: The SNMP capability is controlled by the `ip.snmp.enable` command.

To set the command:

```
! U1 setvar "ip.snmp.enable" "on"
! U1 setvar "ip.snmp.enable" "off"
```

To confirm the command is set:

```
! U1 getvar "ip.snmp.enable"
```

The printer responds with the current setting value, or "?" if not supported.

Return to Command List

POP3 MAIL SERVICE	Supported Printer Types	
Description: The printer has a pop3 mail service and can poll a mailbox for incoming emails.	Zebra Link™	
Considerations: The POP3 service can query a mailbox for incoming emails, which can contain ZPL/CPL/EPL in the body of the email. The printer will execute the command language.		

Control Commands: The POP3 capability is controlled by the `ip.pop3.enable` command.
 	
To set the command:
 	
`! U1 setvar "ip.pop3.enable" "on"`
`! U1 setvar "ip.pop3.enable" "off"`
 	
To confirm the command is set:
 	
`! U1 getvar "ip.pop3.enable"`
 	
The printer responds with the current setting value, or "?" if not supported.
 	
Return to Command List		

NOTE: Ensure that the other dependent settings are configured correctly when using this capability

For further information on POP3 refer to the Programming Guide.

For example:

```
ip.pop3.server_addr
ip.pop3.poll
ip.pop3.username
ip.pop3.password
```

NTP SERVICE	Supported Printer Types	
Description: This command enables or disables the Network Time Protocol (NTP) feature.		
Considerations: The NTP command will enable or disable the Network Time Protocol capability which allows the printer to synchronize with time servers. This may be important if there are date or time fields printed on the label. Time and data can also be provided by the host system. Network security certificates have time fields so it is good to have correct time on the printer for those services.		

Control Commands: The NTP capability is controlled by the `ip.ntp.enable` command.
 	
To set the command:
 	
`! U1 setvar "ip.ntp.enable" "on"`
`! U1 setvar "ip.ntp.enable" "off"`
 	
To confirm the command is set:
 	
`! U1 getvar "ip.ntp.enable"`
 	
The printer responds with the current setting value, or "?" if not supported.
 	
Return to Command List		

NOTE: Ensure that the other dependent settings are configured correctly when using this capability

For further information on NTP refer to the Programming Guide.

For example:

```
ip.ntp.servers
ip.ntp.log
```

TIME	Supported Printer Types	
Description: This command sets or gets the printer time based on the Unix Epoch (UTC) or number of seconds since January 1st 1970.		
Considerations: If NTP is unavailable, time can be set using this command. Setting time in this way is useful for devices that exists across multiple time zones.		

Control Commands: The Unix Epoch capability is controlled by the `rtc.unix_timestamp` command.
 	
To set the command:
 	
`! U1 setvar "rtc.unix_timestamp" "1561492746" (06/25/2019 7:59PM (UTC))`
 	
To confirm the command is set:
 	
`! U1 getvar "rtc.unix_timestamp"`
 	
The printer responds with the current setting value in seconds.
 	
Return to Command List		

NOTE: The printer time and date can also be set using

```
rtc.time
rtc.date
```

It is possible to interrogate the printer to see if a real time clock chip is installed.

```
rtc.exists
```

BLUETOOTH ENABLE	Supported Printer Types	
Description: This command enables or disables the Bluetooth radio in a printer that has that option installed.	Zebra Link™	
Considerations: If you utilize Bluetooth for connection to a mobile computer for printing, this will need to be configured correctly. **NOTE:** Alerts with this destination will not work when this service is disabled.		

Control Commands: The Bluetooth enable capability is controlled by the `bluetooth.enable` command.
 	
To set the command:
 	
`! U1 setvar "bluetooth.enable" "on"`
`! U1 setvar "bluetooth.enable" "off"`
 	
To confirm the command is set:
 	
`! U1 getvar "bluetooth.enable"`
 	
The printer responds with the current setting value, or "?" if not supported.
 	
Return to Command List		

NOTE: Review changes to the default value of `bluetooth.discoverable` implemented in Link-OS 6.

BLUETOOTH DISCOVERABILITY	Supported Printer Types	
Description: This command enables or disables the Bluetooth discoverable mode in a printer that has a BT option installed.	Zebra Link™	
Considerations: The Bluetooth discoverable command will disable the Bluetooth connectivity on the printer. This does not affect a previously paired device only the discovery and pairing of a new device.		

Control Commands: The Bluetooth discoverable capability is controlled by the `bluetooth.discoverable` command.
 	
To set the command:
 	
`! U1 setvar "bluetooth.discoverable" "on"`
`! U1 setvar "bluetooth.discoverable" "off"`
 	
To confirm the command is set:
 	
`! U1 getvar "bluetooth.discoverable"`
 	
The printer responds with the current setting value, or "?" if not supported.
 	
Return to Command List		

NOTE: The default value of this setting has changed as of Link-OS 6 and is now off by default to improve security. Bluetooth Discovery and Pairing Mode can be activated by holding the FEED button on the printer for 5 seconds. For further details, refer to the Link-OS 6 Release Notes.

BLUETOOTH MODE	Supported Printer Types	
Description: For printers that support both Bluetooth Classic and Bluetooth Low Energy (BTLE), this command controls the mode of operation.		
Considerations: The Bluetooth radio can be configured to work in the following mode; BTLE, Classic or Both.		

Control Commands: The Bluetooth controller mode is controlled by the `bluetooth.le.controller_mode` command.
 	
To set the command:
 	
`! U1 setvar "bluetooth.le.controller_mode" "both"`
`! U1 setvar "bluetooth.le.controller_mode" "le"`
`! U1 setvar "bluetooth.le.controller_mode" "classic"`
 	
To confirm the command is set:
 	
`! U1 getvar "bluetooth.le.controller_mode"`
 	
The printer responds with the current setting value, or "?" if not supported.
 	
Return to Command List		

NOTE: There are many other settings related to BT communication and these need to be reviewed and configured accordingly.

Review changes to the default value of `bluetooth.discoverable` implemented in Link-OS 6.

For further information on Bluetooth refer to the Programming Guide.

For example:

```
bluetooth.discoverable
bluetooth.minimum_security_mode
bluetooth.allow_non_display_numeric_comparison
bluetooth.bonding
bluetooth.pin
```

USB HOST	Supported Printer Types	
Description: This command is used to enable or disable USB host capabilities in a printer that supports USB Host		
Considerations: The USB host lockout command disables the USB host capability in a printer that has support for it. USB devices connected to the printer will stop functioning when this is disabled. This will include USB mirror if that is being used.		

Control Commands: The USB host lock out capability is controlled by the `usb.host.lock_out` command.
 	
To set the command:
 	
`! U1 setvar "usb.host.lock_out" "on"`
`! U1 setvar "usb.host.lock_out" "off"`
 	
To confirm the command is set:
 	
`! U1 getvar "usb.host.lock_out"`
 	
The printer responds with the current setting value, or "?" if not supported.
 	
Return to Command List		

WIRED ETHERNET	Supported Printer Types	
Description: Enable or disable the internal wired ethernet port on printers equipped with this option.		
Considerations: The wired LAN enable command will disable or enable the internal wired Ethernet connection. The primary use for this command is to disable a port that is unused, where a different port is being used as the primary connection.		

Control Commands: The wired LAN capability is controlled by the `internal_wired.enable` command.
 	
To set the command:
 	
`! U1 setvar "internal_wired.enable" "on"`
`! U1 setvar "internal_wired.enable" "off"`
 	
To confirm the command is set:
 	
`! U1 getvar "internal_wired.enable"`
 	
The printer responds with the current setting value, or "?" if not supported.
 	
Return to Command List		

WLAN	Supported Printer Types	
Description: This command is used to enable or disable the Wireless Local Area Network functionality in a printer equipped with the WLAN (Wi-Fi) option.		

Considerations:
The WLAN command will fully disable all 802.11 wireless functionality. To improve security, it is recommended that the value of `wlan.enable` be set to "no" if the WLAN (Wi-Fi) option is not being used.

Control Commands: The WLAN capability is controlled by the `wlan.enable` command.

To set the command:

```
! U1 setvar "wlan.enable" "on"
! U1 setvar "wlan.enable" "off"
```

To confirm the command is set:

```
! U1 getvar "wlan.enable"
```

The printer responds with the current setting value, or "?" if not supported.

Return to Command List

ESSID	Supported Printer Types	
Description: This command is used to configure the WLAN Extended Service Set Identifier (ESSID) value, which determines which Wireless Local Area Network the device will connect to.		
Considerations: Set the ESSID network name to match the value of the WLAN the device will connect to automatically. The default value for ESSID is "" (null), which prevents the device from associating to any Access Point.		

Control Commands: The WLAN network name is controlled by the `wlan.essid` command.
 	
To set the command:
 	
`! U1 setvar "wlan.essid" "networkName"`
 	
To confirm the command is set:
 	
`! U1 getvar "wlan.essid"`
 	
The printer responds with the current setting value, or "?" if not supported.
 	
Return to Command List		

NOTE: For versions prior to Link-OS 6, the default value for ESSID is "125". This allowed device administrators to create a network specifically for provisioning new devices quickly. If the device ESSID is set to "" (null), the device will attempt to associate to any available Access Point, regardless of what its ESSID value is.

In Link-OS 6 and higher, the device will not automatically associate to any Access Point until a valid ESSID value is set.

Communications Commands

WIRELESS SECURITY	Supported Printer Types	
Description: This option provides a mechanism to authenticate devices on a wireless LAN		
Considerations: When setting up wireless security, the user must be aware of the movement of data to the printer during setup. Best practices should be employed to ensure that certificates, passwords and passphrases are protected at all time. Configuration should be done over a local connection to prevent eavesdropping.		

Control Commands:
 	
To set the command:
 	
`! U1 setvar "wlan.security" "wpa eap-tls"`
`! U1 setvar "wlan.security" "wpa eap-ttls"`
`! U1 setvar "wlan.security" "wpa eap-fast"`
`! U1 setvar "wlan.security" "wpa sae"`
`! U1 setvar "wlan.security" "wpa peap"`
`! U1 setvar "wlan.security" "wpa psk"`
 	
To confirm the command is set:
 	
`! U1 getvar "wlan.security"`
 	
The printer responds with the current setting value, or "?" if not supported.
 	
Return to Command List		

NOTE: There are many other settings related to wireless security and these need to be reviewed and configured accordingly. The username, password, and privkey have aliases to the same setting under wlan, wlan.peap, and wlan.8021x branches. Some securities require certificates which are discussed in Best_Practices_WLAN_Certificates

For further information on wireless security refer to the Programming Guide.

For example:

```
wlan.8021x.ttls_tunnel
wlan.8021x.ttls_anonymous_identity
wlan.username
wlan.password
wlan.privkey_password
wlan.8021x.peap.validate_server_certificate
wlan.8021x.peap.anonymous_identity

wlan.wpa.psk
```

Communications Commands

WLAN RTS/CTS	Supported Printer Types	
Description: Enables RTS/CTS HT protection frames when configuring a WLAN connection.	Zebra Link™	
Considerations: The WLAN RTS_CTS feature when enabled will put the WLAN radio in RTS/CTS protection mode. If this is not enabled the radio will default to CTS-to-Self mode. The mode that you run in will be dependent on your specific wireless LAN configuration and the devices that connect to it.		

Control Commands: The WLAN RTS_CTS capability is controlled by the `wlan.rts_cts_enable` command.
 	
To set the command:
 	
`! U1 setvar "wlan.rts_cts_enabled" "on"`
`! U1 setvar "wlan.rts_cts_enabled" "off"`
 	
To confirm the command is set:
 	
`! U1 getvar "wlan.rts_cts_enabled"`
 	
The printer responds with the current setting value, or "?" if not supported.
 	
Return to Command List		

NOTE: This command functions on the QLn and ZQ500 series printers.

Communications Commands

ALLOW LISTING	Supported Printer Types	
Description: The allow list capability allows only authorized IP addresses to connect to the printer.		
Considerations: The allow list capability is to ensure that only authorized hosts can connect to the printer. The parameters that you set are the IP addresses that are permitted to connect and can be single IP address or ranges. The maximum string length allowed is 256 bytes.		

Control Commands: The allow list capability is controlled by the `ip.firewall.whitelist_in` command.
 	
To set the command:
 	
`! U1 setvar "ip.firewall.whitelist_in" "192.168.1.20"`
`! U1 setvar "ip.firewall.whitelist_in" "192.168.1.20, 192.168.100.21"`
`! U1 setvar "ip.firewall.whitelist_in" "192.168.1.20-192.168.1.100"`
 	
To confirm the command is set:
 	
`! U1 getvar "ip.firewall.whitelist_in"`
 	
The printer responds with the current setting value, or "?" if not supported.
 	
Return to Command List		

NOTE: This command allows up to 256 characters that define what IP's or ranges of IP's can connect to the printer. If the IP address is not listed the connection will be refused. To reset this list, you will need to connect to a local port and send this command if the IP you are trying to connect with is not in the allowed range.

Examples:
Single IP address
```
! U1 setvar "ip.firewall.whitelist_in" "192.168.1.20"
```
Multiple IP addresses
```
! U1 setvar "ip.firewall.whitelist_in" "192.168.1.20,192.168.1.21"
```
IP address ranges
```
! U1 setvar "ip.firewall.whitelist_in" "192.168.1.20-192.168.1.40"
```
IP ranges and Single/Multiple IPs
```
! U1 setvar "ip.firewall.whitelist_in" "192.168.1.20-192.168.1.40,
192.168.1.50, 192.168.1.75"
```

Communications Commands

TCP RAW PORT	Supported Printer Types	
Description: This port is used to send commands or files that the printer will act upon (this can include, CPCL, EPL, ZPL and Set-Get-Do commands). This is also known as the printer command language parser.	Zebra Link™	
Considerations: Since this is frequently the primary port used for network-based printing, disabling it could disable printing. Of course, printing could be happening over another port, via FTP or web sockets. Additionally, changing the port number used could help obscure the printing port, but note that most port scanning tools can easily discover which ports are open on a networked device.		

Control Commands: The TCP Raw Port setting is controlled by the `ip.port` command.
 	
To set the command:
 	
`! U1 setvar "ip.port" "9100"`
`! U1 setvar "ip.port" "0" (Disables port)`
 	
To confirm the command is set:
 	
`! U1 getvar "ip.port"`
 	
The printer responds with the current setting value, or "?" if not supported.
 	
Return to Command List		

NOTE: Port numbers cannot be the same as any other SGD's in the group below. If you try to set the value to something that is in use it will be ignored. Setting the value to "0" disables the port and can be used to clear the current value, before it is set to a new value. However, remember setting the port to "0" will disable the port.

For further information on ports, refer to the Programming Guide.

For example:

```
ip.port
ip.port_alternate
ip.port_json_config
ip.port_single_conn
```

ALTERNATE TCP RAW PORT	Supported Printer Types	
Description: This is a secondary raw port that can be used to communicate with the printer.		
Considerations: Secondary raw printing port that allows multiple connections to the printer. These are served on and first come first served basis and allow up to x connection before additional connections are refused. This is primarily used for CPCL based printers and there to support legacy application. If ZPL is being used this port could be disabled without any impact. If this port is not being used, setting the value to 0 will disable the port.		

Control Commands: The IP Port alternative capability is controlled by the `ip.port_alternate` command.
 	
To set the command:
 	
`! U1 setvar "ip.port_alternate" "6101"`
`! U1 setvar "ip.port_alternate" "0" (Disables port)`
 	
To confirm the command is set:
 	
`! U1 getvar "ip.port_alternate"`
 	
The printer responds with the current setting value, or "?" if not supported.
 	
Return to Command List		

NOTE: Port numbers cannot be the same as any other SGD's in the group below. If you try to set the value to something that is in use it, will be ignored. Setting the value to "0" disables the port and can be used to clear the current value, before it is set to a new value. However, remember setting the port to "0" will disable the port.

For further information on ports refer to the Programming Guide.

For example:

```
ip.port
ip.port_alternate
ip.port_json_config
ip.port_single_conn
```

Communications Commands

JSON RAW PORT	Supported Printer Types	
Description: This is a JSON port that can be used to send configuration commands to the printer.		
Considerations: This port is used to carry out printer configuration utilizing the JSON format and generally used by Zebra Applications and Utilities (PPME included), which would include 3rd party applications built using our SDKs. If this port is disabled, printers can still be recognized by PPME but communication will be slower.		

Control Commands: The JSON port capability is controlled by the `ip.port_json_config` command.
 	
To set the command:
 	
`! U1 setvar "ip.port_json_config" "9200"`
`! U1 setvar "ip.port_json_config" "0" (Disables port)`
 	
To confirm the command is set:
 	
`! U1 getvar "ip.port_json_config"`
 	
The printer responds with the current setting value, or "?" if not supported.
 	
Return to Command List		

NOTE: Port numbers cannot be the same as any other SGD's in the group below. If you try to set the value to something that is in use it will be ignored. Setting the value to "0" disables the port and can be used to clear the current value, before it is set to a new value. However, remember setting the port to "0" will disable the port.

For further information on ports refer to the Programming Guide.

For example:

```
ip.port
ip.port_alternate
ip.port_json_config
ip.port_single_conn
```

TCP RAW PORT (single)	Supported Printer Types	
Description: This port is used to send commands or files that the printer will act upon over a single TCP connection (this can include, CPCL, EPL, ZPL and Set-Get-Do commands). This is also known as the printer command language parser.		
Considerations: This port is designed to work in the same way as ip.port but it will only allow a single connection to the printer at a time. Any other connection attempts while this port is in use will be rejected.		

Control Commands: The IP port single connection capability is controlled by the `ip.port_single_conn` command.
 	
To set the command:
 	
`! U1 setvar "ip.port_single_conn" "9300"`
`! U1 setvar "ip.port_single_conn" "0" (Disables port)`
 	
To confirm the command is set:
 	
`! U1 getvar "ip.port_single_conn"`
 	
The printer responds with the current setting value, or "?" if not supported.
 	
Return to Command List		

NOTE: Port numbers cannot be the same as any other SGD's in the group below. If you try to set the value to something that is in use it will be ignored. Setting the value to "0" disables the port and can be used to clear the current value, before it is set to a new value. However, remember setting the port to "0" will disable the port.

For further information on ports refer to the Programming Guide.

For example:

```
ip.port
ip.port_alternate
ip.port_json_config
ip.port_single_conn
ip.port_single_conn_idle_timeout
```

TLS RAW PORT	Supported Printer Types	
Description: This port is used to send commands or files that the printer will act upon over a secure TLS channel (this can include CPCL, EPL, ZPL, and Set-Get-Do commands). This is also known as the printer command language parser.		
Considerations: This port is designed to work in the same way as `ip.port`, but it requires a valid certificate loaded on the printer to enable TLS encryption. If you are using the TLS channel, it is recommended that you disable the non-encrypted ports.		

Control Commands: The TLS RAW Port connection capability is controlled by the `ip.tls.port` command.
 	
To set the command:
 	
`! U1 setvar "ip.tls.port" "9143"`
`! U1 setvar "ip.tls.port" "0" (Disables port)`
 	
To confirm the command is set:
 	
`! U1 getvar "ip.tls.port"`
 	
The printer responds with the current setting value, or "?" if not supported.
 	
Return to Command List		

NOTE: New in Link-OS 7.4.2 the printer will generate a self-signed certificate to be used if no user placed certificate and key are present. Older versions require that a valid certificate is present on the printer.

The certificate and private key can be deployed to the device as a single file, or separate files. If using a single file, the name of the file must be:

```
TLSRAW_CERT.NRD
```

If using multiple files:

```
TLSRAW_CERT.NRD – certificate file
TLSRAW_KEY.NRD – private key file
```

Once TLS communication is verified and operational, it is a security best practice to disable unencrypted forms of communicating with the printer over a network.

TLS JSON PORT	Supported Printer Types	
Description: This is a TLS JSON port that can be used to send configuration commands to the printer over a secure connection.		
Considerations: This port is used to carry out printer configuration utilizing the JSON format and when utilizing the TLS connection.		

Control Commands: The TLS connection JSON config port capability is controlled by the `ip.tls.port_json_config` command.
 	
To set the command:
 	
`! U1 setvar "ip.tls.port_json_config" "9243"`
`! U1 setvar "ip.tls.port_json_config" "0" (Disables port)`
 	
To confirm the command is set:
 	
`! U1 getvar "ip.tls.port_json_config"`
 	
The printer responds with the current setting value, or "?" if not supported.
 	
Return to Command List		

NOTE: The value for TLS JSON Port may not be the same as another service already in use. If you try to set the value to something that is in use, it will be ignored. Setting the value to "0" effectively clears the current value and disables the port.

For further information on ports, refer to the Programming Guide.

For example:

```
ip.tls.port
ip.tls.port_json_config
```

Communications Commands

TLS ENABLE	Supported Printer Types	
Description: This is a command that enables or disables the TLS capability.		
Considerations: This is for securing communications to the printer over wired and wireless Ethernet and depends on preloaded certificates on the printer. Ensure that this capability is working before disabling any non-TLS connections.		

Control Commands: The TLS Enable command is controlled by the `ip.tls.enable` command.
 	
To set the command:
 	
`! U1 setvar "ip.tls.enable" "on"`
`! U1 setvar "ip.tls.enable" "off"`
 	
To confirm the command is set:
 	
`! U1 getvar "ip.tls.enable"`
 	
The printer responds with the current setting value, or "?" if not supported.
 	
Return to Command List		

NOTE: New in Link-OS 7.4.2 the printer will generate a self-signed certificate to be used if no user placed certificate and key are present. Older versions require a valid certificate is present on the printer.

Once TLS communication is verified and operational, it is a security best practice to disable unencrypted forms of communicating with the printer over a network.

Communications Commands

ASSET VISIBILITY AGENT	Supported Printer Types	
Description: This command turns the Asset Visibility agent off or on.		
Considerations: This feature can connect a networked Link-OS printer to Zebra's Asset Visibility Service (AVS). The Asset Visibility Service is a Zebra-managed service offering that provides Zebra partners and customers 'at-a-glance' visibility to analytical insights about their device health, utilization, and performance.		

Control Commands: The Asset Visibility capability is controlled by the `weblink.zebra_connector.enable` command.
 	
To set the command:
 	
`! U1 setvar "weblink.zebra_connector.enable" "on"`
`! U1 setvar "weblink.zebra_connector.enable" "off"`
 	
To confirm the command is set:
 	
`! U1 getvar "weblink.zebra_connector.enable"`
 	
The printer responds with the current setting value, or "?" if not supported.
 	
Return to Command List		

MQTT	Supported Printer Types	
Description: This command turns the MQTT capability off or on.		
Considerations: This feature can connect a networked Link-OS printer to an MQTT broker over TLS. MQTT like Web Sockets is a protocol that can be used to manage the printer. The printer supports two simultaneous connections (conn1 and conn2) that must have a server address configured before attempting any MQTT communication. The port used for each connection is specified as part of the connection		

Control Commands: The MQTT capability is controlled by the `mqtt.enable` command.
 	
To set the command:
 	
`! U1 setvar "mqtt.enable" "on"`
`! U1 setvar "mqtt.enable" "off"`
 	
To confirm the command is set:
 	
`! U1 getvar "mqtt.enable"`
 	
The printer responds with the current setting value, or "?" if not supported.
 	
Return to Command List		

NOTE: For further information on MQTT refer to the ZPL Programming Guide.

IPP	Supported Printer Types	
Description: This command enables or disables the IPP server.		
Considerations: The IPP command will disable the IPP service on the printer. This change does not take effect until a network or printer reset occurs.		

Control Commands: The IPP capability is controlled by the `ip.ipp.enable` command.
 	
To set the command:
 	
`! U1 setvar "ip.ipp.enable" "on"`
`! U1 setvar "ip.ipp.enable" "off"`
 	
To confirm the command is set:
 	
`! U1 getvar "ip.ipp.enable"`
 	
The printer responds with the current setting value, or "?" if not supported.
 	
Return to Command List		

IPP MODE	Supported Printer Types	
Description: This command controls the IPP mode of operation.		
Considerations: The IPP server can require secure encrypted connections is set to `"ipps"`. It can also allow secure and insecure connections when set to `"ipp/ipps"`. It is best practice to only use insecure connections if the network is restricted to authorized users.		

Control Commands: The IPP server mode is controlled by the `ip.ipp.mode` command.
 	
To set the command:
 	
`! U1 setvar "ip.ipp.mode" "ipps"`
`! U1 setvar "ip.ipp.mode" "ipp/ipps"`
 	
To confirm the command is set:
 	
`! U1 getvar "ip.ipp.mode"`
 	
The printer responds with the current setting value, or "?" if not supported.
 	
Return to Command List		

NOTE: The default value of this setting depends on Advanced Security Mode and/or firmware version.

Communications Commands

Network Discovery	Supported Printer Types	
Description: This command enables or disables the Network Discovery service.	Zebra Link™	
Considerations: Network Discovery is used by utilities to find printers on the network. This is used by software to connect printers to servers or enable configuration. Disabling this will hinder setup/configuration of the printer. It will not affect connections or configuration already made.		

Control Commands: The Network Discovery capability is controlled by the `ip.discovery.enable` command.
 	
To set the command:
 	
`! U1 setvar "ip.discovery.enable" "on"`
`! U1 setvar "ip.discovery.enable" "off"`
 	
To confirm the command is set:
 	
`! U1 getvar "ip.discovery.enable"`
 	
The printer responds with the current setting value, or "?" if not supported.
 	
Return to Command List		

NOTE: The retrieval and decoding of the discovery packet details is handled by the software utilities/ SDK. There are bits to tell if protected mode is enabled and if firmware upgrades are allowed. Link-OS 7.4.2 added a bit to determine if you have set up your protected mode password.

CAPTURE PORT	Supported Printer Types	
Description: This command specifies the port that should be monitored for user data.		
Considerations: The capture channel command will collect user data from the specified port and store it in the `capture.channel1.data.raw`. To disable the capture channel, the port should be set to `"off"`.		

Control Commands: The capture channel capability is controlled by the `capture.channel1.port` command.
 	
To set the command:
 	
`! U1 setvar "capture.channel1.port" "serial"`
`! U1 setvar "capture.channel1.port" "usb"`
`! U1 setvar "capture.channel1.port" "bt"`
`! U1 setvar "capture.channel1.port" "parallel"`
`! U1 setvar "capture.channel1.port" "off"`
 	
To confirm the command is set:
 	
`! U1 getvar "capture.channel1.port"`
 	
The printer responds with the current setting value, or "?" if not supported.
 	
Return to Command List		

XML PRINTING	Supported Printer Types	
Description: This command enables or disables the XML parsing capability in the printer	Zebra Link™	
Considerations: The XML enable command is primarily used to allow the variable data for a stored format to be passed to the printer in an XML format. This is often used in the Oracle environment and, if disabled, will stop the printer from printing. The XML Data can be in two distinct formats, one for Oracle and one for SAP.		

Control Commands: The XML capability is controlled by the `device.xml.enable` command.
 	
To set the command:
 	
`! U1 setvar "device.xml.enable" "on"`
`! U1 setvar "device.xml.enable" "off"`
 	
To confirm the command is set:
 	
`! U1 getvar "device.xml.enable"`
 	
The printer responds with the current setting value, or "?" if not supported.
 	
Return to Command List		

USB MIRROR	Supported Printer Types	
Description: This command enables or disables the ability to perform mirroring using a USB device memory stick.		
Considerations: The USB mirror capability is only supported by printers that have USB host capability.		

Control Commands: The USB mirror enabled capability is controlled by the `usb.mirror.enable` command.
 	
To set the command:
 	
`! U1 setvar "usb.mirror.enable" "on"`
`! U1 setvar "usb.mirror.enable" "off"`
 	
To confirm the command is set:
 	
`! U1 getvar "usb.mirror.enable"`
 	
The printer responds with the current setting value, or "?" if not supported.
 	
Return to Command List		

NOTE: This command only works on printers with USB Host capabilities.

SYSLOG	Supported Printer Types	
Description: The printer can collect logging events and store them in non-volatile memory for analysis and debugging.		
Considerations: The syslog enable command turns on the logging capability, which is turned off by default. There are other commands that configure other features, such as the content of the file and max file size.		

Control Commands: The syslog capability is controlled by the `device.syslog.enable` command.
 	
To set the command:
 	
`! U1 setvar "device.syslog.enable" "on"`
`! U1 setvar "device.syslog.enable" "off"`
 	
To confirm the command is set:
 	
`! U1 getvar "device.syslog.enable"`
 	
The printer responds with the current setting value, or "?" if not supported.
 	
Return to Command List		

NOTE: For further information on the syslog command refer to the Programming Guide.

For example:

```
device.syslog.clear_log
device.syslog.configuration
device.syslog.entries
device.syslog.log_max_file_size
device.syslog.save_local_file
```

ZEBRA BASIC INTERPRETER	Supported Printer Types	
Description: This is to control the Zebra Basic Interpreter (ZBI) capability in the printer.		
Considerations: The ZBI enable command allows an administrator to enable/disable the ZBI Interpreter in the printer. A license is still required to be able to run ZBI scripts on a printer; however, this is a global command to turn off the ZBI capability, whether a license is installed or not. If you are not utilizing a ZBI script, it is recommended that this be disabled.		

Control Commands: The ZBI enable capability is controlled by the `zbi.enable` command.
 	
To set the command:
 	
`! U1 setvar "zbi.enable" "on"`
`! U1 setvar "zbi.enable" "off"`
 	
To confirm the command is set:
 	
`! U1 getvar "zbi.enable"`
 	
The printer responds with the current setting value, or "?" if not supported.
 	
Return to Command List		

Applications Commands

APL EMULATIONS	Supported Printer Types	
Description: This is to control the Advanced Printer Language (APL) Emulations capability in the printer.		
Considerations: The APL enable command allows an administrator to enable/disable the APL emulations in the printer. A valid file loaded on the printer is required to be able to run that emulation on a printer; however, this is a global command to turn off the APL Emulation capability, whether a file is loaded or not. If you are not utilizing APL Emulations, it is recommended that this be disabled.		

Control Commands: The APL Emulations enable capability is controlled by the `apl.enable` command.
 	
To set the command:
 	
`! U1 setvar "apl.enable" "on"`
`! U1 setvar "apl.enable" "off"`
 	
To confirm the command is set:
 	
`! U1 getvar "apl.enable"`
 	
The printer responds with the current setting value, or "?" if not supported.
 	
Return to Command List		

User Interface

FRONT PANEL PASSWORD	Supported Printer Types	
Description: This is the define password command and allows an admin to change the password for the Front Panel	Zebra Link™	

Considerations: The command allows the changing of the password for Front Panel display. **New in Link-OS 7.4.2:** The front panel password is initially undefined and must be set before it is usable. When protected-mode is enabled, the ^KP command will **not** change the password and its use will be ignored. The protected method must be used instead.

Control Commands: The Define Password capability is controlled by the `display.password.current` and `^KP` commands.

To set using protected mode:

```
{}{
  "protect":{
    "authentication":{
    "username":"admin",
    "password":"<password>",
    "type":"basic"
    },
    "operation":"set",
    "set":{
     "display.password.current":"1251"
    }
  }
}
```

To set the command using ^KP:

```
^XA
^KPxxxx – where xxxx is any four-digit numeric sequence.
^JUS
^XZ
```

To confirm the command is set:

Use the Front Panel and attempt to modify a password-protected configuration.

Return to Command List

User Interface

WEB PAGE PASSWORD	Supported Printer Types	
Description: This is the define password command and allows the changing of the password for the web page	Zebra Link™	
Considerations: The command allows the changing of the password for the web page access. **New in Link-OS 7.4.2:** The web page password is initially undefined and must be set before it is usable.		
Control Commands: The password capability is controlled by the `ip.http.admin_password` command. To set the command: `{}{ "protect":{ "authentication":{ "username":"admin", "password":"<password>", "type":"basic" }, "operation":"set", "set":{ "ip.http.admin_password":"A%29921Hgg" } } }` To reset the device to the default state with an undefined web page password use the above protected-mode syntax, but set the password to "" . The printer will no longer allow web page authentication until a new password is set. Return to Command List		

NOTE: Regarding the `ip.http.admin_password` and `ip.http.admin_name` commands, the minimum length = 0, the maximum length = 25, and valid characters include any character that can be passed as a string.

New for Link-OS 7.4.2: The web pages implement protection against brute-force password guessing. After 3 failed attempts, there will be a 5-second delay for each subsequent login attempt.

User Interface

WEB PAGE USERNAME	Supported Printer Types	
Description: This is the define username command and allows an admin to change the username for the web page	Zebra Link™	
Considerations: The command allows the changing of the username for web page access.		

Control Commands: The username capability is controlled by the `ip.http.admin_name` command.
 	
To set the command when protected-mode is enabled:
 	
`{}{ "protect":{ "authentication":{ "username":"admin", "password":"<password>", "type":"basic" }, "operation":"set", "set":{ "ip.http.admin_name":"Mainuser" } } }`
 	
To confirm the command is set:
 	
`! U1 getvar "ip.http.admin_name"`
 	
The printer responds with the current setting value, or "?" if not supported.
 	
Return to Command List		

NOTE: The default username is "admin" and it can be changed, however there can only be one username.

NOTE: Regarding the "ip.http.admin_password" and "ip.http.admin_name" commands, the minimum length = 0, the maximum length = 25, and valid characters include any character that can be passed as a string.

Best Practices – Secure by Default

New in Link-OS 7.4.2: Advanced Security Mode (ASM) was introduced to allow a quick way to put the printer into a “secure by default” state and enable “Protected Mode.” Printers sold in the European Union are configured in this mode out-of-the-box. In this mode, the SGD "device.advanced_security_mode" reports "advanced". Users in other regions can configure protected mode and turn off services to be just as secure. When initially configured in Advanced Security Mode, Protected Mode is enabled, but a password needs to be set to enable changes to security settings. Refer to Best Practices Protected Mode to continue setup of Protected Mode and use the printer.

The following services are disabled, and their defaults are changed to disabled while in this mode. If you need any of these services, after ensuring other security measures protect printer communications, the services can be reenabled and used.

SGD	New value/default	Notes
device.allow_firmware_downloads	no	Disable firmware download by default
ip.dhcp.auto_provision	off	
ip.ftp.enable	off	
ip.http.enable	off	
ip.https.enable	off	
ip.ipp.mode	ipps	Only allow IPPS by default
Ip.lpd.enable	off	
Ip.pop3.enable	off	
ip.smtp.enable	off	
ip.snmp.enable	off	
ip.tcp.enable	off	
ip.udp.enable	off	
usb.mirror.enable	off	Disallow configuration by mass storage
wlan.enable	off	
zbi.enable	off	
bluetooth.minimum_security_mode	2	Only for printers without a display, for others the default remains at 3.
ip.http.admin_password	""	
display.password.current	""	This PIN must be defined by the user for front panel password/PIN authentication to operate.

The following services are the only services enabled by default in this mode. They are on to allow the setup/use of the printer. Once you have configured your printer for your environment you should disable any services that are not needed.

SGD	Default	Notes
bluetooth.enable	on	Bluetooth interface
internal_wired.enable	on	Ethernet interface
ip.discovery.enable	on	Discover the printer on the network
ip.ipp.enable	on	Encrypted communication channel
ip.tls.enable	on	Encrypted communication channel

Best Practices - Protected Mode

With Zebra printers, there are several ways to configure the printer so that unused services are turned off, reducing the threat surface of the printer. After the printer is securely provisioned and configured, it can be put into Protected Mode. This disables unauthorized changes to settings that affect device security and locks the current configuration down until an admin authorizes updates.

Protected mode interaction is achieved through making use of JSON-formatted Protect commands. These commands incorporate authentication information that must be validated, as well as an operation type and optional information specifying what the command does. Here is the general format for protect commands:

```
{}{
  "protect":{
    "authentication":{<authentication data>},
    "operation":"<operation type>"
    [, <operation data>]
  }
}
```

The general format of responses to commands is:

```
{}{
  "protect":{
    "status":<status code>,
    "operation":<operation type>
    [, <operation response data>]
  }
}
```

`<status code>` values can be found in `Protect JSON Command Response` section

As an example of an actual command, here is how to set the password for a previously non-protected printer.

```
{}{
  "protect":{
    "authentication":{
      "username":"admin",
      "password":"",
      "type":"basic"
    },
    "operation":"setup",
    "setup":{
      "username":"admin",
      "password":"<new password>"
    }
  }
}
Where <new password> is between 14 and 128 bytes containing only printable
ascii characters (0x20-0x7E)
```

In the example above there is a general protect command followed by an authentication section, operation type, and setup section. The password is initially an empty string because it has not been configured yet. Link-OS 6 supports the basic authentication type and a single user of admin.

To set the password, it is necessary to issue a setup operation command. Inside the setup section it is necessary to specify a password of at least 14 characters. Again, only the admin user is supported. As the password is sensitive information, it is highly recommended to configure this over a secure channel or secure provisioning network.

If the command is successful, the response status code will be zero:

```
{}{"protect":{"status":0,"operation":"setup"}}
```

If the command is not successful, the response status code will be non-zero. Go to the Protect JSON Commands Response Codes table for the meaning of non-zero response codes.

To verify the printer is in protected mode, check the return of the SGD command

```
device.protected_mode
```

If the printer is not in Protected Mode, the command will return "`off`". If the printer is in Protected Mode, the command will return "`on`".

Although not recommended, it is possible to force protected mode off. In this scenario it is best practice to leave the admin password configured such that an adversary will be prevented from reenabling protect mode or locking the printer out with an unknown password. This can be achieved by using a separate operation. For example:

```
{}{
  "protect":{
    "authentication":{
    "username":"admin",
    "password":"<password>",
    "type":"basic"
    },
    "operation":"configure-one",
    "configure-one":{
    "protected-mode-allowed":"no"
    }
  }
}
```

If the command is successful, it should return:

```
{"protect":{"status":0,"operation":"configure-one","protected-mode-
allowed":"no"}}
```

If the command is not successful, the response status code will be non-zero. Go to the Protect JSON Commands Response Codes table for the meaning of non-zero response codes.

To turn Protected Mode back on, set protected-mode-allowed to yes. Once in Protected Mode, protected settings can only be changed with a set operation in a protect command.

You can also retrieve values of a setting by passing in a null value field to a setting.

Below is an example of the “set” command, which sets the **wlan.essid** SGD to the value **“125”** and the **usb.host.lock_out** SGD to the value **“true”**:

```
{}{
  "protect":{
    "authentication":{
    "username":"admin",
    "password":"<password>",
    "type":"basic"
    },
    "operation":"set",
    "set":{
     "wlan.essid":"125",
     "usb.host.lock_out":"true"
    }
  }
}
```

If the command was successful, the printer will respond with:

```
{"protect":{"status":0,"operation":"set","set":{"wlan.essid":"125",
"usb.host.lock_out":"true"}}}
```

If the command is not successful, the response status code will be non-zero. Go to the Protect JSON Commands Response Codes table for the meaning of non-zero response codes.

Not every setting on the printer is considered protected however, as there are many valid reasons to perform actions such as changing darkness between batches of print media. In general, settings related to network or security configuration are protected, whereas print settings are not. Any setting can be set within a valid protect set command whether it is protected or not. You can also retrieve values of a setting by passing in a null value field to a setting. But once Protected Mode is enabled, protected settings can only be modified inside a protect command or until protected mode is disabled. To get the full list of protected settings issue the following command:

```
{}{"allconfig":null}
```

This will return all the settings the printer can configure and also includes an item for groups. If the groups value is set to a value of "0" it is not protected and can be modified normally. Otherwise the setting is a protected setting. Commands that are linked to other commands are NOT shown in the allconfig output. Go to Protected SGD Commands for more details.

Recommendation: Keep Protected Mode enabled on the printer to prevent unwanted configuration changes. Any attempts to send unauthorized settings changes from any app or source are rejected when the printer is in Protected Mode.

Here is a list of all the protected mode commands and their formats:

Setup Protected Mode

```
{}{"protect":{
  "authentication":{"username":"admin","password":"","type":"basic"},
  "operation":"setup","setup":{"username":"admin","password":"<new password>"}
}}
```

Change Protected Mode password

```
{}{"protect":{
  "authentication":{"username":"admin","password":"<password>","type":"basic"},
  "operation":"setup","setup":{"username":"admin","password":"<new password>"}
}}
```

Set a protected setting (one setting)

```
{}{"protect":{
  "authentication":{"username":"admin","password":"<password>", "type":"basic"},
  "operation":"set","set":{"wlan.essid":"125"}
}}
```

Set a protected setting (multiple settings, they don't have to be a protected setting to set them)

```
{}{"protect":{
  "authentication":{"username":"admin","password":"<password>", "type":"basic"},
  "operation":"set","set":{
    "wlan.essid":"125",
    "device.friendly_name":"Zone1 Zebra Printer 76"
  }
}}
```

Set and Get a setting (multiple settings)

```
{}{"protect":{
  "authentication":{"username":"admin","password":"<password>", "type":"basic"},
  "operation":"set","set":{"wlan.essid":"125","device.friendly_name":null}
}}
```

Disable Protected Mode (so others cannot enable it, no to disable, yes to enable)

```
{}{"protect":{
  "authentication":{"username":"admin","password":"<password>", "type":"basic"},
  "operation":"configure-one","configure-one":{"protected-mode-allowed":"no"}
}}
```

Disable Firmware Download

```
{}{"protect":{
  "authentication":{"username":"admin","password":"<password>", "type":"basic"},
  "operation":"set",
  "set":{"device.allow_firmware_downloads":"no"}
}}
```

Allow a firmware update when firmware upgrades are disabled
(firmware download allowed until one is processed, or the printer is reset or powered off)

```
{}{"protect":{
  "authentication":{"username":"admin","password":"<password>", "type":"basic"},
  "operation":"allow-next-firmware-download"
}}
```

Best Practices – Configuring SNMPv3

In order to enable and use SNMPv3, the printer must first have Protected Mode enabled. Once Protected Mode is enabled, use the “setup-snmpv3-user” operation to create, update, or delete the admin or monitor user. SNMPv3 is automatically enabled once a user is created.

- 2 users are supported: One admin user with read-write access and one monitor user with read-only access.
- Once a user is configured, only the authentication and privacy parameters can be updated.
    - To change the username or access level, the user must be deleted and recreated.
- SNMPv3 is automatically disabled if no user is configured.
- A network or device reset is required for any changes to take effect.

The “setup-snmpv3-user” operation takes the following parameters:

Parameter	Range	Description
action	"create", "update", "delete"	Specify whether the operation is creating, updating, or deleting a user.
access	"read-write" (Admin user), "read-only" (Monitor user)	Specify the access level of the user when creating a new user. Access default value is "read-write".
username	n/a	SNMPv3 username. When updating or deleting a user, the username is used to

		identify which user to perform the specified action on.
auth-passphrase	n/a	Passphrase used for authentication. Only required if creating or updating a user.
auth-protocol	"SHA", "MD5"	Protocol used for authentication. Only required if creating or updating a user.
priv-passphrase	n/a	Passphrase used for privacy. Only required if creating or updating a user.
priv-protocol	"AES", "DES"	Protocol used for privacy. Only required if creating or updating a user.

Examples

Creating the admin user

```
{}{
	"protect":{
		"authentication":{
			"username":"admin",
			"password":"<your-strong-password-here>",
			"type":"basic"
		}
		"operation":"setup-snmpv3-user",
		"setup-snmpv3-user":{
			"action":"create",
			"access":"read-write",
			"username":"<YourSNMPv3AdminName>",
			"auth-passphrase":"<your-strong-priv-passphrase>",
			"auth-protocol":"SHA ",
			"priv-passphrase":"<your-strong-priv-passphrase>",
			"priv-protocol":"AES"
		}
	}
}
```

Creating the monitor user

```
{}{
      "protect":{
            "authentication":{
                  "username":"admin",
                  "password":"<your-strong-password-here>",
                  "type":"basic"
      },
      "operation":"setup-snmpv3-user",
      "setup-snmpv3-user":{
            "action":"create",
            "access":"read-only",
            "username":"<YourSNMPv3MonitorName>",
            "auth-passphrase":"<your-strong-auth-passphrase>",
            "auth-protocol":"SHA",
            "priv-passphrase":"<your-strong-priv-passphrase>",
            "priv-protocol":"AES"
      }
   }
}
```

Updating the admin user's credentials

```
{}{
      "protect":{
            "authentication":{
                  "username":"admin",
                  "password":"<your-strong-password-here>",
                  "type":"basic"
      },
      "operation":"setup-snmpv3-user",
      "setup-snmpv3-user":{
            "action":"update",
            "username":"<YourSNMPv3AdminName>",
            "auth-passphrase":"new <your-strong-auth-passphrase>",
            "auth-protocol":"MD5",
            "priv-passphrase":"new <your-strong-priv-passphrase>",
            "priv-protocol":"DES"
      }
     }
}
```

Deleting the user

```
{}{
	"protect":{
		"authentication":{
			"username":"admin",
			"password":"<your-strong-password-here>",
			"type":"basic"
	},
	"operation":"setup-snmpv3-user",
	"setup-snmpv3-user":{
		"action":"delete",
		"username":"<YourSNMPv3AdminName>"
	}
   }
}
```

Disabling SNMPv3 (while retaining the SNMPv3 admin user credentials)

```
{}{
	"protect":{
		"authentication":{
			"username":"admin",
			"password":"<your-strong-password-here>",
			"type":"basic"
		},
		"operation":"configure-one",
		"configure-one":{
			"snmpv3-enable":"off"
		}
	}
}
```

Reenabling SNMPv3 (and reenabling previously configured SNMPv3 admin user credentials)

```
{}{
	"protect":{
		"authentication":{
			"username":"admin",
			"password":"<your-strong-password-here>",
			"type":"basic"
		},
		"operation":"configure-one",
		"configure-one":{
			"snmpv3-enable":"on"
		}
	}
}
```

SNMPv3 and v1/2c Interactions

SNMPv1/2c only (default mode)

- get/set community access same as before.
- No access to v3 MIBs.

SNMPv1/2c access with SNMPv3 enabled

- get community read-only access (no v3 MIBs).
- set community not enabled (if different than get community).

SNMPv3 access (once configured/enabled)

- v3 user read-write access.
- v3 MIBs read-only, except for KeyChanges.
- All other security configuration must be done via "protect" operations.

IMPORTANT: When Protected Mode is enabled, writes to protected settings are prevented regardless of protocol version.

SNMPv3 Response Codes

New Protected Mode response codes have been added for SNMPv3 operations.

Code	Operation	Description
107	setup-snmpv3-user	Protected Mode password must be set
306	setup-snmpv3-user	setup-snmpv3-user object missing elements
307	setup-snmpv3-user	Authentication password too short
308	setup-snmpv3-user	Authentication password too long
309	setup-snmpv3-user	Privacy password too short
310	setup-snmpv3-user	Privacy password too long
311	setup-snmpv3-user	Authentication protocol invalid
312	setup-snmpv3-user	Privacy protocol invalid
313	setup-snmpv3-user	Authentication password contains invalid characters
314	setup-snmpv3-user	Privacy password contains invalid characters
315	setup-snmpv3-user	setup-snmpv3-user object missing
316	setup-snmpv3-user	Username too long
317	setup-snmpv3-user	Username too short
318	setup-snmpv3-user	Action invalid
319	setup-snmpv3-user	User already exists

320	setup-snmpv3-user	User does not exist
321	setup-snmpv3-user	User table full
322	setup-snmpv3-user	Operation failure
323	setup-snmpv3-user	Access invalid
506	configure-one	No SNMPv3 user configured

Best Practices – File Modification Protection

When Protected Mode is enabled, modification of user files (E: and R: memory) representing network credentials and encrypted configuration commands are not allowed to be modified without authentication. The following extensions are prevented from being created, deleted, appended, or copied over:

- NRD (network credentials, such as certificates or private keys)
- PAC (network credentials for EAP-FAST authentication)
- NRE (user-encrypted command files)

Zebra printers support many different commands and features that affect user files on the E: and R: files. These include, but are not limited to:

- Multi-Part Form file commands (MPF); preferred
- CPCL **! U1 DEFINE-FORMAT, CISDFCRC16, FILE RENAME, DEL…**
- ZPL **^DF, ~DG/DU/DE, ^ID, ^TO, …**
- Various SGDs (**file.delete, file.rename, file.append, file.capture_response.bin)**
- USB mirror
- Web pages

These features are prevented from creating, modifying, or deleting user files with protected extensions while Protected Mode is enabled. The Multi-Part Form command set is the recommended mechanism to authenticate a user that is provisioning these protected files (for example: initial network configuration, rotation of certificates, and keys), as it directly interoperates with Protected Mode.

To add authentication to an MPF command, add an **Authentication:** header to the command, with parameter **Basic <base64(“{username}:{password}”>.** For example, to store the file PRIVKEY.NRD in non-volatile user memory (E: drive), with Protected Mode username **admin** and password **ZebraTechnologies123!**, you could use the following command:

```
{}--<boundary characters><CR><LF>
Content-Disposition: form-data; name="files";
filename="E:PRIVKEY.NRD"; action="store"<CR><LF>
Authentication: Basic YWRtaW46WmVicmFUZWNobm9sb2dpZXMxMjMh<CR><LF>
Content-Type: application/octet-stream<CR><LF>
Content-Transfer-Encoding: binary<CR><LF>
<CR><LF>
<file contents><CR><LF>
<CR><LF>--<boundary characters>--
```

In the above example, **base64("admin:ZebraTechnologies123")** results in the output **`YWRtaW46WmVicmFUZWNobm9sb2dpZXMxMjMh.`**

If the command is successful, a response like the following will be returned by the printer:

```
[{"filename":"E:PRIVKEY.NRD","size":24,"crc32":3546853830}]
```

If the command is not successful (such as if authentication failed or too many attempts), the following response will be returned by the printer:

```
[{"filename":"E:PRIVKEY.NRD","status":"401"}]
```

Currently defined error status values are **401** for invalid authentication, **404** for file not found, and **429** for too many failed requests. Too many consecutive invalid authentication requests will result in authentication lockout (same as error 102 in Protect Mode JSON commands); when locked out, after 5 seconds, authentication may be tried again.

The **action** values that require authentication for protected file extensions are:

- **store –** create or modify a file in user memory
- **delete** – delete an existing file in user memory
- **place_cert –** place a signed certificate in user memory

Using legacy file commands

If you prefer to continue using older supported file commands, the **configure-one** operation in Protected Mode allows you to temporarily disable this protection, until it is turned back on or the printer is rebooted. Turning off this protection is a non-volatile operation and cannot be saved. An example of this command:

```
{}{
	"protect":{
		"authentication":{
			"username":"admin",
			"password":"<your-password-here>",
			"type":"basic"
		}
		"operation":"configure-one",
		"configure-one":{
			"allow-protected-file-modification":true
		}
	}
}
```

The **allow-protected-file-modification** key accepts **true** (enable modification) or **false** (disable modification) and takes effect immediately. You can add these commands to existing applications or scripts and use older file modification commands.

Using provisioning services

Zebra printers also support network services that can provision and modify user files, including:

- FTP/SFTP mirror
- MQTT / SOTI Connector

As configuration of mirror and MQTT modes is only allowed by an authenticated user, they are considered safe and files provisioned by these modes do not require special support, even if Protected Mode is enabled.

CAVEAT: command scripts executed via mirror that change SGDs are not currently supported in these modes. For FTP/SFTP and USB mirror, it is recommended to edit command scripts to include Protected Mode commands for changing SGD values.

Best Practices – Printer OS Download Protection

Zebra Link-OS printers use robust security mechanisms to ensure the authenticity and integrity of the printer OS download. Like Protected Mode, it is recommended that the ability to update the Printer's OS be restricted. To achieve this, Link-OS 6 has introduced a new SGD setting to prevent the firmware version from being changed.
("device.allow_firmware_downloads")

Recommendation:

Set the "device.allow_firmware_downloads" SGD to "no" and enable Protected Mode to ensure that the Download Protection setting cannot altered, unless an admin authorizes it.

Just like other devices, printers require regular OS updates to stay current with functional and security fixes. It is best practice to establish a regular cadence of updating printers with the latest version. Upgrades work best when part of a planned process, as it involves limited offline downtime to process the new firmware. When the time is right to upgrade a printer, the setting must be changed to allow new printer OS. This can be achieved in one of two ways:

One option is to bring the printer into a secure provisioning location, enable Printer OS downloads with an authorized protect command, download the update, and then disable Printer OS downloads again with a second authorized protect command. However, this involves a lot of steps and may be more complicated than necessary.

The most secure method to temporarily enable a Printer OS download is via the Protected Mode operation "allow-next-firmware-download". This enables the printer to receive an authorized command from an admin to accept the next Printer OS download it receives while still powered on. After the update is processed, the printer reverts back to not allowing any Printer OS to be downloaded.

An example of the command to perform this operation:

```
{}{
 "protect":{
  "authentication":{
   "username":"admin",
   "password":"< password >",
   "type":"basic"
  },
  "operation":"allow-next-firmware-download"
 }
}
```

If the command is successful, the printer will respond with the following response:

```
{} {"protect":{"status":0,"operation":"allow-next-firmware-download"}}
```

If the command is not successful it will respond with a non-zero "status"; see **Protect JSON Commands Response Codes** for a listing of all possible errors.

Recommendation: Utilize the protected mode command to temporarily enable Printer OS downloads when an upgrade is desired.

Printer OS Forced Download Mode

Zebra printers include a **Forced Download** mode, allowing the user to recover a printer with a corrupted or non-functional OS, given USB access to the printer. This mode does not support Protected Mode commands.

However, if Protected Mode is enabled, and the **device.allow_firmware_downloads** SGD is set to “no”, Forced Download Mode will still allow a new Printer OS to be downloaded. In this scenario, a decommission will be performed, wiping out all user data and configuration, including network credentials and all sensitive settings. It will also wipe out the Protected Mode password and configuration, requiring the printer to be reprovisioned securely.

Best Practices - Certificates

A certificate consists of public information identifying the device and a set of public and private keys used for encrypted communication. This section discusses, in general, some best practice considerations for creating and using certificates for network services.

Certificate and key files are sensitive as they are used to establish encrypted and trusted connections. With protected mode enabled, they cannot be modified (stored, deleted, or updated) unless explicitly allowed as described below. They cannot be retrieved from the printer.

Self-Signed Certificates (New for Link-OS 7.4.2)

To support TLS, HTTPS, and IPPS "out-of-the-box," the printer will automatically generate a self-signed certificate as needed. This certificate is used for **TLS raw**, **HTTPS**, and **IPPS** when no user-supplied certificate is available. The self-signed certificate ensures secure communication for these features without requiring immediate user configuration.

Certificate Properties

The self-signed certificate has the following characteristics:

Identity Properties:

- **Common Name (CN):** <printer-model>-<device.unique_id>
  Example: ZD621-D9J201600770
- **Organization Name:** Zebra Technologies
- **Country Name:** US
- **State or Province:** IL
- **Locality Name:** Lincolnshire

Technical Properties:

- **Key Algorithm:** Elliptic curve secp384r1
- **Validity Period:** 5 years from the date of creation (typically the first boot).
  Upon expiration, the printer will automatically generate a new self-signed certificate to replace the expired one.

Storage and Accessibility:

- The self-signed certificate is not stored in the user-accessible flash file system (the E: or Z: drives).
- It is securely stored in the printer's internal memory and is not directly accessible to users.

Usage Behavior

- The self-signed certificate is only used when a user-supplied certificate is not present.
- This fallback ensures secure communication for **TLS raw**, **HTTPS**, and **IPPS** until a user-supplied certificate is provided.

PKI Recommendations

PKI, or public key infrastructure, refers to the organization, creation, maintenance, and disposal of certificates in use for your devices. This section will not exhaustively detail all the best practices for PKI; it will touch on key points to consider for using certificates on your printer.

Certificate Files

The certificate and private key can be deployed to the device as a single file, or separate files. If using a single file, the name of the file must be:

```
XXXX_CERT.NRD
```

If using multiple files:

```
XXXX_CERT.NRD – certificate
XXXX_KEY.NRD – private key
```

The chain of trust file can support as many certificates as needed in this single file. For a PEM format, the two certificates would be concatenated together, one after the other.

The Chain of trust file is always loaded in:

```
XXXX_CA.NRD – certificate authority chain
```

Where XXXX is the name of the network service the certificates are intended for, acceptable values are:

```
WIRED
TLSRAW
HTTPS
IPP
MQTT1
MQTT2
WEBLINK1
WEBLINK2
```

WLAN certificates are an exception to this format and use different names:

```
CERTCLN.NRD - certificate
PRIVKEY.NRD - private key
CACERTSV.NRD - certificate authority chain
```

The printer supports PEM, and P12 certificate formats. It also supports DER files for WLAN and WIRED files.

Certificate Size Requirements

In keeping with latest industry wide recommendations (NIST, 2020), it is recommended to use only certificates with a signature of SHA-256 or higher (not including self-signed "Root" certificates).

For keys based on RSA, the size must be 2048 bits or higher. For keys based on ECDSA, the size must be 256 bits or higher.

Any certificates with a signature or key size smaller than this will not be accepted.

Unique Device Certificates

In general, a certificate is used to uniquely identify a device, determine ownership, and ensure you are communicating with the correct endpoint. The more times a single certificate is used on different devices, the more times the private key must be shared, which increases the risk that the information can be compromised. It is therefore recommended that each printer use its own unique certificate, preferably with a common name that contains the a unique identifier for the printer.

Certificate Life

The longer a certificate is in use, the higher chance it has of being compromised. It is therefore recommended to use the shortest valid certificate life as feasible with the printer in your network. A one-year expiration is the generally accepted recommendation for devices.

The printer has the capability of returning the expiration of the certificates it contains with an SGD command `file.cert.expiration`. This command will list all the network services that use certificates and any corresponding expiration information if a certificate is currently being used for that service. Here is an example of a printer that only contains the built-in certificates:

```
{"file.cert.expiration":[

{"service":"SHA2","file":"SHA2_DEVICE","expires_on":"2028-11-11 09:56:05"},
{"service":"WLAN","file":null,"expires_on":null},
{"service":"WIRED","file":null,"expires_on":null},
{"service":"WEBLINK1","file":null,"expires_on":null},
{"service":"WEBLINK2","file":null,"expires_on":null},
{"service":"TLSRAW","file":null,"expires_on":null},
{"service":"HTTPS","file":null,"expires_on":null},
{"service":"MQTT1","file":null,"expires_on":null},
{"service":"MQTT2","file":null,"expires_on":null},
{"service":"IPP","file":null,"expires_on":null},
{"service":"SELFSIGNED","file":"SELFSIGNED_CERT.NRD","expires_on":"2030-08-18
04:17:05"}]}
```

Certificate Creation

Off Printer, File Loaded

Certificates created on a separate system and loaded afterwards onto the printer file system has been supported since Link-OS 5 using the file naming scheme described earlier. This allows for support of existing workflows and older printer firmware. Unfortunately, it also involves transferring the private key from that system to the printer which increases the likelihood of the key material becoming compromised if not done securely.

Because certificates rely on sufficiently random numbers, you will want to ensure the system it is generated on has entropy sufficiently high for the creation of a new certificate and key. On Linux-based systems, this can be achieved by:

```
cat /proc/sys/kernel/random/entropy_avail
```

You will need to create certificates that contain the host name that the printer will have on the network as its common name in the certificate. As an example, here are some OpenSSL commands to achieve this:

RSA

```
openssl genrsa 2048 > XXXX_KEY.NRD
openssl req -new -x509 -nodes -sha256 -days 365 -key XXXX_KEY.NRD >
XXXX_CERT.NRD
```

You must fill out a valid Country, State, City, Company, and Common name.

ECC

```
openssl ecparam -out ec_params.pem -name prime256v1
openssl req -new -x509 -nodes -sha256 -days 365 -newkey ec:ec_params.pem -
keyout XXXX_KEY.NRD > XXXX_CERT.NRD
```

On Printer, CSR Generation

Generate CSR

A multipart form (MPF) command format is used to pass in parameters required for the printer to generate a new private key and a CSR file in PEM format. The printer automatically ensures enough entropy is present before attempting to generate the files. An alert is generated and sent over the weblink main connection or configured channel(s) when the CSR is ready. The CSR file can then be removed from the printer and sent to your signing authority where a certificate is created. That certificate must then be returned to the printer using the "place_cert" MPF command where it is validated before saving to the E: drive.

Here is an example of the command:

```
{}--<boundary characters><CR><LF>
Content-Disposition: form-data; name="files"; filename="<service name>";
action="generate_csr"<CR><LF>
Content-Type: application/octet-stream<CR><LF>
Content-Transfer-Encoding: binary<CR><LF>
<CR><LF>
{"CN":"<common name>",
  "key":{
    "algo":"ecdsa","size":256,"curve":"prime256v1"},
  "names":[
    {"C":"US",
    "L":"Lincolnshire",
    "O":"Zebra Technologies",
    "OU":"AIT",
    "ST":"Illinois",
    "challengePassword":"<challenge password>",
    "emailAddress":"<email address>",
    "subjectAltName":"<alternate name>"}],
  "message_digest":"sha256"}
<CR><LF>--<boundary characters>--
```

Where:

`{}` = Zebra defined starting characters used to signal the JSON parsing request

`--<boundary characters>` = must start with `--` and must contain no control characters (less than 0x20) until it ends with an end of line which is `<CR><LF>`. This is a group of characters that the exact sequence is not contained in the rest of the request. The boundary must be no more than 72 character which includes the `--`.

`<CR><LF>` = each line ends with a carriage return and line feed characters (0x0A 0x0D)

`<service name>` is the name of the service for which you want a CSR to be generated. It is case sensitive. Non-supported values will cause an error response. Acceptable values are:

```
WLAN
WIRED
TLSRAW
HTTPS
IPP
MQTT1
MQTT2
WEBLINK1
WEBLINK2
```

Following the headers and an additional `<CR><LF>` the body data for the CSR request begins

"`CN`" is the common name for the certificate

"`key`" requires "`algo`" and either "`size`" or "`curve`" field
"`algo`" is the algorithm field. Supported values are "`rsa`" and "`ecdsa`"
"`size`" is the key size.
"`rsa`" supports `2048`, `3072`, and `4096`

"ecdsa" if "curve" is missing, can be the following (and the implied curve):
224 (secp224r1)
256 (secp256r1)
384 (secp384r1)
521 (secp521r1)
"curve" is the name of the curve.
Use "file.cert.curves" to get a list of supported curves

"names" contains fields put into the CSR request and may include
"C" Country
"L" Locality
"O" Organization
"ST" State
"OU" Organizational Unit
"emailAddress" Email Address
"subjectAltName" Subject Alternative Name (SAN)
Without a format specifier the SAN will be considered a DNS name by default
"subjectAltName":"website.com" --> This will produce a CSR with a DNS SAN entry of "website.com"
With an OpenSSL format specifier, other types of SAN can be used such as User Principal Name (UPN), email address, IP address, and DNS.
"subjectAltName":"otherName:msUPN;UTF8:a@b.org" --> This will produce a CSR with a UPN SAN of "a@b.org"
Can be a single JSON string as above, or a JSON array of strings
"subjectAltName":["website.com",
"otherName:msUPN;UTF8:a@b.org"] --> This will produce a CSR with a SAN containing both of the previous SAN types
Refer to OpenSSL documentation for more details.

"challengePassword" Challenge Password required for some PKI systems

"message_digest" can be: sha256, sha384 or sha512

<CR><LF>--<boundary character> = Terminates a multipart request. If you have another request you may start with the next headers immediately, no additional boundary needed. When you have no more requests add an additional – characters (2 dashes) to terminate the multipart form parsing. You mix and match any combination of multipart form requests.

Successful generation will cause a CSR to be generated on the printer named

CSR_<SERVICE_NAME>_CERT.CSR

The CSR will be placed in protected space on the Z drive while the private key generated will be placed on the E: drive. You can retrieve this file from the printer via MPF "retrieve" command or other means. For example:

```
{}--<boundary characters><CR><LF>
Content-Disposition: form-data; name="files";
filename="Z:CSR_<service name>_CERT.CSR"; action="retrieve"<CR><LF>
Content-Type: application/octet-stream<CR><LF>
Content-Transfer-Encoding: binary<CR><LF>
<CR><LF>
<CR><LF>--<boundary characters>--
```

The retrieve command always returns a response even if the file is not present (status 404). It will return the data in the following format:

```
{}--<boundary characters><CR><LF>
Content-Disposition: filename="Z:CSR_<service name>_CERT.CSR";
status="200"; size="<file size>"<CR><LF>
Content-Type: application/octet-stream<CR><LF>
Content-Transfer-Encoding: binary<CR><LF>
<CR><LF>
<pem data><CR><LF>
--<boundary characters>--
```

NOTE: When the printer has Protected Mode enabled, the store, generate_csr, and place_cert commands all require an **Authentication** header, or the command will be rejected with a 401 status. See the section **Best Practices – File Modification Protection** for details.

Return response and alert

The generate_csr command always returns a response. It will return status="processing" if it has found no errors in the request.

```
[{"action"="generate_csr","filename":"<filename>","status"="processing"}]
```

It will return status="error" error_code=<number> if it has encountered an error in the request. If there is an error in the request it will not try to generate a CSR file.

```
[{"action"="generate_csr","filename":"<filename>","status"="error",
"error_code":42}]
```

Here are some error codes that can be returned:

```
No error = 0
System error = 1
Bad service name string, pick one of the supported services = 10
A problem occurred with the CRC when placing a cert over MPF = 11
A problem occurred with the file size when placing a cert over MPF = 12
Too many CSR requests are being processed = 50
Bad JSON formatting = 51
Bad common name (CN) = 53
Bad key size for the algorithm, pick a supported size = 54
Bad curve name, pick a supported name = 55
Bad key algorithm type, pick a supported type = 56
Bad location = 57
Bad state = 58
Bad country = 59
Bad organization = 60
Bad organization unit = 61
Bad email = 62
Bad subject alternate name = 63
Bad digest type, pick a supported digest type = 64
The challenge password specified was too large = 65
The challenge specified was invalid = 67
The customer organization unit was too large = 68
The hardware common name was invalid = 69
```

When the request is processing, an alert will be returned over the weblink main connection or configured channels when the certificate processing is complete. It may be successful or an error. The alert generated looks like this:

```
{
 "alert" : {
 "unique_id" : "XXXYYYZZZ",
 "time_stamp" : "2015-06-09 03:38:12",
 "type_id" : "ALERT or ERROR",
 "condition_id" : "CSR AVAILABLE",
 "condition_state" : "SET",
 "type" : "ALERT or ERROR CONDITION",
 "condition" : "CSR AVAILABLE ",
 "filename" : "UserCert.csr",
 "condition_code" : 0
 }
}
```

Where:

`unique_id` Printer Serial Number, as it appears on printer label
`time_stamp` Date/Time when the alert is generated
`type_id` "`ERROR`" if CSR generation failed or "`ALERT`" if success
`condition_id` Always "`CSR AVAILABLE`", identifies the alert
`condition_state` Always "`SET`"
`type`
"`ERROR CONDITION`" if CSR generation failed
"`ALERT`" if success
`condition` Always "`CSR AVAILABLE`"
`filename` The filename of the generated CSR (extension always .csr)
`condition_code` error code, listed above

Supported ECDSA curves

The following JSON command can be used to determine printer's elliptic curves supported for ECDSA operations:

```
{}{"file.cert.supported_curves":""}
```

You should receive a response like the following:

```
{"file.cert.supported_curves":"secp224k1,secp224r1,secp256k1,secp384r1,secp521r1,s
ect233k1,sect233r1,sect239k1,sect283k1,sect283r1,sect409k1,sect409r1,sect571k1,sec
t571r1,prime239v1,prime239v2,prime239v3,prime256v1,c2tnb239v1,c2tnb239v2,c2tnb239v
3,c2tnb359v1,c2tnb431r1,c2pnb272w1,c2pnb304w1,c2pnb368w1,wap-wsg-idm-ecid-
wtls10,wap-wsg-idm-ecid-wtls11,wap-wsg-idm-ecid-
wtls12,brainpoolP224r1,brainpoolP224t1,brainpoolP256r1,brainpoolP256t1,brainpoolP3
20r1,brainpoolP320t1,brainpoolP384r1,brainpoolP384t1,brainpoolP512r1,brainpoolP512
t1"}
```

Place Cert

A multipart form format to place a certificate onto the printer for usage by the printer. It will try to pair the public key in the certificate with the previously generated private key on the printer. If the private key is not found or there is a mismatch, an error will be returned. With protected mode enabled you will require the Authentication header with the protected mode password to store/update the certificate (new in Link-OS 7.4.2).

```
{}--<boundary characters><CR><LF>
Content-Disposition: form-data; name="files"; filename="<service name>";
action="place_cert"<CR><LF>
Content-Type: application/octet-stream<CR><LF>
Content-Transfer-Encoding: binary<CR><LF>
Authentication: Basic <authentication data><CR><LF>
<CR><LF>
<pem cert data>
<CR><LF>--<boundary characters>--
```

Where:

`{}` = (defined in generate CSR section)

`--<boundary characters>` = (defined in generate CSR section)

`<CR><LF>` = (defined in generate CSR section)

`<service name>` is the name of the service for which you want a to place the signed certificate. It is case sensitive. Other values will cause and error response. Successful placement will cause the private key and certificate to be placed into usage for that service. This should match the same service name used when generating the CSR

`<authentication data>` is the base64-encoded protected mode username and password in the format of **<username>:<password>**

`<pem cert data>` is the actual PEM file contents of the signed certificate. For HTTPS and TLSRAW each line should end with just a <LF> character, not a <CR><LF>.

`<CR><LF>--<boundary character>` = (defined in generate CSR section)

The place_cert command always returns a response. It will return status="success" if it has received a valid certificate, found the matching private key, and place the files into service.

[{"action"="place_cert",filename":"<filename>","status"="success"}]

It will return status="error" error_code=<number> if it has encountered an error in the request.

[{"action"="place_cert",filename":"<filename>","status"="error","error_code":42}]

MPF response error codes:

```
Certificate being placed is formatted incorrectly = 150
Certificate being placed using a weak cipher = 151
Certificate being placed does not match private key generated = 152
Certificate being placed is not valid for time on printer = 153
Authentication header missing, invalid, or bad username/password = 401
Authentication attempts locked, too many failures, wait 5 seconds = 429
```

Supported Ciphers

The following ciphers are supported for Weblink, HTTPS, and TLS. When setting up your system to communicate, you must use a secure cipher to help prevent the connection from being compromised. The following are all supported by Link-OS 7.4.2:

```
ECDHE-ECDSA-AES256-GCM-SHA384
ECDHE-ECDSA-AES128-GCM-SHA256
ECDHE-ECDSA-AES256-SHA384
ECDHE-ECDSA-AES128-SHA256
ECDHE-RSA-AES256-GCM-SHA384
ECDHE-RSA-AES128-GCM-SHA256
```

Certificate Downloading

Certificates themselves do not contain any data that must be kept private. A private key on the other hand must be kept secure to prevent being exposed. It is security best practice to load certificates and keys to the printer in a secure provisioning environment over an encrypted channel such as TLS. Secure provisioning networks are typically segregated from production or widely available networks. If encryption is unavailable, a physical connection such as USB is recommended. To download the various files to the printer, choose one of the following methods in security preferred order:

NOTE: Use the appropriate file name as discussed in the Certificates Best Practices section of this document.
NOTE: All but option 1, in the future 2, with protected mode enabled will require enablement of writing to protected filed before the operation will succeed. See "Best Practices – File Modification Protection" for how that is done.

1. **Multipart Form Store:**

```
{}--<boundary characters><CR><LF>
Content-Disposition: form-data; name="files";
filename="<drive letter>:<file name>"; action="store"<CR><LF>
Content-Type: application/octet-stream<CR><LF>
```

```
Content-Transfer-Encoding: binary<CR><LF>
Authentication: Basic <authentication data><CR><LF>
<CR><LF>
<file contents><CR><LF>
<CR><LF>--<boundary characters>--
```

Where:

<authentication data> is the base64 encoded protected mode username and password in the format of <username>:<password>

2. **SDK:** Use the Zebra Multiplatform SDK command line STORE function to send the files to the printer. The SDK is available for download at www.zebra.com/sdk
3. **ZPL:** Use the ! CISDSFCRC16 command, with the appropriate headers to the certificate to store the files on E: drive of the printer. Details available in the ZPL Programming Guide, available at www.zebra.com.

   Use the ~DY command, with the appropriate header to the certificate to store the files on E: drive of the printer. Details available in the ZPL Programming Guide, available at www.zebra.com.
4. **FTP:** If using FTP, make sure that the printer's "execute file" function is turned off while you send the file, so the file is stored and not processed as a printing command. This can be done by sending the following command:

```
! U1 setvar "ip.ftp.execute_file" "off"
```

NOTE: The command must be followed by a carriage return or a space character. If you plan on using FTP for printing purposes, be sure to reset this feature to "on" after storing the certificate files.

Connect to the printer via FTP and download the certificates to the printer.

Validating Certificates

To validate that your certificates are loaded onto the printer correctly, choose one of the following methods.

1. JSON: Issue the following to get a list of files on E: drive. Those downloaded via Multipart form will also list the CRC32 such that you can assure that the file you have matches the file on the printer.

```
{}{"file.drive_listing":"E"}
```

2. ZPL: Issuing one of the following commands allows you to confirm that the certificates have been stored on the file system. This can be done utilizing a terminal program or Zebra Setup Utilities.

```
^XA^WDE:*.nrd^XZ
```

NOTE: The above command will print a label listing all the files on the E: drive that have the ".nrd" extension.

```
^XA^HWE:*.NRD^XZ
```

NOTE: The above command will transmit a listing back to the host with all the files on the E: drive that have the ".nrd" extension.

3. Internal Web Page: Log into the internal web page and select Directory Listing.

You will be able to confirm that the certificate files are on the file system. However, you will only be able to see the files; you not be able to download them or view the contents.

Deleting Certificates

To delete certificates loaded on the printer, use the following method.

NOTE: All but option 1 with protected mode enabled will require enablement to delete protected files before the operation will succeed. See "Best Practices – File Modification Protection" for how that is done.

1. **Multipart Form Delete:**

   ```
   {}--<boundary characters><CR><LF>
   Content-Disposition: form-data; name="files";
   filename="<drive letter>:<file name>"; action="delete"<CR><LF>
   Content-Type: application/octet-stream<CR><LF>
   Content-Transfer-Encoding: binary<CR><LF>
   Authentication: Basic <authentication data><CR><LF>
   <CR><LF>
   <CR><LF>
   <CR><LF>--<boundary characters>--
   ```

   Where:

   <authentication data> is the base64 encoded protected mode username and password in the format of <username>:<password>

2. JSON: Issue the following command over any connection to delete the file you specify in place of CERTNAME.NRD.

```
{}{"file.delete":"E:CERTNAME.NRD"}
```

3. ZPL:

   a. Issuing the following command allows you to delete a certificate file stored on the file system. This can be done utilizing a terminal program or Zebra Setup Utilities.

```
^XA^IDE:<CERTNAME>.NRD^XZ
```

where <CERTNAME> is a single certificate file name.

or

```
^XA^IDE:*.NRD^XZ
```

This will delete all files with the .nrd extension.

   b. Issuing the following SGD command allows you to delete the specified file stored on the file system.

```
! U1 do "file.delete" "value"
```

Best Practices - WLAN Certificates

As described in the certificate best practices section it is important to use unique certificates per device to minimize access to the private key. Both can be achieved using the printer CSR (certificate signing request) functionality.

Starting in Link-OS 6 the printer supports JSON multi-part form commands for generating CSRs as well as placing the CA signed certificate back onto the printer. There is support for different message digests, ciphers, and key lengths to best meet a variety of security needs.

Private Key Passphrase

The client private key can be optionally encrypted with a passphrase. This is useful if the private key file is in an unprotected part of your network or needs to be transmitted in the clear.

It is important to note that the passphrase itself is not stored in an encrypted fashion on the printer. Because the passphrase must be kept secure, it is a best practice to configure this passphrase over a physical connection (USB), or a segregated provisioning network that is separate from the production or company network. The private key passphrase can be configured with the following SGD:

```
wlan.private_key_password
```

Certificate Files

```
CERTCLN.NRD - certificate
PRIVKEY.NRD - private key (optionally encrypted)
CACERTSV.NRD - certificate authority chain
```

For the certificate authority chain, if one access point certificate was signed by one CA, and another access point certificate was signed by a different CA, the same trust file could be used for both APs as long as both signing certificates were included in the same trust file.

Automation

It is recommended that you automate the process of renewing WLAN certificates. Printer Profile Manager Enterprise (PPME) version 3.1 or later can automate this process for you. Outlined below is the process PPME uses in certificate renewal process:

1. Poll the printer for certificate expiration date and time, on an interval dependent on your certificate lifetime
2. Determine if the WLAN certificate should be renewed or not
3. If the certificate should be renewed, issue a generate_csr command to the printer
4. Once ready, retrieve the CSR from the printer
5. Sign the CSR with a CA
6. Use the "place_cert command" to put that signed certificate back on the printer
7. Plan a time to reset the printer so that the new certificate can be used

If the printer already contains a CSR it can be reused by the CA and signed again without the printer needing to recreate the CSR. This assumes the private key has not been compromised.

Best Practices - LAN 802.1X

802.1X over LAN provides a mechanism to authenticate devices connecting to a network. To get this set up on the printer, a few settings must be configured. Once configured, the settings will take effect after a reset.

Security

The printer currently supports `peap`, `eap-tls`, and `eap-ttls` security. The choice of printer authentication mode should be driven by what is already in place on your network. In general, `eap-tls` provides a more robust mutual authentication and requires client certificates. If starting from scratch and with a robust PKI (public key infrastructure) already in place, `eap-tls` provides a more secure option, but may be more challenging to deploy. You can select your security method by using the following SGD command:

```
internal_wired.8021x.security
```

Username

The username is something that is needed for connection to the network and can be configured with the following SGD:

```
internal_wired.8021x.username
```

Private Key Passphrase

The client private key for use with TLS security can be optionally encrypted with a passphrase. This is useful if the private key file is in an unprotected part of your network or needs to be transmitted in the clear.

It is important to note that the passphrase itself is not stored in an encrypted fashion on the printer. Because the passphrase must be kept secure, it is a best practice to configure this passphrase over a physical connection (USB), or a segregated provisioning network that is separate from the production or company network. The private key passphrase can be configured with the following SGD:

```
internal_wired.8021x.private_key_password
```

Certificate Files

The certificate filename prefix is WIRED

```
WIRED_CERT.NRD – certificate file
WIRED_KEY.NRD – private key file (optionally encrypted)
WIRED_CA.NRD – certificate authority file
```

The Certificate authority file is for `the certificate received from the RADIUS server. This is used by the printer to verify the server's identity.` The printer supports PEM, DER, and P12 certificate formats.

Best Practices - Bluetooth Security

Bluetooth security on Link-OS printers is very important when deploying large numbers of remotely accessible devices into a customer site. Many times, Bluetooth-enabled Zebra devices will follow associates for the duration of a shift - and come into range of the public many times during that shift.

The goal of securing Bluetooth-enabled Zebra printers is to prevent unauthorized access to the printer from a distance. Certain information and profiles can be accessed by any remote device, but some profiles contain sensitive data and/or allow administrative capabilities. For these reasons, it is important to secure Bluetooth connected devices.

Overview

Transports

Bluetooth functionality is divided into two supported *transports*: Classic (also known as BR/EDR) and Low Energy (also known as BTLE, BLE, or LE). Each transport has slightly different security features and considerations; this document will address them separately.

Some Bluetooth-capable Zebra printers support only Bluetooth Classic, some support only Bluetooth LE, and some support both.

Pairing and Encryption

Pairing in Bluetooth refers to a process in which you can associate two Bluetooth devices with a shared, private encryption key. The storage of these encryption keys for later use is referred to as *bonding.* It is important to note that once two Bluetooth devices are bonded, they are considered **trusted.** That is, future connections between those two devices will resume the encrypted session silently, and the remote device will retain access to sensitive profiles. This makes it crucial that two untrusted devices are never paired.

Authentication

Establishing an encrypted connection between two Bluetooth devices is not the only consideration for secure communications; it is often important to establish an *authenticated* connection in addition to an *encrypted* connection. An encrypted connection is considered authenticated if it can be proven that the connected devices exchanged encryption keys without a Man-in-the-Middle (MITM) being able to intercept the keys. Bluetooth uses distinct security procedures depending on whether devices can provide authenticated connections; these will be discussed below for both Classic and LE.

Bluetooth Classic

Discoverability

The SGD command "`bluetooth.discoverable`" controls whether the Zebra printer will respond to *inquiry requests* from a remote device. This Classic feature is called *discoverable mode*: if it is disabled, remote devices are not able to easily find the printer.

NOTE: Starting with Link-OS 6, the "`bluetooth.discoverable`" function is now **off** by default and other devices cannot see or connect to the printer.

With discoverability disabled, the printer will still make connections with a remote device that was previously paired.

RECOMMENDATIONS: Only keep discoverable mode enabled while paring to a remote device in a secure non-public environment. Once paired, discoverable mode should be disabled. Starting with Link-OS 6, a new feature was introduced to enable limited discovery. Holding down the FEED button for 5 seconds will enable limited pairing mode. Limited pairing mode enables discovery and pairing for 2 minutes. This enables the printer to operate safely with discoverable mode disabled until a user with physical access to the printer activates it.

Upon entering Bluetooth Pairing Mode, the printer will provide feedback that the printer is in Pairing Mode using one of these methods:

- On printers with a "Bluetooth" screen icon or Bluetooth LED, the printer shall flash the "Bluetooth" screen icon or Bluetooth LED on and off every second while in pairing mode
- On printers without a "Bluetooth" screen icon or Bluetooth LED, the printer shall flash the "Data" icon or Data LED on and off every second while in pairing mode
- Specifically, on the ZD220, ZD230, and ZD888 models, the 4 flash LED sequence places the printer into Bluetooth Pairing Mode.
- Specifically, on the ZD510 model, the 5 flash LED sequence places the printer into Bluetooth Pairing Mode.

NOTE: If the user wants to completely disable Bluetooth connectivity, including discovery and pairing, they can disable the Bluetooth radio entirely.

Pairing

Bluetooth Classic security and pairing modes have evolved with revisions to the standard, and can be divided into three major groups:

1) **No security** – Neither encryption nor authentication are required to access sensitive profiles.

2) **Legacy security (pre-SSP)** – Prior to Bluetooth 2.1, Classic connections could only be secured with a "PIN"; this is a variable-length shared passphrase that allows two devices to start encryption and pairing. Any sequence of bytes may be used to form a PIN, including ASCII characters. It is not limited to numeric values, although not all Bluetooth devices support alphanumeric PIN entry.

3) **Secure Simple Pairing (SSP)** – With the introduction of Bluetooth 2.1, Secure Simple Pairing allows for several types of simple modes to encrypt and authenticate communications between two SSP-enabled devices. The modes available depend on the *I/O capabilities* of the two devices wishing to communicate and provide varying levels of authenticity guarantees and protection against MITM attacks.

When a device supporting SSP tries to access one of the printer's Serial Port Profiles, SSP pairing will always be used. If both devices have a display and support some level of MITM protection, the *Numeric Comparison* pairing procedure will be used. This procedure requires both sides to display and confirm a 6-digit numeric code that is securely exchanged between the two devices. If either device displays a different numeric code, it is possible the connection is being tampered with and pairing should be rejected by the user.

If one or both devices do not support a display, the *Just Works* pairing procedure will be used, if allowed by the printer's configuration. *Just* Works mode encrypts the connection, but no prompts will be shown by either side to confirm this process. There is no way to verify that a third device has not performed an MITM attack; *Just Works* is an unauthenticated pairing procedure.

Zebra printers also support "no security" and legacy PIN pairing modes to be backwards compatible with early Bluetooth radios and stacks, many of which are still in use by our customers. This feature is enabled by default. However, it is recommended that customers who do not need these modes disable them to prevent unauthorized access.

Bluetooth Classic security capabilities are controlled by four SGDs:

1. "`bluetooth.minimum_security_mode`": Selects minimum level of security required for a remote device to access all profiles and services on the printer.
   - "1" - No security is required.
   - "2" - Encryption is required; Authentication is *not* required.
   - "3" - Encryption and Authentication are required; legacy pairing is enabled.
   - "4" - Encryption and Authentication are required; SSP is required. This will force Numeric Comparison mode.
2. "`bluetooth.allow_non_display_numeric_comparison`": for printers without a display, this setting controls whether the Numeric Comparison confirmation code is displayed by physically printing it (**default**), automatically confirming it, or disabling Numeric Comparison entirely.
3. "`bluetooth.bonding`": enable (**default**) or disable storage of link keys for paired printers. It is **not recommended** to disable this feature.

4. "`bluetooth.bluetooth_pin`": Configure the legacy PIN shared secret; the printer supports PINs up to the maximum of 16 bytes. If the PIN is empty, legacy PIN pairing is disabled. The PIN is **empty by default**.

NOTE: For printers that have a display, the minimum-security level default changed from 1 to 3 in Link-OS 6.

NOTE: For printers that do not have a display, the minimum-security level default changed from 1 to 2 in Link-OS 7.4.2.

RECOMMENDATIONS: The recommended Bluetooth security configuration will depend on the types of printers in use and the remote devices connecting to them. If the remote devices expected to connect to Zebra printers have a display and support Secure Simple Pairing, and the Zebra printer has a display, it is highly recommended to configure the minimum security level to 4. This forces the remote device to use a pairing mode that supports some level of MITM protection and will not allow legacy nor unencrypted access.

If the printer is a model without a display, it is a bit trickier to use minimum security level 4, as the numeric comparison code for SSP cannot be displayed. Such printers are configured by default to print the comparison code on the customer's media; however, this may not be desirable if frequent pairing is required or if the customer's media is expensive.

If the remote device does not support Bluetooth 2.1 with SSP, the minimum security level should be set to 3 and "`bluetooth.bluetooth_pin`" must be set to the desired shared secret. This forces authentication while allowing legacy PIN pairing. **Legacy PIN pairing is not recommended for new integrations, and will be removed in future releases.**

Currently Zebra printers do not support the ability to enable 'Secure Connections Only', a specific Bluetooth Classic security feature. Regardless of which transport or security level is in use, it is important to reduce risk from MITM attacks by making use of bonded devices originally paired from a secure and trusted non-public environment.

Bluetooth Low Energy (BTLE)

Advertising

The concept of *advertising* mode is similar to discoverable mode in Bluetooth Classic, with a few key differences. Unlike in Bluetooth Classic, Bluetooth LE devices are only connectable while they are advertising.

NOTE: Zebra printers do not currently support a capability to disable LE advertising without completely disabling Bluetooth LE support, which implies LE-enabled printers are always connectable. To disable Bluetooth LE on dual-mode (Classic+LE) printers, you can set the SGD `bluetooth.le.controller_mode` to "classic".

Pairing

Pairing in Bluetooth LE is similar to Classic; pairing can be both authenticated (with MITM protection) and unauthenticated. The SGD "`bluetooth.minimum_security_mode`" controls whether pairing/encryption is required to access the Zebra Printer and Configuration Service.

1. "`bluetooth.minimum_security_mode`": Selects minimum level of security required for a remote device to access all profiles and services on the printer.
    - "1" - No security is required.
    - "2" - Encryption is required; Authentication is *not* required.
    - "3" or "4" - Encryption and Authentication are required.
2. "`bluetooth.allow_non_display_numeric_comparison`" allows printers without a display to print the passkey or numeric comparison code on the user's media.
3. "`bluetooth.bonding`": enable (**default**) or disable storage of link keys for paired printers. It is **not recommended** (or for some LE-only printers not possible) to disable this feature.

Much like Classic, LE supports a "Just Works" mode (no authentication or MITM protection) for devices without a display, and a "passkey" mode that is similar to "Numeric Comparison" on Classic.

LE versions 4.2+ also support a "Numeric Comparison" pairing mode; this is supported on printers with 4.2-compatible Bluetooth radios, and firmware versions Link-OS 5 and newer. Passkey and Numeric Comparison pairing modes provide authentication.

RECOMMENDATIONS: Force pairing requiring Authentication by setting "`bluetooth.minimum_security_mode`" to "4". If the printer cannot support display of the passkey, set it to "2".

Currently Zebra printers do not support the ability to enable 'Secure Connections Only', a specific Bluetooth LE security feature. Regardless of which transport or security procedure is in use, it is important to reduce risk from MITM attacks by making use of bonded devices originally paired from a secure and trusted non-public environment.

Best Practices - HTTPS Security

Certificate Files

Starting in Link-OS 5, you can also communicate using HTTPS to view printer web pages over a TLS channel to ensure that communication is encrypted. Even with this extra encryption, it is important to limit unauthorized access of the printer such that it is not accessible on the public Internet. Instead, consider accessing it through a firewall or on an internal private network only. To begin communicating with the printer over HTTPS, you first need to deploy a certificate to the device. A certificate consists of public information identifying the device and a set of public and private keys used for encrypted communication to the device.

Please note that any common name will be accepted by most browsers. However, you should select a common name that preferably contains the printer's host name.

The certificate filename prefix is HTTPS.

```
HTTPS_CERT.NRD – certificate file
HTTPS_KEY.NRD – private key file (cannot be encrypted)
HTTPS_CA.NRD – certificate authority chain
```

The certificate authority chain will be presented during connection to the client. It should contain all the appropriate intermediary certificates in the trust chain between the printer's certificate and a trusted authority.

HTTPS Port

Once the device certificates are loaded and the printer has rebooted, you can begin using HTTPS. The port for HTTPS is, by default 443, and can be configured using the following SGD command:

"`ip.https.port`"

This assumes that HTTPS is enabled with the following SGD command:

"`ip.https.enable`"

Disable HTTP Access

Once HTTPS communication is verified and operational, it is a security best practice to disable unencrypted forms of communicating with the printer over a network. This includes disabling HTTP access using the "`ip.http.enable`" command.

Public Key Validation

As stated earlier, the HTTPS implementation does no authentication of devices connecting to it. The client connecting to the printer can validate it is talking directly to the printer through the use of comparing public keys. The client should know the public key of the printer that was originally loaded. When making the first connection to the printer, the client can verify this pinned public key to the one it is currently receiving from the printer to ensure there is no Man In The Middle (MITM) interference occurring.

Best Practices - IPPS Security

Certificate Files

Starting in Link-OS 7.4, you can communicate using IPP/IPPS with the printer. It is best practice to do this using IPPS, which uses a TLS channel that ensures communication is encrypted. Even with this extra encryption, it is important to limit unauthorized access of the printer such that it is not accessible on the public Internet. Instead, consider accessing it through a firewall or on an internal private network only.

IPPS communication has built-in certificates, but you can override them with your own certificates. A certificate consists of public information identifying the device and a set of public and private keys used for encrypted communication to the device. Starting in Link-OS 7.4.2, self-signed certificates can be generated as needed. (See Self-Signed Certificates (**New for Link-OS 7.4.2.**)

Please note when supplying your own certificates that any common name will be accepted by most browsers. However, you should select a common name that preferably contains the printer's host name.

The certificate filename prefix is IPP.

```
IPP_CERT.NRD – certificate file
IPP_KEY.NRD – private key file (cannot be encrypted)
```

Disable IPP Access

Once IPPS communication is verified and operational, it is a security best practice to disable unencrypted forms of communicating with the printer over a network. This includes disabling IPP access by setting the IPP mode to IPPS only using the "`ip.ipp.mode`" command.

Public Key Validation

As stated earlier, the IPPS implementation does no authentication of devices connecting to it. The client connecting to the printer can validate it is talking directly to the printer through the use of comparing public keys. User-loaded certificates should be provided to the client or the built in certificate can be gathered from a web browser. When making the connection to the printer, the client can verify this pinned public key to the one it is currently receiving from the printer to ensure there is no Man In The Middle (MITM) interference occurring.

Best Practice - TLS Security

Disable Unsecure Network Access

Once TLS communication is verified and operational, it is a security best practice to disable unencrypted forms of communicating with the printer over a network. This includes disabling:

```
ip.tcp.enable
ip.udp.enable
ip.ftp.enable
ip.lpd.enable
ip.http.enable
ip.snmp.enable
```

Enable Firewall Allow list

It is important to note that in the steps above, we have only established encrypted communication, but not authentication. The printer accepts any connection over TLS and does no authentication of the host. As such, you could also ensure that only communication from the desired host IP address is allowed through use of the following SGD:

```
ip.firewall.whitelist_in
```

Public Key Validation

As stated earlier, the TLS implementation does no authentication of devices connecting to it. The client connecting to the printer can, however, validate it is, in fact, talking directly to the printer by comparing public keys. The client should know the public key of the printer that was originally loaded. When making first connection to the printer, the client can verify this pinned public key to the one it is currently receiving from the printer to ensure there is no Man In The Middle (MITM) interference occurring.

Best Practices - TCP Channel Security

TCP Configuration

TCP Raw Ports

Communication with the printer command language parser is enabled over TCP via multiple ports. For unencrypted TCP raw access, there are two ports available, 6101 and 9100, and may be configured respectively using the following SGD commands:

```
ip.port
ip.port_alternate
```

To make use of TCP raw communication, ensure that it is enabled using the following SGD command:

```
ip.tcp.enable
```

JSON Raw Port

In addition to the printer command language parser, JSON is used exclusively for configuration retrieval and modification with no label formatting support. This is accessible via a separate port, 9200, which is configurable using the following SGD command:

```
ip.port_json_config
```

TCP Raw Communication

To easily verify the printer is responding, you can connect to the printer via a telnet application using one of the ports specified above. Then, send a simple command to the printer (such as ~HI if it supports ZPL) to verify it was received and sends data back. You will also be able to view traffic unencrypted via any packet capturing software.

NOTE: TCP Raw is disabled by default in Link-OS 7.4.2.

TLS Configuration

Certificate Files

Starting in Link-OS 5, you can also communicate using TLS to provide an encrypted channel to the printer. Starting in Link-OS 7.4.2 the printer generates a self-signed certificate that is used when user certificate/key is not present. Older versions first need to deploy a certificate to the device. A certificate consists of public information identifying the device and a set of public and private keys used for encrypted communication to the device.

Please note that any common name will be accepted. However, you should select a common name that preferably contains the printer's host name.

The certificate filename prefix is TLSRAW

```
TLSRAW_CERT.NRD – certificate file
TLSRAW_KEY.NRD – private key file (cannot be encrypted)
TLSRAW_CA.NRD – certificate authority chain
```

The certificate authority chain will be presented during connection to the client. It should contain all the appropriate intermediary certificates in the trust chain between the printer's certificate and a trusted authority. The root certificate should be installed on the machine(s) that will be connecting to the printer's TLSRAW server to establish the root of the trust chain of the printer.

TLS Raw Port

Once the device certificates are loaded and the printer has rebooted, you can begin encrypted communication using TLS. The port for TLS connecting to the printer command language parser is, by default, 9143, and can be configured using the following SGD command:

```
ip.tls.port
```

This, of course, assumes that TLS is enabled using the following SGD command:

```
ip.tls.enable
```

TLS JSON Raw Port

As before, the printer also has a JSON interface for encrypted communication with TLS using port 9243, and can be configured using the following SGD command:

```
ip.tls.port_json_config
```

TLS Communication

To verify the printer is working with the device certificates over TLS, you can issue the following OpenSSL command:

```
echo "~WC" | openssl s_client – connect 10.80.124.159:9143 -quiet
```

This sends the ~WC ZPL print config label command to openssl for a TLS connection to the printer and port specified. If you attempt to view captured packets, you will also find that the data is encrypted and unreadable.

Best Practices - Weblink (Web Sockets) Security

Certificates

By default, the printer comes supplied with a generic weblink device certificate and Zebra server certificate authority. These certificates can be used for connecting to a weblink or web sockets server with a Zebra signed server certificate.

Another option is to use Link-OS 5 or greater user supplied certificates. Individual certs are best but general printer certificates can be used with care as well. Upon reset, once the printer has an IP address, it will attempt to use the provided certificates to make an initial weblink connection.

Certificate Files

The following filenames shall be used to store the certificates:

```
WEBLINKX_CERT.NRD – device printer certificate
WEBLINKX_KEY.NRD – device printer private key (cannot be encrypted)
WEBLINKX_CA.NRD – server certificate authority chain
WEBLINKX_CRL.NRD – certificate revocation list
```

Where "WEBLINKX" is either "WEBLINK1" or "WEBLINK2"

Retry Interval

To prevent flooding a weblink server with connections, it is recommended to configure a random retry interval. This allows for all the devices connecting to the weblink server to attempt reconnection at different times after a connection loss event. The SGD to configure this is:

```
weblink.ip.connX.retry_interval_random_max
```

Where `connX` is the connection 1 or 2 for weblink

If this is set to a non-zero value, the printer will wait a random number of seconds between 1 and the value specified when attempting to reconnect. If the value is zero, then another SGD will be used to configure the number of seconds it will wait before attempting reconnection. The SGD to configure this is:

```
weblink.ip.connX.retry_interval
```

Where `connX` is the connection 1 or 2 for weblink

How to Create a Weblink Server CSR (certificate signing request)

For detailed steps, go to: https://techdocs.zebra.com/link-os/2-14/webservices/

When the CSR has been created, it can be signed by Zebra or whichever PKI certificate authority is preferred.

Best Practices - MQTT Security

Certificates

By default, the printer comes supplied with a generic MQTT device certificate, but unlike Weblink does not contain a Zebra broker certificate authority.

A broker certificate authority must be provided to enable a successful connection via MQTT over TLS. Some brokers may also require username and password authentication, or specific device certificates that can be loaded on to the printer instead of using the generic default certificate.

Certificate Files

The following filenames shall be used to store the certificates:

```
MQTTX_CERT.NRD – device printer certificate
MQTTX_KEY.NRD – device printer private key (cannot be encrypted)
MQTTX_CA.NRD – broker certificate authority chain
```

Where "MQTTX" is either "MQTT1" or "MQTT2"

Retry Interval

To prevent flooding an MQTT broker with connections, it is recommended to configure a random retry interval. This allows for all the devices connecting to the MQTT broker to attempt reconnection at different times after a connection loss event. The SGD to configure this is:

```
mqtt.connX.retry_interval_random_max
```

Where `mqttX` is the connection 1 or 2 for MQTT

The printer will wait a random number of seconds between 1 and the value specified when attempting to reconnect.

Best Practices - Printer Time

Many certificates use time to ensure that the certificate is valid. The printer must also have the correct time set. If the printer is set to an earlier time than the certificate begins, or a later time than the certificate expires, the connection will be rejected. Additionally, having the correct time on the printer is useful for log event correlation.

Recommendation

The printer supports NTP configuration that will automatically set the printer time based on NTP server time using the following SGD commands:

```
ip.ntp.enable
ip.ntp.servers
```

If NTP is unavailable, manually set the printer time, using the following SGD commands:

```
rtc.time
rtc.date
```

Alternatively, you can also set the time using the standard Unix Epoch (number of seconds since January 1, 1970). Setting time in this manner is useful for devices that exist across multiple time zones. This can be configured using the following SGD command:

```
rtc.unix_timestamp
```

Best Practices - Printer Decommissioning

Starting in Link-OS 6, Zebra printers have a new capability - to delete all user data, reset all settings, and admin configurations. This feature also includes the option to wipe flash memory of any previous data with a maximum of 3 passes. The Decommissioning process provides the ability to know that sensitive data has been removed from the printer and it can be used for other purposes. It is also useful for restoring a printer back to configurability if a Protected Mode admin password is forgotten or lost.
To Decommission the printer, the user must specify the following ZPL command using the USB (client) connection:

```
~PM<printer serial number>,<number of flash wipe passes (default of 0)><CR>
```

For example:

```
~PM456c766973
```

NOTE: Decommissioning can only be performed using the USB (client) port. If the ~PM command is received on any other port, such as Bluetooth or Ethernet, it will be ignored.

This command would Decommission that printer only if the serial number matched what was specified in the command. The command will be ignored if the serial number does not match the printer, or if it was sent over any other port than USB.

Decommissioning a printer will remove the device from Protected Mode. If Protected Mode is being used, the printer will need to be placed back in that Mode after the Decommission is finished.

NOTE: There was an issue in Link-OS 6.0 that requires an additional sequence to be executed to finalize the Decommissioning Process. This issue was corrected in Link-OS 6.1, so the following only applies if using v6.0.

The required steps are:

1. Once the printer reboots, place the printer in Protected Mode, using this JSON command:

```
{}{
   "protect":{
       "authentication":{
       "username":"admin",
       "password":"",
       "type":"basic"
       },
       "operation":"setup",
       "setup":{
       "username":"admin",
       "password":"Ant1%oTdq$2P9f"
       }
   }
}
```

2. Then, exit Protected Mode, using the Password you previously used to enter Protected Mode. For example, if your password was “Ant1%oTdq$2P9f” as shown above, you’d send this JSON command to the printer:

```
{}{
   "protect":{
       "authentication":{
       "username":"admin",
       "password":"Ant1%oTdq$2P9f",
       "type":"basic"
       },
       "operation":"setup",
       "setup":{
       "username":"admin",
       "password":""
       }
   }
}
```

Recommendation: It is security best practice to issue a decommission command before reselling or recycling the device to another group to ensure there is no access to printer data. This may include proprietary fonts, formats, files, or network configuration. Depending on the sensitivity of the data, you may want to consider a flash wipe as part of the decommission as well. A flash wipe does take considerable time, which will vary in length, based on printer model.

Protected SGD/ZPL/CPCL Commands

The following Set/Get/Do (SGD) commands are affected by Protected Mode, which was introduced in Link-OS 6.

For more information on the syntax and use of each command, refer to the Zebra Programming Guide for ZPL II, ZBI 2, Set-Get-Do, Mirror, WML.

Protected SGD Command
alerts.configured alerts.add alerts.http.proxy alerts.http.authentication.add alerts.http.authentication.remove alerts.http.logging.clear alerts.http.logging.max_entries
apl.enable
bluetooth.allow_non_display_numeric_comparison bluetooth.bluetooth_pin bluetooth.bonding bluetooth.clear_bonding_cache bluetooth.discoverable bluetooth.enable bluetooth.enable_reconnect bluetooth.friendly_name bluetooth.json_config_channel_enable bluetooth.le.controller_mode bluetooth.le.power_class bluetooth.minimum_security_mode bluetooth.power_class
capture.channel1.port
card.enable
device.allow_firmware_downloads device.fips.enabled device.friendly_name device.prompted_network_reset device.reset device.syslog.configuration device.syslog.enable device.xml.enable
display.password.current display.password.level
input.capture
interface.network.active.arp_interval interface.network.active.default_addr_enable interface.network.active.gateway interface.network.active.ip_addr interface.network.active.netmask interface.network.active.protocol
internal_wired.8021x.password internal_wired.8021x.peap.anonymous_identity internal_wired.8021x.peap.validate_server_certificate

Protected SGD Command
internal_wired.8021x.privkey_password internal_wired.8021x.security internal_wired.8021x.ttls_tunnel internal_wired.8021x.username internal_wired.auto_switchover internal_wired.enable internal_wired.activity_led internal_wired.ip.addr internal_wired.ip.arp_interval internal_wired.ip.default_addr_enable internal_wired.ip.dhcp.arp_verify internal_wired.ip.dhcp.cache_ip internal_wired.ip.dhcp.cid_all internal_wired.ip.dhcp.cid_enable internal_wired.ip.dhcp.cid_prefix internal_wired.ip.dhcp.cid_suffix internal_wired.ip.dhcp.cid_type internal_wired.ip.dhcp.option12 internal_wired.ip.dhcp.option12_format internal_wired.ip.dhcp.option12_value internal_wired.ip.dhcp.request_timeout internal_wired.ip.dhcp.requests_per_session internal_wired.ip.dhcp.session_interval internal_wired.ip.dns.domain internal_wired.ip.dns.servers internal_wired.ip.gateway internal_wired.ip.netmask internal_wired.ip.port internal_wired.ip.port_alternate internal_wired.ip.port_json_config internal_wired.ip.protocol internal_wired.ip.timeout.enable internal_wired.ip.timeout.value internal_wired.ip.wins.addr internal_wired.ip.wins.permanent_source internal_wired.ipv6.address_type
ip.bootp.enable ip.dhcp.auto_provision_enable ip.dhcp.enable ip.dhcp.ntp.enable ip.dhcp.user_class_id ip.dhcp.vendor_class_id ip.discovery.enable ip.discovery.port ip.firewall.authentication.add ip.firewall.authentication.remove ip.firewall.proxy ip.firewall.whitelist_in ip.ftp.enable ip.ftp.execute_file

Protected SGD Command
ip.ftp.request_password
ip.http.admin_name
ip.http.admin_password
ip.http.authorization_timeout
ip.http.custom_link_name
ip.http.custom_link_url
ip.http.enable
ip.http.faq_url
ip.http.port
ip.https.enable
ip.lpd.enable
ip.mirror.appl_path
ip.mirror.auto
ip.mirror.error_retry
ip.mirror.feedback.auto
ip.mirror.feedback.freq
ip.mirror.feeback.odometer
ip.mirror.feeback.path
ip.mirror.fetch
ip.mirror.freq_hours
ip.mirror.interface
ip.mirror.mode
ip.mirror.password
ip.mirror.path
ip.mirror.reset_delay
ip.mirror.server
ip.mirror.username
ip.ntp.enable
ip.ntp.servers
ip.ping_remote
ip.ping_gateway_interval
ip.pop3.enable
ip.pop3.password
ip.pop3.poll
ip.pop3.print_body
ip.pop3.print_headers
ip.pop3.save_attachments
ip.pop3.server_addr
ip.pop3.username
ip.pop3.verbose_headers
ip.port
ip.port_alternate
ip.port_json_config
ip.port_single_conn
ip.primary_network
ip.remote
ip.roam_packet
ip.smtp.domain
ip.smtp.enable
ip.smtp.server_addr
ip.snmp.enable

Protected SGD Command
ip.snmp.get_community_name ip.snmp.set_community_name ip.snmp.trap_community_name ip.tcp.enable ip.tls.enable ip.tls.port ip.tls.port_json_config ip.udp.enable
mqtt.conn1.clean_session_flag mqtt.conn1.mqtt_version mqtt.conn1.password mqtt.conn1.ping_interval mqtt.conn1.qos mqtt.conn1.reset_now mqtt.conn1.retry_interval_random_max mqtt.conn1.server_address mqtt.conn1.tenant_id mqtt.conn1.username mqtt.conn2.clean_session_flag mqtt.conn2.mqtt_version mqtt.conn2.password mqtt.conn2.ping_interval mqtt.conn2.qos mqtt.conn2.reset_now mqtt.conn2.retry_interval_random_max mqtt.conn2.server_address mqtt.conn2.tenant_id mqtt.conn2.username mqtt.enable mqtt.logging.max_entries mqtt.logging.clear mqtt.restore_defaults
netmanage.avalanche.agent_addr netmanage.avalanche.available_agent netmanage.avalanche.available_port netmanage.avalanche.encryption_type netmanage.avalanche.interval netmanage.avalanche.interval_update netmanage.avalanche.model_name netmanage.avalanche.realtime_update_int netmanage.avalanche.set_property netmanage.avalanche.startup_update netmanage.avalanche.tcp_connection_timeout netmanage.avalanche.terminal_id netmanage.avalanche.text_msg.print netmanage.avalanche.text_mesg.display netmanage.avalanche.text_mesg.beep netmanage.avalanche.upd_timeout netmanage.type
power.shutdown
rtc.date

Protected SGD Command
rtc.time rtc.timezone rtc.unix_timestamp
usb.host.lock_out usb.mirror.appl_path usb.mirror.auto usb.mirror.enable usb.mirror.error_retry usb.mirror.feedback.auto usb.mirror.feedback.odometer usr.mirror.feedback.path usb.mirror.fetch usb.mirror.path usb.mirror.reset_Delay
weblink.cloud_connect.configuration_confirmation weblink.cloud_connect.configuration_key weblink.cloud_connect.connect weblink.ip.conn1.authentication.add weblink.ip.conn1.authentication.remove weblink.ip.conn1.location weblink.ip.conn1.maximum_simultaneous_connections weblink.ip.conn1.proxy weblink.ip.conn1.retry_interval weblink.ip.conn1.retry_interval_random_max weblink.ip.conn1.test.location weblink.ip.conn1.test.retry_interval weblink.ip.conn1.test.test_on weblink.ip.conn2.authentication.add weblink.ip.conn2.authentication.remove weblink.ip.conn2.location weblink.ip.conn2.maximum_simultaneous_connections weblink.ip.conn2.proxy weblink.ip.conn2.retry_interval weblink.ip.conn2.retry_interval_random_max weblink.ip.conn2.test.location weblink.ip.conn2.test.retry_interval weblink.ip.conn2.test.test_on weblink.logging.clear weblink.logging.max_entries weblink.zebra_connector.authentication.add weblink.zebra_connector.authentication.remove weblink.zebra_connector.enable weblink.zebra_connector.proxy
wlan.11d.enable wlan.8021x.authentication wlan.8021x.eap.password wlan.8021x.eap.privkey_password wlan.8021x.eap.username wlan.8021x.enable wlan.8021x.peap.anonymous_identity wlan.8021x.peap.peap_password

Protected SGD Command
wlan.8021x.peap.peap_username
wlan.8021x.peap.privkey_password
wlan.8021x.peap.validate_server_certificate
wlan.8021x.ttls_tunnel
wlan.allowed_band
wlan.band_preference
wlan.channel_mask
wlan.country_code
wlan.enable
wlan.essid
wlan.international_mode
wlan.ip.addr
wlan.ip.arp_interval
wlan.ip.default_addr_enable
wlan.ip.dhcp.arp_verify
wlan.ip.dhcp.cache_ip
wlan.ip.dhcp.cid_all
wlan.ip.dhcp.cid_enable
wlan.ip.dhcp.cid_prefix
wlan.ip.dhcp.cid_suffix
wlan.ip.dhcp.cid_type
wlan.ip.dhcp.option12
wlan.ip.dhcp.option12_format
wlan.ip.dhcp.option12_value
wlan.ip.dhcp.requests_per_session
wlan.ip.dhcp.request_timeout
wlan.ip.dhcp.required
wlan.ip.dhcp.session_interval
wlan.ip.dns.domain
wlan.ip.dns.servers
wlan.ip.gateway
wlan.ip.netmask
wlan.ip.protocol
wlan.ip.timeout.enable
wlan.ip.timeout.value
wlan.ip.wins.addr
wlan.ip.wins.permanent_source
wlan.ipv6.address_type
wlan.leap_mode
wlan.leap_password
wlan.leap_username
wlan.operating_mode
wlan.password
wlan.pmf
wlan.poor_signal_threshold
wlan.private_key_password
wlan.roam.interchannel_delay
wlan.roam.interval
wlan.roam.max_chan_scan_time
wlan.roam.max_fail
wlan.roam.monitor

Protected SGD Command
wlan.roam.neighbor_assist wlan.roam.rssi wlan.roam.signal wlan.rts_cts_enabled wlan.secure_ssid wlan.security wlan.transition_disable_clear wlan.user_channel_list wlan.username wlan.wpa.authentication wlan.wpa.enable wlan.wpa.groupkey_ciphersuite wlan.wpa.pairwise_ciphersuite wlan.wpa.psk wlan.wpa.timecheck wlan.wpa.wpa_version
zbi.enable
zpl.label_length_always

Protected ZPL commands These will not function as expected when Protected Mode is enabled. Underlying protected settings will remain unchanged.	**Alternative Protected SGD**
^ND	Various wlan.ip and internal_wired.ip SGDs
^NN	Various ip.snmp SGDs
^NT	Various ip.smtp SGDs
^KC	Various wlan.ip.dhcp and internal_wired.ip.dhcp SGDs
^KP	display.password.current
^WP	wlan.wpa.psk
^WS	Various wlan SGDs
^WX	wlan.security
~JR	device.reset
~WR	device.prompted_network_reset

Protected CPCL commands These are ignored when Protected Mode is enabled	Alternative Protected SGD
<ESC>p	power.shutdown

Protect JSON Commands Response Codes

Code	Meaning
0	Command completed successfully
100	Invalid or missing user name or password
101	Invalid user name or password
102	Command is protected, requested operation will not be taken
103	Invalid authentication type
105	Authentication missing
106	Session unavailable
107	A password must be set to use this command
200	Unsupported operation
205	Requested operation is missing or not expressed as a string
300	Invalid setup section (missing user name or password)
301	Invalid user name
302	Password used is too short
303	Password used is too long
304	Password used invalid characters
305	Setup missing
324	Empty password not allowed to be set.
405	Set missing
500	Too many items for configure-one
501	Invalid item for configure-one
502	Invalid value for configure-one
503	Password required for configure-one
505	Configure-one missing