

ConneXium

TCSESL Lite Managed Switch

Benutzerhandbuch Konfiguration

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Sicherheitshinweise

■ Wichtige Informationen

Beachten Sie: Lesen Sie diese Anweisungen gründlich durch und machen Sie sich mit dem Gerät vertraut, bevor Sie es installieren, in Betrieb nehmen oder warten. Die folgenden Hinweise können an verschiedenen Stellen in dieser Dokumentation enthalten oder auf dem Gerät zu lesen sein. Die Hinweise warnen vor möglichen Gefahren oder machen auf Informationen aufmerksam, die Vorgänge erläutern bzw. vereinfachen.



Erscheint dieses Symbol zusätzlich zu einem Warnaufkleber, bedeutet dies, dass die Gefahr eines elektrischen Schlags besteht und die Nichtbeachtung des Hinweises zu Verletzungen führt.



Dies ist ein allgemeines Warnsymbol. Es macht Sie auf mögliche Verletzungsgefahren aufmerksam. Beachten Sie alle unter diesem Symbol aufgeführten Hinweise, um Verletzungen oder Unfälle mit Todesfolge zu vermeiden.



GEFAHR

GEFAHR macht auf eine unmittelbar gefährliche Situation aufmerksam, die bei Nichtbeachtung **unweigerlich** einen schweren oder tödlichen Unfall zur Folge hat.



WARNUNG

WARNUNG verweist auf eine mögliche Gefahr, die – wenn sie nicht vermieden wird – Tod oder schwere Verletzungen **zur Folge haben kann**.



VORSICHT

VORSICHT verweist auf eine mögliche Gefahr, die – wenn sie nicht vermieden wird – leichte Verletzungen **zur Folge haben kann**.

Bitte beachten: Elektrische Geräte dürfen nur von Fachpersonal installiert, betrieben, gewartet und instand gesetzt werden. Schneider Electric haftet nicht für Schäden, die aufgrund der Verwendung dieses Materials entstehen.
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Über dieses Handbuch

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Bei Einsatz der Geräte für Anwendungen mit technischen Sicherheitsanforderungen bitte die einschlägigen Anweisungen beachten.

Das Unterlassen der Verwendung von Schneider-Electric-Software oder freigegebener Software zusammen mit unseren Hardware-Erzeugnissen kann zu falschen Arbeitsergebnissen führen.

Das Unterlassen der Beachtung dieser produktbezogenen Warnung kann zu Verletzungen oder Gerätebeschädigungen führen.

Benutzerkommentar

Ihre Anmerkungen und Hinweise sind uns jederzeit willkommen. Senden Sie sie einfach an unsere E-Mail-Adresse: techpub@schneider-electric.com

Weiterführende Dokumentation

Titel	Referenz-Nummer
ConneXium TCSESL Lite Managed Switch Benutzer-Handbuch Konfiguration	NHA24795
ConneXium TCSESL Lite Managed Switch Installations-Handbuch	NHA24776

Das Dokument „Anwender-Handbuch Konfiguration“ enthält die Informationen, die Sie zur Inbetriebnahme des Gerätes benötigen. Es leitet Sie Schritt für Schritt von der ersten Inbetriebnahme bis zu den grundlegenden Einstellungen für einen Ihrer Umgebung angepassten Betrieb.

Das Dokument „Anwender-Handbuch Installation“ enthält eine Gerätebeschreibung, Sicherheitshinweise, Anzeigebeschreibung und weitere Informationen, die Sie zur Installation des Gerätes benötigen, bevor Sie mit der Konfiguration des Gerätes beginnen.

Legende

Verwendete Auszeichnungen:

▶	Aufzählung
□	Arbeitsschritt
■	Zwischenüberschrift
Link	Querverweis mit Verknüpfung
Anmerkung:	Eine Anmerkung betont eine wichtige Tatsache oder lenkt Ihre Aufmerksamkeit auf eine Abhängigkeit.
<code>Courier</code>	ASCII-Darstellung in Bedienoberfläche

Einleitung

Die TCSESL-Geräte sind konzipiert für die speziellen Anforderungen der industriellen Automatisierung. Sie erfüllen die relevanten Industriestandards, bieten eine sehr hohe Betriebssicherheit auch unter extremen Bedingungen, langjährige Verfügbarkeit und Flexibilität.

Anmerkung: Geänderte Einstellungen speichert das Gerät im flüchtigen Arbeitsspeicher, wenn Sie auf „Schreiben“ klicken.
Über den Dialog `Grundeinstellungen > Laden/Speichern` **speichern** Sie geänderte Einstellungen nicht-flüchtig im lokalen Speicher des Gerätes.

Anmerkung: Die folgenden Versionen von Web-Browsern werden unterstützt:

- ▶ Firefox 31 (oder neuer)
- ▶ Chrome 36 (oder neuer)
- ▶ Internet Explorer 9 (oder neuer)

1 IP-Parameter festlegen

Anmerkung: Hintergrundinformation zu diesem Thema bietet Ihnen [„Grundlagen IP-Parameter“](#) auf Seite 108.

Um das Gerät bei der Erstinstallation über das Netz zu erreichen, benötigen Sie die IP-Parameter des Gerätes.

Das Gerät bietet Ihnen folgende Möglichkeiten, IP-Parameter festzulegen:

- ▶ [IP-Parameter über DHCP festlegen \(Lieferzustand\)](#)
Hierzu benötigen Sie einen DHCP-Server. Der DHCP-Server weist dem Gerät anhand seiner MAC-Adresse oder seines Systemnamens die IP-Parameter zu.
- ▶ [IP-Parameter über Ethernet Switch Configurator festlegen](#)
Wählen Sie diese Methode für ein bereits installiertes Netzgerät oder wenn eine weitere Ethernet-Verbindung zwischen Ihrem PC und dem Gerät besteht.
- ▶ [IP-Parameter über BOOTP festlegen](#)
Hierzu benötigen Sie einen BOOTP-Server. Der BOOTP-Server weist dem Gerät anhand seiner MAC-Adresse die IP-Parameter zu.
- ▶ [IP-Parameter über die grafische Benutzeroberfläche festlegen](#)
Wählen Sie diese Methode, wenn Ihr Gerät bereits über eine IP-Adresse verfügt und über das Netz erreichbar ist.

1.1 IP-Parameter über DHCP festlegen (Lieferzustand)

Anmerkung: Hintergrundinformation zu diesem Thema bietet Ihnen [„Grundlagen Dynamic Host Configuration Protocol \(DHCP\)“](#) auf Seite 114.

Voraussetzung:

- Sie benötigen einen DHCP-Server. Der DHCP-Server weist dem Gerät anhand seiner MAC-Adresse oder seines Systemnamens die IP-Parameter zu.

Im Lieferzustand ist die Festlegung der IP-Parameter über einen DHCP-Server aktiviert. Das Gerät versucht, von einem DHCP-Server eine IP-Adresse zu beziehen.

Bleibt die Antwort des DHCP-Servers aus, setzt das Gerät die IP-Adresse auf 0.0.0.0 und versucht erneut, eine gültige IP-Adresse zu erhalten.

Um die Festlegung der IP-Parameter über einen DHCP-Server zu aktivieren oder zu deaktivieren, ändern Sie im Dialog `Grundeinstellungen > Netz` im Rahmen „Management-Schnittstelle“ die Quelle, aus welcher das Gerät seine IP-Parameter bezieht.

1.2 IP-Parameter über Ethernet Switch Configurator festlegen

Das Ethernet Switch Configurator-Protokoll ermöglicht Ihnen, dem Gerät über das Ethernet IP-Parameter zuzuweisen.

Installieren Sie die Ethernet Switch Configurator-Software auf Ihrem PC. Sie finden die Software auf den Schneider Electric-Produktseiten zum Download.

- ☐ Starten Sie das Programm Ethernet Switch Configurator.

No	MAC Address	Writable	IP Address	Subnet Mask	Default Gateway	Product	Name
1	00:80:63:51:74:00	<input checked="" type="checkbox"/>	10.0.1.105	255.255.255.0	10.0.1.200		
2	00:80:63:18:2F:CE	<input checked="" type="checkbox"/>	10.0.1.100	255.255.255.0	10.0.1.200		
3	00:80:63:1F:10:54	<input checked="" type="checkbox"/>	10.0.1.13	255.255.255.0	0.0.0.0		
4	00:80:63:57:4C:67	<input checked="" type="checkbox"/>	10.0.1.203	255.255.255.0	0.0.0.0		
5	00:80:63:70:E8:70	<input checked="" type="checkbox"/>	10.0.1.14	255.255.255.0	10.0.1.200		
6	00:80:63:0F:1D:B0	<input checked="" type="checkbox"/>	10.0.1.5	255.255.255.0	0.0.0.0		
7	00:80:63:74:02:5E	<input checked="" type="checkbox"/>	10.0.1.17	255.255.255.0	0.0.0.0		
8	00:80:63:51:7A:80	<input checked="" type="checkbox"/>	10.0.1.116	255.255.255.0	0.0.0.0		
9	00:80:63:51:82:80	<input checked="" type="checkbox"/>	10.0.1.112	255.255.255.0	0.0.0.0		
10	00:80:63:10:9A:D7	<input checked="" type="checkbox"/>	10.0.1.53	255.255.255.0	0.0.0.0		
11	00:80:63:17:2B:79	<input checked="" type="checkbox"/>	10.0.1.4	255.255.255.0	0.0.0.0		
12	00:80:63:FD:3B:A1	<input checked="" type="checkbox"/>	10.0.1.6	255.255.255.0	0.0.0.0		
13	00:80:63:4A:A7:B3	<input checked="" type="checkbox"/>	10.0.1.10	255.255.255.0	0.0.0.0		
14	00:80:63:2F:FB:B8	<input checked="" type="checkbox"/>	10.0.1.2	255.255.255.0	10.0.1.200		
15	00:80:63:74:67:C8	<input checked="" type="checkbox"/>	10.0.1.15	255.255.255.0	0.0.0.0		

Abb. 1: Ethernet Switch Configurator

Beim Start von Ethernet Switch Configurator untersucht Ethernet Switch Configurator automatisch das Netz nach Geräten, die das Ethernet Switch Configurator-Protokoll unterstützen.

Ethernet Switch Configurator benutzt das erste gefundene Netz-Interface des PCs. Sollte Ihr Rechner über mehrere Netzwerkkarten verfügen, können Sie das gewünschte in der Werkzeugleiste von Ethernet Switch Configurator auswählen.

Ethernet Switch Configurator zeigt für jedes Gerät, das auf das Ethernet Switch Configurator-Protokoll reagiert, eine Zeile an.

Ethernet Switch Configurator ermöglicht das Identifizieren der angezeigten Geräte.

- ☐ Wählen Sie eine Gerätezeile aus.
- ☐ Klicken Sie auf das „Signal“-Symbol in der Werkzeugleiste, um das Blinken der LEDs des ausgewählten Gerätes einzuschalten. Ein weiteres Klicken auf das Symbol schaltet das Blinken aus.
- ☐ Mit einem Doppelklick auf eine Zeile öffnen Sie ein Fenster, in dem Sie den Gerätenamen und die IP-Parameter eintragen können.

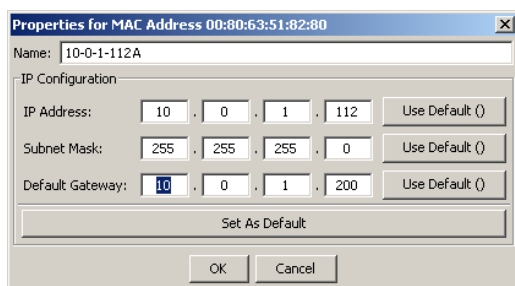


Abb. 2: Ethernet Switch Configurator – IP-Parameter-Zuweisung

Anmerkung: Schalten Sie aus Sicherheitsgründen im Graphical User Interface die Ethernet Switch Configurator-Funktion des Gerätes aus, nachdem Sie dem Gerät die IP-Parameter zugewiesen haben.

Siehe „Ethernet Switch Configurator-Zugriff aus-/einschalten“ auf Seite 42.

Anmerkung: Damit die Eingaben nach einem Neustart wieder zur Verfügung stehen, speichern Sie die Einstellungen über den Dialog „Laden/Speichern“ im lokalen nicht-flüchtigen Speicher des Gerätes .

1.3 IP-Parameter über die grafische Benutzeroberfläche festlegen

Voraussetzung:

- Ihr Gerät verfügt bereits über eine IP-Adresse und ist über das Netz erreichbar.

Vorgehen:

- ☐ Öffnen Sie den Dialog `Grundeinstellungen > Netz`.
- ☐ Legen Sie im Rahmen „IP-Parameter“ die IP-Parameter des Gerätes fest:

Parameter	Bedeutung
IP-Adresse	Legt die IP-Adresse fest, unter der das Management des Gerätes über das Netz erreichbar ist. Mögliche Werte: <ul style="list-style-type: none">► Gültige IPv4-Adresse (Voreinstellung: —)
Netzmaske	Legt die Netzmaske fest. Die Netzmaske kennzeichnet in der IP-Adresse das Netzpräfix und die Host-Adresse des Gerätes. Mögliche Werte: <ul style="list-style-type: none">► Gültige IPv4-Netzmaske (Voreinstellung: —)
Gateway-Adresse	Legt die IP-Adresse eines Routers fest, über den das Gerät andere Geräte außerhalb des eigenen Netzes erreicht. Mögliche Werte: <ul style="list-style-type: none">► Gültige IPv4-Adresse (Voreinstellung: —)

- ☐ Um die Änderungen flüchtig zu speichern, klicken Sie „Schreiben“.

Anmerkung: Damit die Eingaben nach einem Neustart wieder zur Verfügung stehen, speichern Sie die Einstellungen über den Dialog „Laden/Speichern“ im lokalen nicht-flüchtigen Speicher des Gerätes .

1.4 IP-Parameter über BOOTP festlegen

Voraussetzung:

- Hierzu benötigen Sie einen BOOTP-Server. Der BOOTP-Server weist dem Gerät anhand seiner MAC-Adresse die IP-Parameter zu.

Vorgehen:

- ☐ Öffnen Sie den Dialog `Grundeinstellungen > Netz`.
- ☐ Um die Zuweisung der IP-Parameter durch einen BOOTP-Server zu aktivieren, wählen Sie im Rahmen „Management-Schnittstelle“ den Wert `BOOTP`.

Bei aktivierter BOOTP-Funktion sendet das Gerät eine Boot-Anforderungsnachricht an den BOOTP-Server. Der Server antwortet mit einer Boot-Antwort-Nachricht. Die Boot-Antwort-Nachricht enthält die zugewiesene IP-Adresse.

Bleibt die Antwort des BOOTP-Servers aus, setzt das Gerät die IP-Adresse auf 0.0.0.0 und versucht erneut, eine gültige IP-Adresse zu erhalten.

2 Grafische Benutzeroberfläche starten

Voraussetzung:

- Die IP-Parameter des Gerätes sind festgelegt und das Gerät ist über das Netz erreichbar.

[Siehe „IP-Parameter festlegen“ auf Seite 15.](#)

Vorgehen:

- ☐ Starten Sie Ihren Web-Browser.
- ☐ Schreiben Sie die IP-Adresse des Gerätes in das Adressfeld des Web-Browsers. Verwenden Sie folgende Form:

`https://xxx.xxx.xxx.xxx`

Der Web-Browser stellt die Verbindung zum Gerät her und zeigt das Log-in-Fenster.

- ☐ Wählen Sie die Sprache für die grafische Benutzeroberfläche.
- ☐ Wählen Sie den Benutzernamen und das Passwort:

Benutzername	Passwort (Voreinstellung)	Berechtigung
admin	private	Lese- und Schreibrecht
user	public	ausschließlich Leserecht

- ☐ Klicken Sie „OK“.

Der Web-Browser zeigt das Fenster mit der grafischen Benutzeroberfläche.

3 Konfiguration laden/speichern

Das Gerät bietet Ihnen folgende Möglichkeiten, Konfigurationen zu laden oder zu speichern:

- ▶ Konfiguration in den Lieferzustand zurücksetzen
- ▶ Konfiguration importieren
- ▶ Konfiguration im Gerät speichern
- ▶ Konfiguration exportieren

Anmerkung: Geänderte Einstellungen speichert das Gerät im flüchtigen Arbeitsspeicher, wenn Sie auf „Schreiben“ klicken.

Über den Dialog `Grundeinstellungen > Laden/Speichern` **speichern** Sie geänderte Einstellungen nicht-flüchtig im lokalen Speicher des Gerätes.

3.1 Konfiguration in den Lieferzustand zurücksetzen

Bei einem Neustart lädt das Gerät seine Konfiguration vom lokalen nicht-flüchtigen Speicher.

Wenn Sie die Einstellungen im Gerät in den Lieferzustand zurücksetzen, löscht das Gerät die Konfiguration im flüchtigen Arbeitsspeicher und im nicht-flüchtigen Speicher. Anschließend startet das Gerät neu und lädt die voreingestellten Werte.

Voraussetzung:

- Sie greifen als Benutzer „admin“ mit Lese- und Schreibrechten auf das Gerät zu.

Vorgehen:

- ☐ Wählen Sie den Dialog `Grundeinstellungen > Laden/Speichern`.
- ☐ Klicken Sie im Rahmen „Laden/Speichern“ neben „Auf Lieferzustand zurücksetzen“ die Schaltfläche „Zurücksetzen“.

3.2 Konfiguration importieren

Das Gerät bietet Ihnen die Möglichkeit, Einstellungen aus einer Konfigurationsdatei von Ihrem PC oder von einem TFTP-Server zu laden.

Voraussetzung:

- ▶ Sie greifen als Benutzer „admin“ mit Lese- und Schreibrechten auf das Gerät zu.
- ▶ Import von einem TFTP-Server:
Die Konfigurationsdatei ist in den entsprechenden Pfad des TFTP-Servers mit dem Dateinamen gespeichert, z.B. `backup/config.bin`
[Siehe „Konfiguration exportieren“ auf Seite 30.](#)
- ▶ Import von Ihrem PC:
Die Konfigurationsdatei ist als Binärdatei auf Ihrem PC gespeichert.

Vorgehen:

- ☐ Wählen Sie den Dialog `Grundeinstellungen > Laden/Speichern`.
- ☐ Wählen Sie im Rahmen „Konfigurations-Übertragung“ für die Übertragungsrichtung den Wert `vom Server zum Gerät`.
 - ▶ Geben Sie den Pfad zur Konfigurationsdatei auf einem TFTP-Server ein.
Der URL kennzeichnet den Pfad zu der auf dem TFTP-Server gespeicherten Konfigurationsdatei mit dem Dateinamen. Der URL hat die Form
`tftp://IP-Adresse des tftp-Servers/Pfadname/Dateiname`.
 - ▶ Oder ziehen Sie die Datei per Drag-and-Drop in den gestrichelt umrandeten Bereich im Rahmen „Konfigurations-Übertragung“. Diese Möglichkeit unterstützen die gängigen Web-Browser mit Ausnahme des Internet Explorer.
- ☐ Klicken Sie „Übertragen“.
Nach erfolgreichem Übertragen aktivieren Sie die Konfiguration:
Starten Sie das Gerät neu, indem Sie „Neustart“ klicken.

Anmerkung: Das Laden einer Konfiguration bewirkt das Abschalten der Ports während des Einrichtens der Konfiguration. Danach setzt das Gerät den Portstatus entsprechend der neuen Konfiguration.

Anmerkung: Geänderte Einstellungen speichert das Gerät im flüchtigen Arbeitsspeicher, wenn Sie auf „Schreiben“ klicken.

Über den Dialog `Grundeinstellungen > Laden/Speichern` **speichern** Sie geänderte Einstellungen nicht-flüchtig im lokalen Speicher des Gerätes.

3.3 Konfiguration im Gerät speichern

Das Gerät bietet Ihnen die Möglichkeit, die aktuellen Konfigurationsdaten in den lokalen nicht-flüchtigen Speicher des Gerätes zu speichern.

Voraussetzung:

- Sie greifen als Benutzer „admin“ mit Lese- und Schreibrechten auf das Gerät zu.

Vorgehen:

- ☐ Wählen Sie den Dialog `Grundeinstellungen > Laden/Speichern`.
- ☐ Klicken Sie im Rahmen „Laden/Speichern“ neben „Aktuelle Konfiguration speichern“ die Schaltfläche „Speichern“.

3.4 Konfiguration exportieren

Das Gerät bietet Ihnen die Möglichkeit, Einstellungen in eine Konfigurationsdatei auf Ihrem PC oder auf einem TFTP-Server zu speichern.

Voraussetzung:

- ▶ Sie greifen als Benutzer „admin“ mit Lese- und Schreibrechten auf das Gerät zu.

Vorgehen:

- ☐ Wählen Sie den Dialog `Grundeinstellungen > Laden/Speichern`.
- ☐ Wählen Sie im Rahmen „Konfigurations-Übertragung“ für die Übertragungsrichtung den Wert `vom Gerät zum Server`.
 - ▶ Entweder klicken Sie im Rahmen „Konfigurations-Übertragung“ neben „Speichern unter“ „Download“, um die Konfiguration auf Ihrem PC zu speichern.
 - ▶ Oder geben Sie den Pfad zum Speicherort auf einem TFTP-Server ein.
Der URL kennzeichnet den Pfad zu der auf dem TFTP-Server gespeicherten Konfigurationsdatei mit dem Dateinamen. Der URL hat die Form
`tftp://IP-Adresse des tftp-Servers/Pfadname/Dateiname`.
Klicken Sie „Übertragen“.

Anmerkung: Geänderte Einstellungen speichert das Gerät im flüchtigen Arbeitsspeicher, wenn Sie auf „Schreiben“ klicken.

Über den Dialog `Grundeinstellungen > Laden/Speichern` speichern Sie geänderte Einstellungen nicht-flüchtig im lokalen Speicher des Gerätes.

4 Stand der Software prüfen/Software aktualisieren

4.1 Stand der Software prüfen

Das Gerät bietet Ihnen die Möglichkeit, den Stand der im Gerät gespeicherten Software anzuzeigen.

Vorgehen:

- ☐ Wählen Sie den Dialog `Grundeinstellungen > Software`.
- ☐ Der Rahmen „Laufende Version“ zeigt Ihnen die Release-Nummer der im Gerät gespeicherten Software an.

4.2 Software aktualisieren

Voraussetzung:

- ▶ Die Datei mit der aktuelleren Software-Version ist auf einem TFTP-Server, auf Ihrem PC oder auf einem Netzlaufwerk gespeichert.

Vorgehen:

- ☐ Wählen Sie den Dialog `Grundeinstellungen > Software`.

Sie haben 2 Möglichkeiten, die Software zu aktualisieren:

- ▶ Geben Sie den Pfad zur Geräte-Software auf einem TFTP-Server ein. Der URL kennzeichnet den Pfad zu der auf dem TFTP-Server gespeicherten Software mit dem Dateinamen. Der URL hat die Form `tftp://IP-Adresse des tftp-Servers/Pfadname/Dateiname`.
 - ▶ Oder ziehen Sie die Datei per Drag-and-Drop in den gestrichelt umrandeten Bereich im Rahmen „Software-Update“ . Diese Möglichkeit unterstützen die gängigen Web-Browser mit Ausnahme des Internet Explorer.
- ☐ Klicken Sie „Installieren“, um die Software auf das Gerät zu laden. Der Rahmen „Status“ zeigt den Fortschritt des Installationsvorganges. Nach erfolgreichem Installationsvorgang sehen Sie im Fortschrittsbalken die Meldung „Flash 100.00 % Abgeschlossen“.
 - ☐ Nach erfolgreichem Laden aktivieren Sie die neue Software: Starten Sie das Gerät neu, indem Sie „Neustart“ klicken.

5 Ports konfigurieren

Das Gerät bietet Ihnen folgende Möglichkeiten, grundlegende Einstellungen für die Ports festzulegen:

- ▶ **Port aus-/einschalten**
Um einen höheren Zugangsschutz zu erzielen, schalten Sie die Ports aus, an denen Sie keine weiteren Netzkomponenten anschließen.
- ▶ **Betriebsmodus wählen**
Das Gerät bietet Ihnen die Möglichkeit, die Datenrate und Halbduplex- oder Vollduplexverbindung manuell zu wählen oder automatisch durch das Gerät festlegen zu lassen (Autonegotiation).
- ▶ **Link-Überwachung (Alarmmeldungen) ein-/ausschalten**
Das Gerät bietet Ihnen die Möglichkeit, Alarmmeldungen an eine Netzmanagementstation zu übermitteln.

5.1 Port aus-/einschalten

Im Lieferzustand ist jeder Port eingeschaltet. Um einen höheren Zugangsschutz zu erzielen, schalten Sie die Ports aus, an denen Sie keine Netz-komponenten anschließen.

Vorgehen:

- ☐ Wählen sie den Dialog `Grundeinstellungen > Port > Konfiguration`
- ☐ Um einen Port ein- oder auszuschalten, wählen Sie in der Spalte „Zustand“ des jeweiligen Ports den Wert `Aus` oder `An`.

Anmerkung: Geänderte Einstellungen speichert das Gerät im flüchtigen Arbeitsspeicher, wenn Sie auf „Schreiben“ klicken.

Über den Dialog `Grundeinstellungen > Laden/Speichern` speichern Sie geänderte Einstellungen nicht-flüchtig im lokalen Speicher des Gerätes.

5.2 Betriebsmodus wählen

Im Lieferzustand befinden sich die Ports im Betriebsmodus „Autonegotiation“.

Bei Autonegotiation ermittelt das Gerät die maximal mögliche Datenrate und den Duplex-Betrieb zwischen den verbundenen Ports selbständig.

Ist bei der Gegenstelle Autonegotiation ausgeschaltet, verwendet das Gerät das Verfahren „Parallel Detection“. Das Gerät ermittelt die maximal mögliche Datenrate und wählt den Halb-Duplex Modus. Die Gegenstelle muss fest auf Halb-Duplex eingestellt sein, andernfalls ist das Ergebnis ein Duplex Mismatch (eine Seite unterstützt Voll-Duplex, die andere Seite unterstützt Halb-Duplex). Auswirkung ist eine sehr langsame Verbindung.

Vorgehen:

- ☐ Wählen Sie den Dialog `Grundeinstellungen > Port > Konfiguration`.
- ☐ Falls das an diesem Port angeschlossene Gerät eine feste Einstellung voraussetzt, wählen Sie in der Spalte „Manuelle Konfiguration“ die Übertragungsgeschwindigkeit und den Duplexbetrieb.

Anmerkung: Geänderte Einstellungen speichert das Gerät im flüchtigen Arbeitsspeicher, wenn Sie auf „Schreiben“ klicken.

Über den Dialog `Grundeinstellungen > Laden/Speichern` speichern Sie geänderte Einstellungen nicht-flüchtig im lokalen Speicher des Gerätes.

5.3 Link-Überwachung (Alarmmeldungen) ein- /ausschalten

Das Gerät bietet Ihnen die Möglichkeit, Alarmmeldungen an eine Netzmanagementstation zu übermitteln. Im Dialog `Grundeinstellungen > Port > Konfiguration` legen Sie fest, ob das Gerät einen SNMP-Trap sendet, wenn es eine Änderung bei überwachten Funktionen erkennt. Die überwachten Funktionen legen Sie im Dialog `Diagnose > Alarme (Traps)` fest.

Vorgehen:

- ☐ Wählen Sie den Dialog `Grundeinstellungen > Port > Konfiguration`.
- ☐ Um die Übermittlung von Alarmmeldungen an eine Netzmanagementstation ein- oder auszuschalten, wählen Sie in der Spalte „Link-Überwachung“ des jeweiligen Ports in der Auswahlliste `An` oder `Aus`.
- ☐ Um die geänderten Einstellungen im flüchtigen Arbeitsspeicher des Gerätes zu speichern, klicken Sie „Schreiben“.

Anmerkung: Geänderte Einstellungen speichert das Gerät im flüchtigen Arbeitsspeicher, wenn Sie auf „Schreiben“ klicken.

Über den Dialog `Grundeinstellungen > Laden/Speichern` speichern Sie geänderte Einstellungen nicht-flüchtig im lokalen Speicher des Gerätes.

6 Unterstützung beim Schutz vor unberechtigten Zugriffen

Das Gerät bietet Ihnen folgende Möglichkeiten zur Unterstützung beim Schutz vor unberechtigten Zugriffen:

- ▶ **Passwörter ändern**
Um einen höheren Zugangsschutz zu erzielen, ändern Sie die voreingestellten Passwörter für den Zugriff auf das Gerät.
- ▶ **Port aus-/einschalten**
Schalten Sie die Ports aus, an denen Sie keine weiteren Netzkomponenten anschließen.
- ▶ **Ethernet Switch Configurator-Zugriff aus-/einschalten**
Schränken Sie die Ethernet Switch Configurator-Funktion des Gerätes ein oder schalten Sie sie aus, nachdem Sie dem Gerät die IP-Parameter zugewiesen haben.
- ▶ **SNMP-Zugriff anpassen**
Um unerwünschte Zugriffe auf das Gerät zu erschweren, ändern Sie die Community für Lese-/Schreibzugriffe, legen Sie für Lese-/Schreibzugriffe eine andere Community fest als für Lesezugriffe und verwenden Sie SNMPv1 oder SNMPv2 ausschließlich in abhörsicheren Umgebungen. Wir empfehlen, SNMPv3 zu nutzen und im Gerät den Zugriff über SNMPv1 und SNMPv2 auszuschalten.

6.1 Passwörter ändern

Anmerkung: Die Passwörter für den Zugriff auf das Gerät über die grafische Benutzeroberfläche entsprechen den Passwörtern für den Zugriff auf das Gerät über SNMPv3.

Eine Netzmanagementstation kommuniziert über das Simple Network Management Protocol (SNMP) mit dem Gerät.

Jedes SNMP-Paket enthält die IP-Adresse des sendenden Rechners und das Passwort, mit welchem der Absender des Paketes auf die Management Information Base (MIB) des Gerätes zugreifen will.

Das Gerät empfängt das SNMP-Paket und vergleicht die IP-Adresse des sendenden Rechners und das Passwort mit den Einträgen in der MIB des Gerätes.

Liegt das Passwort mit dem entsprechenden Zugriffsrecht vor und ist die IP-Adresse des sendenden Rechners eingetragen, dann gewährt das Gerät den Zugriff.

Im Lieferzustand voreingestellte Passwörter:

Benutzername	Passwort (Voreinstellung)	Berechtigung
admin	private	Lese- und Schreibrecht
user	public	ausschließlich Leserecht

Voraussetzung:

- Sie greifen als Benutzer „admin“ mit Lese- und Schreibrechten auf das Gerät zu.

Bitte beachten Sie folgende Hinweise für ein Passwort:

- ☐ Definieren Sie ein neues Passwort, unter welchem Sie mit Schreibrechten von Ihrem Rechner aus zugreifen können. Behandeln Sie dieses Passwort vertraulich, denn jeder, der das Passwort kennt, kann mit der IP-Adresse Ihres Rechners auf die MIB des Gerätes zugreifen.
- ☐ Stellen Sie für das Lese Passwort und das Schreib-/Lese Passwort unterschiedliche Passwörter ein, damit ein Benutzer, der ausschließlich Lesezugriff hat (Benutzername „user“), das Passwort für den Schreib-/Lesezugriff (Benutzername „admin“) nicht kennen oder erraten kann.

Vorgehen:

- ☐ Wählen Sie den Dialog `Gerätesicherheit > Passwort`.
- ☐ Wählen Sie „Lese Passwort ändern (user)“, um das Lese Passwort einzugeben oder „Schreib-/Lese Passwort ändern (admin)“, um das Schreib-/Lese Passwort einzugeben.
Die Mindestpasswortlänge beträgt 8 Zeichen. Zulässig sind alle Groß- und Kleinbuchstaben, Zahlen und Sonderzeichen.
- ☐ Geben Sie das Passwort des Benutzers „admin“ im Feld „Aktuelles Administrator-Passwort“ ein.
- ☐ Geben Sie das neue Passwort im Feld „Neues Passwort“ ein.
- ☐ Wiederholen Sie die Eingabe im Feld „Bitte nochmals eingeben“.
- ☐ Um die geänderten Einstellungen im flüchtigen Arbeitsspeicher des Gerätes zu speichern, klicken Sie „Schreiben“.

Anmerkung: Damit die Eingaben nach einem Neustart wieder zur Verfügung stehen, speichern Sie die Einstellungen über den Dialog „Laden/Speichern“ im lokalen nicht-flüchtigen Speicher des Gerätes .

6.2 Ethernet Switch Configurator-Zugriff aus-/einschalten

Das Ethernet Switch Configurator-Protokoll bietet Ihnen die Möglichkeit, dem Gerät über das Ethernet IP-Parameter zuzuweisen.

Weitere Informationen zu diesem Thema bietet Ihnen [„IP-Parameter über Ethernet Switch Configurator festlegen“](#) auf Seite 17.

Anmerkung: Schränken Sie die Ethernet Switch Configurator-Funktion des Gerätes ein oder schalten Sie sie aus, nachdem Sie dem Gerät die IP-Parameter zugewiesen haben.

Vorgehen:

- ☐ Wählen Sie den Dialog `Grundeinstellungen > Netz`.
- ☐ Um die Ethernet Switch Configurator-Funktion auszuschalten, wählen Sie im Rahmen „Ethernet Switch Configurator-Protokoll“ für „Funktion“ den Wert `Aus`.
- ☐ Um den Schreibzugriff auf das Gerät per Ethernet Switch Configurator auszuschalten, wählen Sie im Rahmen „Ethernet Switch Configurator-Protokoll“ für „Schreibrecht“ den Wert `Aus`.
- ☐ Um die geänderten Einstellungen im flüchtigen Arbeitsspeicher des Gerätes zu speichern, klicken Sie „Schreiben“.

Anmerkung: Geänderte Einstellungen speichert das Gerät im flüchtigen Arbeitsspeicher, wenn Sie auf „Schreiben“ klicken.

Über den Dialog `Grundeinstellungen > Laden/Speichern` speichern Sie geänderte Einstellungen nicht-flüchtig im lokalen Speicher des Gerätes.

6.3 SNMP-Zugriff anpassen

Das Protokoll SNMP bietet Ihnen die Möglichkeit, das Gerät über das Netz mit einem Netzmanagementsystem (NMS) zu überwachen und zu konfigurieren. Wenn das NMS über SNMPv1 oder SNMPv2 auf das Gerät zugreift, authentifiziert sich das NMS mit der Community. Wenn das NMS über SNMPv3 auf das Gerät zugreift, authentifiziert sich das NMS mit den Zugangsdaten eines Benutzers.

Treffen Sie folgende grundsätzlichen Vorkehrungen, um unerwünschte Zugriffe auf das Gerät zu erschweren:

- ☐ Ändern Sie die Community für Lese-/Schreibzugriffe. Behandeln Sie diese Community vertraulich. Jeder, der die Community kennt, hat die Möglichkeit, die Einstellungen des Gerätes zu ändern.
[Siehe „Community für Lese-/Schreibzugriffe ändern“ auf Seite 44.](#)
- ☐ Legen Sie für Lese-/Schreibzugriffe eine andere Community fest als für Lesezugriffe.
[Siehe „Community für Lese-/Schreibzugriffe ändern“ auf Seite 44.](#)
- ☐ Verwenden Sie SNMPv1 oder SNMPv2 ausschließlich in abhörsicheren Umgebungen. Die Protokolle verwenden keine Verschlüsselung. Die SNMP-Pakete enthalten die Community im Klartext. Wir empfehlen, SNMPv3 zu nutzen und im Gerät den Zugriff über SNMPv1 und SNMPv2 auszuschalten.
[Siehe „Zugriff über SNMPv1 oder SNMPv2 im Gerät ausschalten“ auf Seite 45.](#)
[Siehe „Zugriff über SNMPv3 im Gerät einschalten“ auf Seite 45.](#)

6.3.1 Community für Lese-/Schreibzugriffe ändern

Im Lieferzustand erreichen Sie das Gerät über die Communitys `public` (Lesezugriffe) und `private` (Lese-/Schreibzugriffe).

Die Community ist in jedem SNMP-Paket enthalten. Beim Empfangen vergleicht das Gerät diese Community mit den im Gerät festgelegten Communitys. Wenn die Communitys übereinstimmen, akzeptiert das Gerät das SNMP-Paket und gewährt den Zugriff.

Voraussetzung:

- ▶ Sie greifen als Benutzer „admin“ mit Lese- und Schreibrechten auf das Gerät zu.

Vorgehen:

- ☐ Öffnen Sie den Dialog `Gerätesicherheit > SNMP`.
Der Dialog zeigt die eingerichteten Communitys.
- ☐ Klicken Sie in der Zeile der Community `Schreiben` in das Feld „Name“. Geben Sie die Community ein.
 - ▶ Erlaubt sind bis zu 32 alphanumerische Zeichen.
 - ▶ Das Gerät unterscheidet zwischen Groß- und Kleinschreibung.
 - ▶ Legen Sie eine andere Community fest als für Lesezugriffe.
- ☐ Um die geänderten Einstellungen im flüchtigen Arbeitsspeicher des Gerätes zu speichern, klicken Sie „Schreiben“.

Anmerkung: Geänderte Einstellungen speichert das Gerät im flüchtigen Arbeitsspeicher, wenn Sie auf „Schreiben“ klicken.

Über den Dialog `Grundeinstellungen > Laden/Speichern` speichern Sie geänderte Einstellungen nicht-flüchtig im lokalen Speicher des Gerätes.

6.3.2 Zugriff über SNMPv1 oder SNMPv2 im Gerät ausschalten

Voraussetzung:

- ▶ Sie greifen als Benutzer „admin“ mit Lese- und Schreibrechten auf das Gerät zu.

Vorgehen:

- ☐ Öffnen Sie den Dialog `Gerätesicherheit > SNMP`.
- ☐ Um das Protokoll SNMPv1 zu deaktivieren, heben Sie die Markierung des Kontrollkästchens „SNMPv1 ein“ auf.
- ☐ Um das Protokoll SNMPv2 zu deaktivieren, heben Sie die Markierung des Kontrollkästchens „SNMPv2 ein“ auf.
- ☐ Um die geänderten Einstellungen im flüchtigen Arbeitsspeicher des Gerätes zu speichern, klicken Sie „Schreiben“.

Anmerkung: Geänderte Einstellungen speichert das Gerät im flüchtigen Arbeitsspeicher, wenn Sie auf „Schreiben“ klicken.

Über den Dialog `Grundeinstellungen > Laden/Speichern` speichern Sie geänderte Einstellungen nicht-flüchtig im lokalen Speicher des Gerätes.

6.3.3 Zugriff über SNMPv3 im Gerät einschalten

Voraussetzung:

- ▶ Sie greifen als Benutzer „admin“ mit Lese- und Schreibrechten auf das Gerät zu.

Vorgehen:

- ☐ Öffnen Sie den Dialog `Gerätesicherheit > SNMP`.
- ☐ Um das Protokoll SNMPv3 zu aktivieren, markieren Sie das Kontrollkästchen „SNMPv3 ein“.
- ☐ Um die geänderten Einstellungen im flüchtigen Arbeitsspeicher des Gerätes zu speichern, klicken Sie „Schreiben“.

Anmerkung: Geänderte Einstellungen speichert das Gerät im flüchtigen Arbeitsspeicher, wenn Sie auf „Schreiben“ klicken.

Über den Dialog `Grundeinstellungen > Laden/Speichern` **speichern** Sie geänderte Einstellungen nicht-flüchtig im lokalen Speicher des Gerätes.

7 Netzlaststeuerung

Das Gerät bietet Ihnen folgende Möglichkeiten, die Netzlast zu reduzieren:

- ▶ Gezielte Paketvermittlung
- ▶ Priorisieren des Datenverkehrs (Quality of Service)

7.1 Gezielte Paketvermittlung

Durch gezielte Paketvermittlung reduziert das Gerät die Netzlast.

Das Gerät lernt an jedem Port die MAC-Adresse der Absender von empfangenen Datenpaketen. Die Kombination „Port und MAC-Adresse“ speichert das Gerät in einer MAC-Adresstabelle (Forwarding Database).

Durch Anwenden des „Store-and-Forward“-Verfahrens speichert das Gerät empfangene Daten zwischen und prüft sie vor dem Weiterleiten auf Gültigkeit. Ungültige Datenpakete verwirft das Gerät.

7.1.1 Lernen der MAC-Adressen

Wenn das Gerät ein Datenpaket empfängt, prüft es, ob die MAC-Adresse des Absenders bereits in der MAC-Adresstabelle gespeichert ist. Ist die MAC-Adresse des Absenders noch unbekannt, erzeugt das Gerät einen neuen Eintrag. Anschließend vergleicht das Gerät die Ziel-MAC-Adresse des Datenpakets mit den in der MAC-Adresstabelle gespeicherten Einträgen:

- ▶ Datenpakete mit bekannter Ziel-MAC-Adresse vermittelt das Gerät gezielt an Ports, die bereits Datenpakete von dieser MAC-Adresse empfangen haben.
- ▶ Datenpakete mit unbekannter Zieladresse flutet das Gerät, d. h. das Gerät leitet diese Datenpakete an sämtliche Ports weiter.

7.1.2 Aging gelernter MAC-Adressen

Adressen, die das Gerät seit der Zeitspanne (Aging Time) von 30 Sekunden nicht ein weiteres Mal erkannt hat, löscht das Gerät aus der MAC-Adresstabelle. Ein Neustart oder das Zurücksetzen der MAC-Adresstabelle löscht die Einträge in der MAC-Adresstabelle.

7.1.3 Statische Adresseinträge erzeugen

Ergänzend zum Lernen der Absender-MAC-Adresse bietet Ihnen das Gerät die Möglichkeit, MAC-Adressen von Hand einzurichten. Diese MAC-Adressen bleiben eingerichtet und überdauern das Zurücksetzen der MAC-Adresstabelle sowie den Neustart des Gerätes.

Anhand von statischen Adresseinträgen bietet Ihnen das Gerät die Möglichkeit, Datenpakete gezielt an ausgewählte Geräte-Ports zu vermitteln.

Voraussetzung:

- Sie greifen als Benutzer „admin“ mit Lese- und Schreibrechten auf das Gerät zu.

Vorgehen:

- ☐ Öffnen Sie den Dialog `Switching > Filter für MAC-Adressen`.
- ☐ Um eine benutzerdefinierte MAC-Adresse hinzuzufügen, klicken Sie „Erzeugen“.
- ☐ Legen Sie im Feld „Adresse“ die Ziel-MAC-Adresse fest, für die der Tabelleneintrag gilt.
- ☐ Markieren Sie im Feld „Mögliche Ports“ die Geräte-Ports, an die das Gerät Datenpakete mit der angegebenen Ziel-MAC-Adresse vermittelt.
 - ☐ Markieren Sie genau einen Geräte-Port, wenn Sie im Feld „Adresse“ eine Unicast-MAC-Adresse festgelegt haben.
 - ☐ Markieren Sie einen oder mehrere Geräte-Ports, wenn Sie im Feld „Adresse“ eine Multicast-MAC-Adresse festgelegt haben.
- ☐ Klicken Sie „OK“.
- ☐ Um die geänderten Einstellungen im flüchtigen Arbeitsspeicher des Gerätes zu speichern, klicken Sie „Schreiben“.

Anmerkung: Geänderte Einstellungen speichert das Gerät im flüchtigen Arbeitsspeicher, wenn Sie auf „Schreiben“ klicken.

Über den Dialog `Grundeinstellungen > Laden/Speichern` speichern Sie geänderte Einstellungen nicht-flüchtig im lokalen Speicher des Gerätes.

7.1.4 Gelernte Adresseinträge löschen

Voraussetzung:

- ▶ Sie greifen als Benutzer „admin“ mit Lese- und Schreibrechten auf das Gerät zu.

Vorgehen:

- ☐ Um die gelernten Adressen aus der MAC-Adresstabelle (FDB) zu löschen, öffnen Sie den Dialog `Switching > Filter für MAC-Adressen` und klicken dort die Schaltfläche „Löschen“ neben dem zu löschenden Adresseintrag.
- ☐ Um die geänderten Einstellungen im flüchtigen Arbeitsspeicher des Gerätes zu speichern, klicken Sie „Schreiben“.

Anmerkung: Geänderte Einstellungen speichert das Gerät im flüchtigen Arbeitsspeicher, wenn Sie auf „Schreiben“ klicken.

Über den Dialog `Grundeinstellungen > Laden/Speichern` speichern Sie geänderte Einstellungen nicht-flüchtig im lokalen Speicher des Gerätes.

7.2 Priorisieren des Datenverkehrs (Quality of Service)

Anmerkung: Hintergrundinformation zu diesem Thema bietet Ihnen „[Grundlagen Spanning-Tree-Protokoll](#)“ auf Seite 116.

Quality of Service (QoS) ist ein in der Norm IEEE 802.1D beschriebenes Verfahren, mit dem Sie die Ressourcen im Netz verteilen. QoS gibt Ihnen die Möglichkeit, Daten wichtiger Anwendungen zu priorisieren.

Die Priorisierung verhindert insbesondere bei starker Netzlast, dass Datenverkehr mit geringerer Priorität verzögerungsempfindlichen Datenverkehr stört. Zum verzögerungsempfindlichen Datenverkehr zählen beispielsweise Sprach-, Video- und Echtzeitdaten.

7.2.1 Priorisierung einstellen

■ Port-Priorität zuweisen

- ☐ Öffnen Sie den Dialog `Switching > QoS/Priorität > Port-Konfiguration`.
- ☐ In der Spalte „Port-Priorität“ definieren Sie die Priorität, mit welcher das Gerät die an diesem Port empfangenen Datenpakete ohne VLAN-Tag vermittelt.
- ☐ In der Spalte „Trust Mode“ definieren Sie, nach welchem Kriterium das Gerät empfangenen Datenpaketen eine Verkehrsklasse zuordnet.
- ☐ Um die geänderten Einstellungen im flüchtigen Arbeitsspeicher des Gerätes zu speichern, klicken Sie „Schreiben“.

■ VLAN-Priorität einer Verkehrsklasse zuordnen

- ☐ Öffnen Sie den Dialog Switching > QoS/Priorität > 802.1D/p-Mapping.
- ☐ Um einer VLAN-Priorität eine Verkehrsklasse zuzuordnen, fügen Sie in der Spalte „Traffic-Class“ den betreffenden Wert ein.
- ☐ Um die geänderten Einstellungen im flüchtigen Arbeitsspeicher des Gerätes zu speichern, klicken Sie „Schreiben“.

■ DSCP einer Verkehrsklasse zuweisen

- ☐ Öffnen Sie den Dialog Switching > QoS/Priorität > IP-DSCP-Mapping.
- ☐ Tragen Sie in der Spalte „Traffic-Class“ die gewünschten Werte ein.
- ☐ Um die geänderten Einstellungen im flüchtigen Arbeitsspeicher des Gerätes zu speichern, klicken Sie „Schreiben“.

Anmerkung: Geänderte Einstellungen speichert das Gerät im flüchtigen Arbeitsspeicher, wenn Sie auf „Schreiben“ klicken.

Über den Dialog Grundeinstellungen > Laden/Speichern speichern Sie geänderte Einstellungen nicht-flüchtig im lokalen Speicher des Gerätes.

8 Diagnose

Das Gerät bietet Ihnen folgende Diagnosewerkzeuge:

- ▶ [Alarmer \(Traps\) einstellen](#)
- ▶ [Topologie-Erkennung anzeigen](#)
- ▶ [System-Log](#)

8.1 Alarme (Traps) einstellen

Das Gerät meldet außergewöhnliche Ereignisse, die während des Normalbetriebs auftreten, sofort an die Verwaltungsstation. Dies geschieht über Nachrichten, sogenannte „Traps“, die das Polling-Verfahren umgehen („Polling“: Abfrage der Datenstationen in regelmäßigen Abständen). Traps ermöglichen eine schnelle Reaktion auf außergewöhnliche Ereignisse.

Das Gerät sendet Traps an jene Hosts, die in der Zieltabelle für Traps eingetragen sind. Das Gerät bietet Ihnen die Möglichkeit, die Trap-Zieltabelle mit der Verwaltungsstation über SNMP zu konfigurieren.

■ Auflistung der SNMP-Traps

Die folgende Tabelle zeigt eine kurze Liste der möglichen vom Gerät gesendeten Traps an:

Bezeichnung des Traps	Bedeutung
authenticationFailure	Wird gesendet, falls eine Station versucht, unberechtigt auf einen Agenten zuzugreifen.
coldStart	Wird während der Boot-Phase bei Kaltstarts gesendet (nach erfolgreicher Initialisierung des Netzmanagements).
linkDown	Wird gesendet, wenn die Verbindung zu einem Port unterbrochen wird.
linkUp	Wird gesendet, wenn die Verbindung zu einem Port hergestellt ist.
lldpRemTablesChange	wird gesendet, wenn sich ein Eintrag in der Topologie-Tabelle ändert
newRoot	Wird gesendet, wenn der sendende Agent zur neuen Wurzel des Spannbauums wird.
topologyChange	Wird gesendet, wenn sich der Port-Zustand von „blocking“ auf „forwarding“ oder von „forwarding“ auf „blocking“ ändert.

Tab. 1: Mögliche Traps

Voraussetzung:

- Sie greifen als Benutzer „admin“ mit Lese- und Schreibrechten auf das Gerät zu.

Vorgehen:

- ☐ Öffnen Sie den Dialog `Diagnose > Alarme (Traps)`. Dieser Dialog gibt Ihnen die Möglichkeit, zu bestimmen, welche Ereignisse einen Trap auslösen und wohin das Gerät diese Nachrichten sendet.
- ☐ Geben Sie im Rahmen „Zieladressen“ den Namen der Trap Community an, den das Gerät verwendet, um sich als Quelle des Traps zu identifizierenden.
- ☐ Geben Sie die IP-Adresse der Verwaltungsstationen an, an die das Gerät die Traps sendet.

Das Gerät generiert Traps für Änderungen, die im Rahmen `Alarme (Traps)` ausgewählt wurden. Legen Sie mindestens einen SNMP-Manager an, der Traps empfängt.

8.2 Topologie-Erkennung anzeigen

Anmerkung: Hintergrundinformation zu diesem Thema bietet Ihnen „[Grundlagen Topologie-Erkennung](#)“ auf Seite 136.

Vorgehen:

☐ Öffnen Sie den Dialog `Diagnose > LLDP`.

Der Rahmen „Topologie-Erkennung“ zeigt Ihnen die gesammelten LLDP-Informationen zu den Nachbargeräten an. Mit diesen Informationen ist eine Netzmanagementstation in der Lage, die Struktur Ihres Netzes darzustellen.

Parameter	Bedeutung
Port	Zeigt die Nummer des Geräte-Ports.
Nachbar-Bezeichner	Zeigt die Chassis-ID des Nachbargerätes. Dies kann z. B. die Basis-MAC-Adresse des Nachbargerätes sein.
Nachbar-IP-Adresse	Zeigt die IP-Adresse, mit der die Management-Funktionen des Nachbargerätes erreichbar sind.
Nachbar-Port-Beschreibung	Zeigt eine Beschreibung für den Geräte-Port des Nachbargerätes.
Nachbar-System-name	Zeigt den Gerätenamen des Nachbargerätes.
Nachbar-System-beschreibung	Zeigt eine Beschreibung für das Nachbargerät.

Wenn Sie an einen Port mehrere Geräte anschließen (z. B. über einen Hub), zeigt die Tabelle für jedes angeschlossene Gerät eine Zeile an.

Die Weiterleitungstabelle (FDB) enthält MAC-Adressen von Geräten, die die Topologie-Tabelle aus Gründen der Übersicht ausblendet.

8.3 System-Log

Die System-Log-Datei ist eine HTML-Datei, in die das Gerät alle wichtigen geräteinternen Ereignisse schreibt. Dieser Bericht gibt im Service-Fall dem Techniker die notwendigen Informationen.

In der Tabelle im Dialog `Diagnose > System Log` werden die protokollierten Ereignisse aufgeführt.

- ☐ Klicken Sie die Schaltfläche „Speichern“, um den Inhalt des Protokolls als HTML-Datei zu archivieren.

9 Redundanzverfahren Rapid Spanning Tree Protocol konfigurieren

Anmerkung: Hintergrundinformation zu diesem Thema bietet Ihnen „[Grundlagen Spanning-Tree-Protokoll](#)“ auf Seite 116.



WARNUNG

GEFAHR EINER RSTP-SCHLEIFE

Um Schleifen während der Konfigurationsphase zu vermeiden, konfigurieren Sie alle Geräte der RSTP-Konfiguration individuell. Warten Sie mit dem Anschließen der redundanten Strecke, bis Sie die Konfiguration aller Geräte der RSTP-Konfiguration abgeschlossen haben.

Das Nicht-Beachten dieser Anweisung kann zu Tod, schwerer Körperverletzung oder Materialschäden führen.

Das Gerät unterstützt das in der Norm IEEE 802.1D-2004 definierte Rapid Spanning Tree Protocol (RSTP). Dieses Protokoll ist eine Weiterentwicklung des Spanning Tree Protocols (STP) und zu diesem kompatibel.

Das Rapid Spanning Tree Protocol ermöglicht schnelles Umschalten auf eine Neuberechnete Topologie, ohne dabei bestehende Verbindungen zu unterbrechen.

RSTP konfiguriert die Netztopologie komplett selbständig. Das Gerät mit der niedrigsten Bridge-Priorität wird dabei automatisch Root-Bridge.

Um dennoch eine bestimmte Netzstruktur vorzugeben, legen Sie ein Gerät als Root-Bridge fest. Im Regelfall übernimmt diese Rolle ein Gerät im Backbone.

Vorgehen:

- ☐ Bauen Sie das Netz nach Ihren Erfordernissen auf, zunächst ohne redundante Strecken.
- ☐ Schalten Sie Spanning Tree auf allen Geräten im Netz ein.
Im Lieferzustand ist Spanning Tree auf dem Gerät eingeschaltet.
 - ☐ Öffnen Sie den Dialog `Redundanz > Spanning Tree > Global`.
 - ☐ Wählen Sie im Rahmen „Funktion“ den Wert `An`.
- ☐ Klicken Sie „Schreiben“, um die Änderungen zu speichern.
- ☐ Schließen Sie nun die redundanten Strecken an.
- ☐ Legen Sie die Einstellungen für das Gerät fest, das die Rolle der Root-Bridge übernimmt.
- ☐ Legen Sie im Feld „Priorität“ einen numerisch kleineren Wert fest.
Die Bridge mit der numerisch niedrigsten Bridge-ID hat die höchste Priorität und wird zur Root-Bridge des Netzes.
- ☐ Klicken Sie „Schreiben“, um die Änderungen zu speichern.
- ☐ Ändern Sie gegebenenfalls die Werte in den Feldern „Forward Delay [s]“ und „Max Age“.
- ☐ Klicken Sie „Schreiben“, um die Änderungen zu speichern.

Anmerkung: Die Parameter „Forward Delay [s]“ und „Max Age“ stehen in folgender Beziehung zueinander:

$$\text{„Forward Delay [s]“} \geq (\text{„Max Age“}/2) + 1$$

Wenn Sie in die Felder einen Wert einfügen, der dieser Beziehung widerspricht, ersetzt das Gerät diese Werte mit den zuletzt gültigen Werten oder mit der Voreinstellung.

- ☐ Prüfen Sie in den anderen Geräten die folgende Werte:
 - Bridge-ID (Bridge-Priorität und MAC-Adresse) des jeweiligen Gerätes sowie der Root-Bridge.
 - Nummer des Geräte-Ports, der zur Root-Bridge führt.
 - Pfadkosten vom Root-Port des Gerätes bis zur Root-Bridge.

10 Referenzen

Dieses Kapitel bietet Ihnen Beschreibungen der einzelnen Parameter, die Sie über die grafische Benutzeroberfläche konfigurieren.

Anmerkung: Die Inhalte der Online-Hilfe entsprechen den Informationen im Kapitel „Referenzen“ im vorliegenden Anwender-Handbuch Konfiguration. Rufen Sie die Online-Hilfe über die Schaltfläche „Hilfe“ in der grafischen Benutzeroberfläche auf.

10.1 Grundeinstellungen

Dieses Menü bietet Ihnen die Möglichkeit, die grundlegenden Einstellungen des Gerätes zu konfigurieren.

10.1.1 Grundeinstellungen > System

Dieser Dialog zeigt Geräteeigenschaften an.



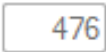
■ Systemdaten

Parameter	Bedeutung
Name	Legt den Gerätenamen fest. Mögliche Werte: ▶ Alphanumerische ASCII-Zeichenfolge mit 0..255 Zeichen
Standort	Legt den Standort des Gerätes fest. Mögliche Werte: ▶ Alphanumerische ASCII-Zeichenfolge mit 0..255 Zeichen
Ansprechpartner	Legt den Ansprechpartner für dieses Gerät fest. Mögliche Werte: ▶ Alphanumerische ASCII-Zeichenfolge mit 0..255 Zeichen
Gerätetyp	Zeigt die Produktbezeichnung des Gerätes.
Betriebszeit	Zeigt die Zeit, die seit dem letzten Neustart dieses Gerätes vergangen ist. Mögliche Werte: ▶ Zeit im Format Tag(e) , hh:mm:ss

■ Zeit

Parameter	Bedeutung
Systemzeit (UTC)	Zeigt das aktuelle Datum und die aktuelle Uhrzeit bezogen auf die koordinierte Weltzeit UTC an.
Systemzeit	Zeigt das aktuelle Datum und die aktuelle Uhrzeit bezogen auf die lokale Zeit an: „Systemzeit“ = „Systemzeit (UTC)“ + „Lokaler Offset [min]“
Lokaler Offset [min]	Legt die Differenz zwischen lokaler Zeit und „Systemzeit (UTC)“ in Minuten fest: „Lokaler Offset [min]“ = „Systemzeit“ – „Systemzeit (UTC)“
	Mögliche Werte: ▶ -780 . . 840 (Voreinstellung: 60)
Setze Zeit vom PC	Das Gerät verwendet die Uhrzeit des PCs als Systemzeit.

■ Schaltflächen

	Beendet die Sitzung und trennt die Verbindung zum Gerät.
	Startet das Gerät neu.
	Zeigt die Zeit in Sekunden, nach der das Gerät bei Inaktivität des Benutzers die Sitzung automatisch beendet.
Laden	Lädt die Anzeige der Seite in Ihrem Web-Browser neu.
Schreiben	Überträgt die Änderungen in den flüchtigen Speicher des Gerätes. Um die Änderungen im nicht-flüchtigen lokalen Speicher des Gerätes zu speichern, gehen Sie wie folgt vor: <input type="checkbox"/> Öffnen Sie den Dialog Grundeinstellungen > Laden/Speichern . <input type="checkbox"/> Klicken Sie „Speichern“ im Rahmen „Laden/Speichern“ neben „Aktuelle Konfiguration speichern“.
Hilfe	Öffnet die Online-Hilfe.

10.1.2 Grundeinstellungen > Netz

Dieser Dialog bietet Ihnen die Möglichkeit, die für den Zugriff über das Netz auf das Management des Gerätes erforderlichen IP- und Ethernet Switch Configurator-Einstellungen festzulegen.

■ Management-Schnittstelle

Parameter	Bedeutung
Zuweisung IP-Adresse	<p>Legt fest, aus welcher Quelle das Gerät nach dem Starten seine IP-Parameter erhält:</p> <p>Mögliche Werte:</p> <ul style="list-style-type: none"> ▶ BOOTP Das Gerät erhält seine IP-Parameter von einem BOOTP- oder DHCP-Server. Der Server wertet die MAC-Adresse des Gerätes aus und weist daraufhin die IP-Parameter zu. ▶ DHCP (Lieferzustand) Das Gerät erhält seine IP-Parameter von einem DHCP-Server. Der Server wertet die MAC-Adresse, den DHCP-Namen oder andere Parameter des Gerätes aus und weist daraufhin die IP-Parameter zu. ▶ Lokal Das Gerät verwendet die IP-Parameter aus dem internen Speicher. Die Einstellungen dafür legen Sie im Rahmen „IP-Parameter“ fest. <p>Anmerkung: Bleibt die Antwort des BOOTP- oder DHCP-Servers aus, setzt das Gerät die IP-Adresse auf 0.0.0.0 und versucht erneut, eine gültige IP-Adresse zu erhalten.</p>
MAC-Adresse	Zeigt die MAC-Adresse des Gerätes. Mit der MAC-Adresse ist das Management des Gerätes über das Netz erreichbar.

■ IP-Parameter



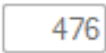
Parameter	Bedeutung
IP-Adresse	<p>Legt die IP-Adresse fest, unter der das Management des Gerätes über das Netz erreichbar ist.</p> <p>Mögliche Werte:</p> <ul style="list-style-type: none"> ▶ Gültige IPv4-Adresse (Voreinstellung: —)
Netzmaske	<p>Legt die Netzmaske fest. Die Netzmaske kennzeichnet in der IP-Adresse das Netzpräfix und die Host-Adresse des Gerätes.</p> <p>Mögliche Werte:</p> <ul style="list-style-type: none"> ▶ Gültige IPv4-Netzmaske (Voreinstellung: —)
Gateway-Adresse	<p>Legt die IP-Adresse eines Routers fest, über den das Gerät andere Geräte außerhalb des eigenen Netzes erreicht.</p> <p>Mögliche Werte:</p> <ul style="list-style-type: none"> ▶ Gültige IPv4-Adresse (Voreinstellung: —)

■ Ethernet Switch Configurator-Protokoll

Auf einem PC zeigt Ihnen die Ethernet Switch Configurator-Software im Netz erreichbare Schneider Electric-Geräte, auf denen die Ethernet Switch Configurator-Funktion eingeschaltet ist. Sie erreichen die Geräte sogar dann, wenn diese keine oder ungültige IP-Parameter haben. Die Ethernet Switch Configurator-Software bietet Ihnen die Möglichkeit, die IP-Parameter im Gerät zu ändern.

Parameter	Bedeutung
Funktion	<p>Schaltet die Ethernet Switch Configurator-Funktion im Gerät ein/aus.</p> <p>Mögliche Werte:</p> <ul style="list-style-type: none"> ▶ An (Voreinstellung) Ethernet Switch Configurator ist eingeschaltet. Sie haben die Möglichkeit, das Gerät mit der Ethernet Switch Configurator-Software von Ihrem PC aus zu erreichen. ▶ Aus Ethernet Switch Configurator ist ausgeschaltet.
Schreibrecht	<p>Schaltet den Schreibzugriff auf das Gerät per Ethernet Switch Configurator an/aus.</p> <p>Mögliche Werte:</p> <ul style="list-style-type: none"> ▶ An (Voreinstellung) Die Ethernet Switch Configurator-Software erhält Schreibzugriff auf das Gerät. Mit dieser Einstellung haben Sie die Möglichkeit, die IP-Parameter im Gerät zu ändern. ▶ Aus Die Ethernet Switch Configurator-Software erhält ausschließlich Lesezugriff auf das Gerät. Mit dieser Einstellung haben Sie die Möglichkeit, die IP-Parameter im Gerät anzusehen. <p>Empfehlung: Ändern Sie erst nach Inbetriebnahme des Gerätes die Einstellung auf Aus.</p>

■ Schaltflächen

	Beendet die Sitzung und trennt die Verbindung zum Gerät.
	Startet das Gerät neu.
	Zeigt die Zeit in Sekunden, nach der das Gerät bei Inaktivität des Benutzers die Sitzung automatisch beendet.
Laden	Lädt die Anzeige der Seite in Ihrem Web-Browser neu.

Schreiben	Überträgt die Änderungen in den flüchtigen Speicher des Gerätes. Um die Änderungen im nicht-flüchtigen lokalen Speicher des Gerätes zu speichern, gehen Sie wie folgt vor: <input type="checkbox"/> Öffnen Sie den Dialog Grundeinstellungen > Laden/Speichern. <input type="checkbox"/> Klicken Sie „Speichern“ im Rahmen „Laden/Speichern“ neben „Aktuelle Konfiguration speichern“.
Hilfe	Öffnet die Online-Hilfe.

10.1.3 Grundeinstellungen > Software

Dieser Dialog bietet Ihnen die Möglichkeit, die Geräte-Software zu aktualisieren und Informationen über die Geräte-Software anzuzeigen.

■ Version

Parameter	Bedeutung
Bootcode	Zeigt Versionsnummer und Erstellungsdatum des Bootcodes.
Laufende Version	Zeigt Versionsnummer und Erstellungsdatum der Geräte-Software, die das Gerät beim letzten Neustart geladen hat und derzeit ausführt.

■ Software-Update




Parameter	Bedeutung
Datei	Legt Pfad und Dateiname der Datei fest, mit der Sie die Geräte-Software aktualisieren. Das Gerät bietet Ihnen die Möglichkeit, die Geräte-Software per TFTP-Download zu aktualisieren. <input type="checkbox"/> Geben Sie den URL zur Datei in der folgenden Form ein: tftp://<IP-Adresse>/<Pfad>/<Dateiname>

Parameter	Bedeutung
Upload	Das Gerät bietet Ihnen die Möglichkeit, die Datei, mit der Sie die Geräte-Software aktualisieren, per Drag-and-Drop abzulegen. Diese Möglichkeit unterstützen die gängigen Web-Browser mit Ausnahme des Internet Explorer. <input type="checkbox"/> Ziehen Sie die Datei per Drag-and-Drop in den gestrichelt umrandeten Bereich.
Installieren	Aktualisiert die Geräte-Software. Das Gerät installiert die im Feld „Datei“ festgelegte oder per Drag-and-Drop abgelegte Datei im lokalen nicht-flüchtigen Speicher und ersetzt die bisher dort gespeicherte Geräte-Software. Beim nächsten Neustart lädt das Gerät die installierte Geräte-Software.

■ Status

Parameter	Bedeutung
URL	Zeigt die URL zur Datei, mit der Sie die Geräte-Software aktualisieren.
Fortschritt	Zeigt den Fortschritt der Aktualisierung der Geräte-Software.

■ Schaltflächen

	Beendet die Sitzung und trennt die Verbindung zum Gerät.
	Startet das Gerät neu.
	Zeigt die Zeit in Sekunden, nach der das Gerät bei Inaktivität des Benutzers die Sitzung automatisch beendet.
Laden	Lädt die Anzeige der Seite in Ihrem Web-Browser neu.
Neustart	Startet das Gerät neu.
Hilfe	Öffnet die Online-Hilfe.

10.1.4 Grundeinstellungen > Laden/Speichern

Dieser Dialog bietet Ihnen die Möglichkeit, das Konfigurationsprofil permanent zu speichern. Wenn Sie im laufenden Betrieb in einem Dialog die Schaltfläche „Schreiben“ klicken, speichert das Gerät die Änderungen lediglich flüchtig.

Sie haben die Möglichkeit, Konfigurationsprofile auf zu exportieren oder in das Gerät zu kopieren.



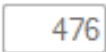
■ Laden/Speichern

Parameter	Bedeutung
Speichern	Überträgt die Einstellungen aus dem flüchtigen Speicher (RAM) in das Konfigurationsprofil im permanenten Speicher (NVM).
Zurücksetzen	Setzt die Einstellungen im Gerät auf die voreingestellten Werte zurück. ► Das Gerät löscht die gespeicherten Konfigurationsprofile aus dem flüchtigen Speicher (RAM) und aus dem permanenten Speicher (NVM).

■ Konfigurations-Übertragung

Parameter	Bedeutung
Übertragungsrichtung	Legt die Übertragungsrichtung fest, in der das Konfigurationsprofil übertragen wird. Mögliche Werte: ► vom Gerät zum Server Wählen Sie diesen Wert aus, wenn Sie das Konfigurationsprofil vom Gerät übertragen. ► vom Server zum Gerät Wählen Sie diesen Wert aus, wenn Sie das Konfigurationsprofil zum Gerät übertragen.
Server-IP-Adresse	Legt die IP-Adresse des Servers fest, von oder zu dem das Konfigurationsprofil übertragen wird. Geben Sie den URL zur Datei in der folgenden Form ein: tftp://<IP-Adresse>/<Pfad>/<Dateiname>
Übertragen	Überträgt das Konfigurationsprofil in der gewählten Übertragungsrichtung.
Download	Exportiert das aktuelle Konfigurationsprofil als Datei im Binärformat.

■ Schaltflächen

	Beendet die Sitzung und trennt die Verbindung zum Gerät.
	Startet das Gerät neu.
	Zeigt die Zeit in Sekunden, nach der das Gerät bei Inaktivität des Benutzers die Sitzung automatisch beendet.
Laden	Lädt die Anzeige der Seite in Ihrem Web-Browser neu.
Hilfe	Öffnet die Online-Hilfe.

10.1.5 Grundeinstellungen > Port > Konfiguration

Dieser Dialog bietet Ihnen die Möglichkeit, Einstellungen für die einzelnen Geräte-Ports festzulegen. Der Dialog zeigt außerdem Betriebsmodus und Verbindungszustand für jeden Geräte-Port.

■ Konfiguration

Parameter	Bedeutung
Port	Zeigt die Nummer des Geräte-Ports.
Zustand	Aktiviert/deaktiviert den Geräte-Port. Mögliche Werte: <ul style="list-style-type: none"> ▶ An (Voreinstellung) Der Geräte-Port ist aktiviert. ▶ Aus Der Geräte-Port ist deaktiviert. Der Geräte-Port sendet und empfängt keine Daten.

Parameter	Bedeutung
Link/Aktueller Betriebsmodus	<p>Zeigt den Betriebsmodus, den der Geräte-Port momentan verwendet.</p> <p>Mögliche Werte:</p> <ul style="list-style-type: none"> ▶ – Kein Kabel angesteckt, keine Verbindung. ▶ 10 Mbit/s HDX Halbduplex-Verbindung ▶ 10 Mbit/s FDX Vollduplex-Verbindung ▶ 100 Mbit/s HDX Halbduplex-Verbindung ▶ 100 Mbit/s FDX Vollduplex-Verbindung
Manuelle Konfiguration	<p>Legt den Betriebsmodus des Geräte-Ports fest.</p> <p>Mögliche Werte:</p> <ul style="list-style-type: none"> ▶ Autoneg (Voreinstellung) Der Geräte-Port handelt den Betriebsmodus per Autonegotiation selbstständig aus und erkennt die Belegung der Anschlüsse des TP-Ports automatisch (Auto Cable-Crossing). Diese Einstellung hat Vorrang vor der manuellen Einstellung des Betriebsmodus. Bis der Geräte-Port den Betriebsmodus eingestellt hat, vergehen einige Sekunden. ▶ 10 Mbit/s HDX Halbduplex-Verbindung ▶ 10 Mbit/s FDX Vollduplex-Verbindung ▶ 100 Mbit/s HDX Halbduplex-Verbindung ▶ 100 Mbit/s FDX (Voreinstellung auf TP-Ports) Vollduplex-Verbindung
Link-Überwachung	<p>Aktiviert/deaktiviert die Meldung von erkannten Verbindungsfehlern.</p> <p>Mögliche Werte:</p> <ul style="list-style-type: none"> ▶ An Die Link-Überwachung ist eingeschaltet. ▶ Aus Die Link-Überwachung ist ausgeschaltet.

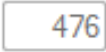
■ Schaltflächen



Beendet die Sitzung und trennt die Verbindung zum Gerät.



Startet das Gerät neu.

	Zeigt die Zeit in Sekunden, nach der das Gerät bei Inaktivität des Benutzers die Sitzung automatisch beendet.
Laden	Lädt die Anzeige der Seite in Ihrem Web-Browser neu.
Schreiben	Überträgt die Änderungen in den flüchtigen Speicher des Gerätes. Um die Änderungen im nicht-flüchtigen lokalen Speicher des Gerätes zu speichern, gehen Sie wie folgt vor: <input type="checkbox"/> Öffnen Sie den Dialog <i>Grundeinstellungen</i> > <i>Laden/Speichern</i> . <input type="checkbox"/> Klicken Sie „Speichern“ im Rahmen „Laden/Speichern“ neben „Aktuelle Konfiguration speichern“.
Hilfe	Öffnet die Online-Hilfe.




10.1.6 Grundeinstellungen > Port > Statistiken

Dieser Rahmen zeigt pro Geräte-Port folgenden Überblick:

- ▶ Anzahl der vom Gerät gesendeten Datenpakete/Bytes
 - ▶ „Gesendete Pakete“
 - ▶ „Gesendete Unicast-Pakete“
 - ▶ „Gesendete Non-Unicast-Pakete“
- ▶ Anzahl der vom Gerät empfangenen Datenpakete/Bytes
 - ▶ „Empfangene Pakete“
 - ▶ „Empfangene Bytes“
- ▶ Anzahl der vom Gerät erkannten Fehler
 - ▶ „Erkannte Kollisionen“
 - ▶ „Erkannte CRC-Fehler“
 - ▶ „Empfangene Fragmente“
- ▶ Anzahl der vom Gerät empfangenen und gesendeten Datenpakete pro Größenkategorie
 - ▶ „Pakete 64 Byte“
 - ▶ „Pakete 65 bis 127 Byte“
 - ▶ „Pakete 128 bis 255 Byte“
 - ▶ „Pakete 256 bis 511 Byte“
 - ▶ „Pakete 512 bis 1023 Byte“
 - ▶ „Pakete 1024 bis 1518 Byte“

Um die Portstatistik-Zähler in der Tabelle auf 0 zurückzusetzen, klicken Sie „Portzähler zurücksetzen“ im Dialog Grundeinstellungen > Port > Statistiken.

■ Schaltflächen

	Beendet die Sitzung und trennt die Verbindung zum Gerät.
	Startet das Gerät neu.
	Zeigt die Zeit in Sekunden, nach der das Gerät bei Inaktivität des Benutzers die Sitzung automatisch beendet.
Portzähler zurücksetzen	Setzt die Portstatistik-Zähler in der Tabelle auf 0 zurück.
Hilfe	Öffnet die Online-Hilfe.

10.2 Gerätesicherheit

Dieses Menü bietet Ihnen die Möglichkeit, die Einstellungen für den Zugriff auf das Gerät festzulegen.



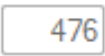
10.2.1 Gerätesicherheit > Passwort

Das Gerät gewährt Benutzern Zugriff auf seine Management-Funktionen, wenn diese sich mit gültigen Zugangsdaten anmelden.

■ Passwort auswählen (HTTPS/SNMPv3)

Parameter	Bedeutung
Passwort auswählen	Zeigt das zu ändernde Passwort. Mögliche Werte: <ul style="list-style-type: none">▶ Lese Passwort ändern (user) Ändert das Passwort für den Lesezugriff.▶ Schreib-/Lese Passwort ändern (admin) Ändert das Passwort für den Schreib- und Lesezugriff.
Aktuelles Administrator-Passwort	Geben Sie hier das Administrator-Passwort ein.
Neues Passwort	Geben Sie hier das neue Passwort ein. Die Mindestpasswortlänge beträgt 8 Zeichen.
Bitte nochmals eingeben	Geben Sie hier das neue Passwort nochmals ein.

■ Schaltflächen

	Beendet die Sitzung und trennt die Verbindung zum Gerät.
	Startet das Gerät neu.
	Zeigt die Zeit in Sekunden, nach der das Gerät bei Inaktivität des Benutzers die Sitzung automatisch beendet.
Laden	Lädt die Anzeige der Seite in Ihrem Web-Browser neu.
Schreiben	Überträgt die Änderungen in den flüchtigen Speicher des Gerätes. Um die Änderungen im nicht-flüchtigen lokalen Speicher des Gerätes zu speichern, gehen Sie wie folgt vor: <ul style="list-style-type: none"><input type="checkbox"/> Öffnen Sie den Dialog <code>Grundeinstellungen > Laden/Speichern</code>.<input type="checkbox"/> Klicken Sie „Speichern“ im Rahmen „Laden/Speichern“ neben „Aktuelle Konfiguration speichern“.
Hilfe	Öffnet die Online-Hilfe.

10.2.2 Gerätesicherheit > HTTPS

Dieser Dialog bietet Ihnen die Möglichkeit, Einstellungen für den HTTPS-Server des Gerätes festzulegen und den Server neu zu starten.

Der HTTPS-Server liefert die grafische Benutzeroberfläche (GUI) über eine verschlüsselte HTTP-Verbindung aus. Die grafische Benutzeroberfläche kommuniziert SNMP-basiert mit dem Gerät über die verschlüsselte HTTP-Verbindung und ermöglicht den Zugriff auf die Management-Funktionen.

Für die Verschlüsselung der HTTP-Verbindung ist ein digitales Zertifikat notwendig. Das Gerät bietet Ihnen die Möglichkeit, dieses Zertifikat selbst zu erzeugen oder ein vorhandenes Zertifikat auf das Gerät zu laden.

■ Konfiguration



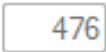
Parameter	Bedeutung
Web-Interface Session-Timeout [s]	Legt die Timeout-Zeit in Sekunden fest. Bei Inaktivität beendet das Gerät nach dieser Zeit die Sitzung des angemeldeten Benutzers.
TCP-Port	<p>Legt die Nummer des TCP-Ports fest, auf dem der Server Anfragen von den Clients entgegennimmt.</p> <p>Mögliche Werte:</p> <p>► 1..65535 (Voreinstellung: 443)</p> <p>Nach Ändern des Ports startet der Server automatisch neu. Offene Verbindungen zum Server beendet das Gerät dabei.</p>

■ Zertifikat

Parameter	Bedeutung
Status	<p>Zeigt, ob das digitale Zertifikat im Gerät vorhanden ist.</p> <p>Mögliche Werte:</p> <ul style="list-style-type: none"> ▶ Zertifikat vorhanden Das Zertifikat ist vorhanden. ▶ Kein Zertifikat vorhanden Das Zertifikat wurde entfernt. ▶ Zertifikat wird erzeugt... Das Zertifikat wird auf dem Gerät erzeugt. ▶ Zertifikat erzeugt Das Zertifikat ist auf dem Gerät erzeugt.
Erzeugen	<p>Erzeugt ein digitales Zertifikat auf dem Gerät.</p> <p>Damit der Server dieses Zertifikat verwendet, klicken Sie die Schaltfläche „Erzeugen“ und starten Sie den Server neu über die Schaltfläche „Webserver neu starten“.</p> <p>Alternativ haben Sie die Möglichkeit, ein eigenes Zertifikat in das Gerät zu kopieren.</p>
Löschen	<p>Entfernt das digitale Zertifikat.</p> <p>Um das Zertifikat endgültig vom Gerät zu entfernen, speichern Sie die Änderungen. Dabei schaltet das Gerät den HTTPS-Server aus.</p>
Datei	<p>Legt Pfad und Dateiname des Zertifikats fest. Zulässig sind X.509-Zertifikate (PEM).</p> <p>Das Gerät bietet Ihnen folgende Möglichkeiten, das Zertifikat in das Gerät zu kopieren:</p> <ul style="list-style-type: none"> ▶ Import vom PC Befindet sich das Zertifikat auf Ihrem PC oder auf einem Netzlaufwerk, markieren Sie die zu importierende Datei und ziehen Sie sie per Drag-and-Drop in das gestrichelt umrandete Feld. Diese Möglichkeit unterstützen die gängigen Web-Browser mit Ausnahme des Internet Explorer. ▶ Import von einem TFTP-Server Befindet sich das Zertifikat auf einem TFTP-Server, geben Sie den URL zur Datei in folgender Form ein: tftp://<IP-Adresse>/<Pfad>/<Dateiname>
Upload	<p>Befindet sich das Zertifikat auf Ihrem PC oder auf einem Netzlaufwerk, markieren Sie die zu importierende Datei und ziehen Sie sie per Drag-and-Drop in das gestrichelt umrandete Feld.</p>
Import	<p>Kopiert das Zertifikat in das Gerät.</p> <p>Damit der Server dieses Zertifikat verwendet, klicken Sie die Schaltfläche „Schreiben“ und starten Sie den Server neu.</p>
Webserver neu starten	<p>Startet den HTTPS-Server des Gerätes neu.</p>

Anmerkung: Ihr Webbrowser zeigt beim Laden der grafischen Benutzeroberfläche eine Warnung, wenn Sie ein Zertifikat ohne Verifizierung durch eine Zertifizierungsorganisation verwenden. Um die grafische Benutzeroberfläche zu laden, fügen Sie im Webbrowser eine Ausnahme-regel für das Zertifikat hinzu.

■ Schaltflächen

	Beendet die Sitzung und trennt die Verbindung zum Gerät.
	Startet das Gerät neu.
	Zeigt die Zeit in Sekunden, nach der das Gerät bei Inaktivität des Benutzers die Sitzung automatisch beendet.
Laden	Lädt die Anzeige der Seite in Ihrem Web-Browser neu.
Schreiben	Überträgt die Änderungen in den flüchtigen Speicher des Gerätes. Um die Änderungen im nicht-flüchtigen lokalen Speicher des Gerätes zu speichern, gehen Sie wie folgt vor: <ul style="list-style-type: none"> <input type="checkbox"/> Öffnen Sie den Dialog Grundeinstellungen > Laden/Speichern. <input type="checkbox"/> Klicken Sie „Speichern“ im Rahmen „Laden/Speichern“ neben „Aktuelle Konfiguration speichern“.
Hilfe	Öffnet die Online-Hilfe.

10.2.3 Gerätesicherheit > SNMP

Dieser Dialog bietet Ihnen die Möglichkeit, Einstellungen für den SNMP-Agenten des Gerätes festzulegen und den Zugriff auf das Gerät mit unterschiedlichen SNMP-Versionen ein-/auszuschalten.

Der SNMP-Agent ermöglicht den Zugriff auf die Management-Funktionen des Gerätes mit SNMP-basierten Anwendungen, z. B. mit der grafischen Benutzeroberfläche.

■ Konfiguration

Parameter	Bedeutung
SNMPv1 ein	<p>Aktiviert/deaktiviert den Zugriff auf das Gerät per SNMP Version 1.</p> <p>Mögliche Werte:</p> <ul style="list-style-type: none">▶ <code>markiert</code> (Voreinstellung) Zugriff aktiviert▶ <code>unmarkiert</code> Zugriff deaktiviert <p>Die Community-Namen legen Sie fest im Rahmen <code>SNMPv1/v2 Community</code>.</p>
SNMPv2 ein	<p>Aktiviert/deaktiviert den Zugriff auf das Gerät per SNMP Version 2.</p> <p>Mögliche Werte:</p> <ul style="list-style-type: none">▶ <code>markiert</code> (Voreinstellung) Zugriff aktiviert▶ <code>unmarkiert</code> Zugriff deaktiviert <p>Die Community-Namen legen Sie fest im Rahmen <code>SNMPv1/v2 Community</code>.</p>

Parameter	Bedeutung
SNMPv3 ein	<p>Aktiviert/deaktiviert den Zugriff auf das Gerät per SNMP Version 3.</p> <p>Mögliche Werte:</p> <ul style="list-style-type: none"> ▶ <code>markiert</code> (Voreinstellung) Zugriff aktiviert ▶ <code>unmarkiert</code> Zugriff deaktiviert <p>Diese Funktion verwendet z. B. die Netzmanagement-Software <code>ConneXium Network Manager</code>, um Änderungen an den Einstellungen durchzuführen.</p>
Port-Nummer	<p>Legt die Nummer des UDP-Ports fest, auf dem der SNMP-Agent Anfragen von Clients entgegennimmt.</p> <p>Mögliche Werte:</p> <ul style="list-style-type: none"> ▶ <code>1..65535</code> (Voreinstellung: <code>161</code>) <p>Damit der SNMP-Agent nach einer Änderung den neuen Port verwendet, verfahren Sie wie folgt:</p> <ul style="list-style-type: none"> <input type="checkbox"/> Klicken Sie die Schaltfläche „Schreiben“. <input type="checkbox"/> Klicken Sie im Dialog <code>Grundeinstellungen > Laden/Speichern</code> die Schaltfläche „Speichern“ neben „Aktuelle Konfiguration speichern“. <input type="checkbox"/> Starten Sie das Gerät neu.



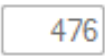
■ SNMPv1/v2 Community

Dieser Rahmen zeigt die Berechtigung für SNMPv1/v2-Anwendungen auf dem Gerät:

- ▶ Lesen
Bei Anfragen mit dem nebenstehenden Community-Namen erhält die Anwendung Leserechte auf dem Gerät.
- ▶ Schreiben
Bei Anfragen mit dem nebenstehenden Community-Namen erhält die Anwendung Lese- und Schreibrechte auf dem Gerät.

Parameter	Bedeutung
Lesen	<p>Legt den Community-Namen für die nebenstehende Berechtigung fest.</p> <p>Mögliche Werte:</p> <ul style="list-style-type: none"> ▶ Alphanumerische ASCII-Zeichenfolge mit 0..32 Zeichen <code>public</code> (Voreinstellung für Leserechte)
Schreiben	<p>Legt den Community-Namen für die nebenstehende Berechtigung fest.</p> <p>Mögliche Werte:</p> <ul style="list-style-type: none"> ▶ Alphanumerische ASCII-Zeichenfolge mit 0..32 Zeichen <code>private</code> (Voreinstellung für Lese- und Schreibrechte)

■ Schaltflächen

	Beendet die Sitzung und trennt die Verbindung zum Gerät.
	Startet das Gerät neu.
	Zeigt die Zeit in Sekunden, nach der das Gerät bei Inaktivität des Benutzers die Sitzung automatisch beendet.
Laden	Lädt die Anzeige der Seite in Ihrem Web-Browser neu.
Schreiben	Überträgt die Änderungen in den flüchtigen Speicher des Gerätes. Um die Änderungen im nicht-flüchtigen lokalen Speicher des Gerätes zu speichern, gehen Sie wie folgt vor: <ul style="list-style-type: none"><input type="checkbox"/> Öffnen Sie den Dialog <code>Grundeinstellungen > Laden/Speichern</code>.<input type="checkbox"/> Klicken Sie „Speichern“ im Rahmen „Laden/Speichern“ neben „Aktuelle Konfiguration speichern“.
Hilfe	Öffnet die Online-Hilfe.

10.3 Switching

Dieses Menü bietet Ihnen die Möglichkeit, die Einstellungen für das Switching zu konfigurieren.

10.3.1 Switching > Filter für MAC-Adressen

Dieser Dialog bietet Ihnen die Möglichkeit, Adressfilter für die Adresstabelle (Forwarding Database) anzuzeigen und zu bearbeiten. Adressfilter legen die Vermittlungsweise der Datenpakete im Gerät anhand der Ziel-MAC-Adresse fest.

Jede Zeile in der Tabelle stellt einen Filter dar. Das Gerät richtet die Filter automatisch ein. Das Gerät bietet Ihnen die Möglichkeit, von Hand weitere Filter einzurichten.

Das Gerät vermittelt die Datenpakete wie folgt:




- ▶ Enthält die Tabelle einen Eintrag für die Zieladresse eines Datenpakets, vermittelt das Gerät das Datenpaket vom Empfangsport an die im Tabelleneintrag angegebenen Ports.
- ▶ Existiert kein Tabelleneintrag für die Zieladresse, vermittelt das Gerät das Datenpaket vom Empfangsport an alle anderen Ports.

■ Tabelle

Parameter	Bedeutung
Adresse	Zeigt die Ziel-MAC-Adresse, für die der Tabelleneintrag gilt.
Status	Zeigt, auf welche Weise das Gerät den Adressfilter eingerichtet hat. Mögliche Werte: <ul style="list-style-type: none"> ▶ <code>gelernt</code> Adressfilter automatisch durch das Gerät eingerichtet anhand empfangener Datenpakete. ▶ <code>statisch</code> Adressfilter manuell eingerichtet. Der Adressfilter bleibt dauerhaft eingerichtet.
Port	Zeigt den Geräte-Port, der dem Tabelleneintrag zugewiesen ist.
Löschen	Löscht die nebenstehende Zieladresse aus der MAC-Adresstabelle.

Um alle gelernten MAC-Adressen aus der Adresstabelle (Forwarding Database) zu entfernen, klicken Sie die Schaltfläche „MAC-Adresstabelle zurücksetzen“.

■ Schaltflächen

	Beendet die Sitzung und trennt die Verbindung zum Gerät.
	Startet das Gerät neu.
	Zeigt die Zeit in Sekunden, nach der das Gerät bei Inaktivität des Benutzers die Sitzung automatisch beendet.
Laden	Lädt die Anzeige der Seite in Ihrem Web-Browser neu.
MAC-Adresstabelle zurücksetzen	Entfernt aus der Forwarding-Tabelle (FDB) die MAC-Adressen, die im Feld „Status“ den Wert <code>gelernt</code> haben.
Erzeugen	Öffnet den Dialog „Eintrag erstellen“, um der Tabelle einen neuen Eintrag hinzuzufügen. <ul style="list-style-type: none"> ▶ Im Feld „Adresse“ legen Sie die Ziel-MAC-Adresse fest. ▶ Im Feld „Mögliche Ports“ legen Sie den Geräte-Port fest. <ul style="list-style-type: none"> – Wählen Sie einen Port aus, wenn die Ziel-MAC-Adresse eine Unicast-Adresse ist. – Wählen Sie einen oder mehrere Ports aus, wenn die Ziel-MAC-Adresse eine Multicast-Adresse ist. – Wählen Sie keinen Port aus, um einen Discard-Filter einzurichten. Das Gerät verwirft Datenpakete mit der im Tabelleneintrag angegebenen Ziel-MAC-Adresse.
Hilfe	Öffnet die Online-Hilfe.

10.3.2 QoS/Priorität

Kommunikationsnetze übertragen gleichzeitig eine Vielzahl von Anwendungen, die jeweils unterschiedliche Anforderungen an Verfügbarkeit, Bandbreite und Latenzzeiten haben.

QoS (Quality of Service) ist ein in der Norm IEEE 802.1D beschriebenes Verfahren, mit dem Sie die Ressourcen im Netz verteilen. Sie haben damit die Möglichkeit, wichtigen Anwendungen eine Mindest-Bandbreite zur Verfügung zu stellen. Voraussetzung ist, dass die Endgeräte und die Geräte im Netz die priorisierte Datenübertragung unterstützen. Hochpriorisierte Datenpakete vermitteln die Geräte im Netz bevorzugt. Datenpakete mit niedriger Priorität vermitteln sie, wenn keine höher priorisierten Datenpakete zu vermitteln sind.

Das Gerät bietet Ihnen folgende Einstellmöglichkeiten:

- ▶ Für eingehende Datenpakete legen Sie fest, wie das Gerät die QoS-/Priorisierungs-Information auswertet.
- ▶ Für ausgehende Datenpakete legen Sie fest, welche QoS-/Priorisierungs-Information das Gerät in das Datenpaket schreibt (z.B. Priorität für Management-Pakete, Portpriorität).

10.3.3 Switching > QoS/Priorität > Port-Konfiguration



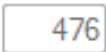
In diesem Dialog legen Sie für jeden Geräte-Port die QoS-/Priorisierungseinstellungen für empfangene Datenpakete fest.

■ Tabelle

Parameter	Bedeutung
Port	Zeigt die Nummer des Geräte-Ports.
Port-Priorität	<p>Legt die VLAN-Priorität der Datenpakete fest, die der Port empfängt.</p> <p>Das Gerät wendet diese Einstellung abhängig vom Wert in der Spalte „Trust-Modus“ auf die Datenpakete an:</p> <ul style="list-style-type: none">– Trust-Mode = <code>untrusted</code> Das Gerät vermittelt das Datenpaket mit der hier festgelegten VLAN-Priorität.– Trust-Mode = <code>trustDot1p</code> Wenn das Datenpaket keine VLAN- oder Prioritätsmarkierung enthält, vermittelt das Gerät das Datenpaket mit der hier festgelegten VLAN-Priorität.– Trust-Mode = <code>trustIpDscp</code> Wenn das Datenpaket kein IP-Paket ist, vermittelt das Gerät das Datenpaket mit der hier festgelegten Priorität. <p>Mögliche Werte:</p> <p>► 0..7 (Voreinstellung: 0)</p> <p>Im Dialog <code>Switching > QoS/Priorität > 802.1D/p-Mapping</code> weisen Sie jeder VLAN-Priorität eine Verkehrsklasse zu. Abhängig von der VLAN-Priorität weist das Gerät das Datenpaket einer bestimmten Verkehrsklasse zu und dementsprechend einer bestimmten Warteschlange des Ports.</p>

Parameter	Bedeutung
Trust-Modus	<p>Legt fest, wie das Gerät empfangene Datenpakete behandelt, die eine QoS-/Prioritätsinformation enthalten.</p> <p>Mögliche Werte:</p> <ul style="list-style-type: none"> ▶ <code>untrusted</code> Das Gerät vermittelt das Datenpaket mit der im Feld „Port-Priorität“ festgelegten VLAN-Priorität. Die im Datenpaket enthaltene QoS-/Prioritätsinformation ignoriert das Gerät. ▶ <code>trustDot1p</code> (Voreinstellung) <ul style="list-style-type: none"> – Wenn das Datenpaket eine VLAN-Markierung enthält, vermittelt das Gerät das Datenpaket anhand der enthaltenen QoS-/Prioritätsinformation. Im Dialog <code>Switching > QoS/Priorität > 802.1D/p-Mapping</code> weisen Sie jeder VLAN-Priorität eine Verkehrsklasse zu. Abhängig von der VLAN-Priorität weist das Gerät das Datenpaket einer bestimmten Verkehrsklasse zu und dementsprechend einer bestimmten Warteschlange des Ports. – Wenn das Datenpaket keine VLAN-Markierung enthält, vermittelt das Gerät das Datenpaket mit der im Feld „Port-Priorität“ festgelegten VLAN-Priorität. ▶ <code>trustIpDscp</code> <ul style="list-style-type: none"> – Wenn das Datenpaket ein IP-Datenpaket ist, vermittelt das Gerät das Datenpaket anhand des enthaltenen IP-DSCP-Werts. Im Dialog <code>Switching > QoS/Priorität > IP-DSCP-Mapping</code> weisen Sie jedem IP-DSCP-Wert eine Verkehrsklasse zu. Abhängig vom IP-DSCP-Wert weist das Gerät das Datenpaket einer bestimmten Verkehrsklasse zu und dementsprechend einer bestimmten Warteschlange des Ports. – Wenn das Datenpaket kein IP-Datenpaket ist, vermittelt das Gerät das Datenpaket mit der im Feld „Port-Priorität“ festgelegten VLAN-Priorität.
Untrusted Traffic Class	<p>Zeigt die Verkehrsklasse. Das Gerät weist Datenpakete dieser Verkehrsklasse zu, wenn im Feld „Trust-Mode“ der Wert <code>untrusted</code> festgelegt ist.</p> <p>Mögliche Werte:</p> <ul style="list-style-type: none"> ▶ <code>0..3</code> <p>Im Dialog <code>Switching > QoS/Priorität > 802.1D/p-Mapping</code> weisen Sie jeder VLAN-Priorität eine Verkehrsklasse zu. Abhängig von der VLAN-Priorität weist das Gerät das Datenpaket einer bestimmten Verkehrsklasse zu und dementsprechend einer bestimmten Warteschlange des Ports.</p>

■ Schaltflächen

	Beendet die Sitzung und trennt die Verbindung zum Gerät.
	Startet das Gerät neu.
	Zeigt die Zeit in Sekunden, nach der das Gerät bei Inaktivität des Benutzers die Sitzung automatisch beendet.

Laden	Lädt die Anzeige der Seite in Ihrem Web-Browser neu.
Schreiben	Überträgt die Änderungen in den flüchtigen Speicher des Gerätes. Um die Änderungen im nicht-flüchtigen lokalen Speicher des Gerätes zu speichern, gehen Sie wie folgt vor: <input type="checkbox"/> Öffnen Sie den Dialog Grundeinstellungen > Laden/Speichern. <input type="checkbox"/> Klicken Sie „Speichern“ im Rahmen „Laden/Speichern“ neben „Aktuelle Konfiguration speichern“.
Hilfe	Öffnet die Online-Hilfe.

10.3.4 Switching > QoS/Priorität > 802.1D/p-Mapping

Das Gerät vermittelt Datenpakete mit VLAN-Markierung anhand der enthaltenen QoS-/Priorisierungsinformation mit hoher oder mit niedriger Priorität.

In diesem Dialog weisen Sie jeder VLAN-Priorität eine Verkehrsklasse zu. Die Verkehrsklassen sind den Warteschlangen der Ports (Prioritäts-Queues) fest zugeordnet.



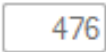
■ Tabelle

Parameter	Bedeutung
VLAN-Priorität	Zeigt die VLAN-Priorität.
Traffic-Class	Legt die Verkehrsklasse fest, die der VLAN-Priorität zugewiesen ist. Mögliche Werte: ► 0..3 0 ist der Warteschlange mit der niedrigsten Priorität zugeordnet. 3 ist der Warteschlange mit der höchsten Priorität zugeordnet. Anmerkung: Netzmanagementprotokolle und Redundanzmechanismen nutzen die höchste Verkehrsklasse. Wählen Sie deshalb für Anwendungsdaten eine andere Verkehrsklasse.

■ Werksseitige Zuordnung der VLAN-Priorität zu Verkehrsklassen

VLAN-Priorität	Traffic Class	Inhaltskennzeichnung gemäß IEEE 802.1D
0	1	Standard Normale Daten
1	0	Background Zeitunkritische Daten und Hintergrunddienste
2	0	Background Zeitunkritische Daten und Hintergrunddienste
3	1	Standard Normale Daten
4	2	Best Effort Normale Daten ohne Priorisierung
5	2	Best Effort Normale Daten ohne Priorisierung
6	3	Excellent Effort Wichtige Daten
7	3	Excellent Effort Wichtige Daten

■ Schaltflächen

	Beendet die Sitzung und trennt die Verbindung zum Gerät.
	Startet das Gerät neu.
	Zeigt die Zeit in Sekunden, nach der das Gerät bei Inaktivität des Benutzers die Sitzung automatisch beendet.
Laden	Lädt die Anzeige der Seite in Ihrem Web-Browser neu.
Schreiben	Überträgt die Änderungen in den flüchtigen Speicher des Gerätes. Um die Änderungen im nicht-flüchtigen lokalen Speicher des Gerätes zu speichern, gehen Sie wie folgt vor: <input type="checkbox"/> Öffnen Sie den Dialog Grundeinstellungen > Laden/Speichern . <input type="checkbox"/> Klicken Sie „Speichern“ im Rahmen „Laden/Speichern“ neben „Aktuelle Konfiguration speichern“.
Hilfe	Öffnet die Online-Hilfe.

10.3.5 QoS/Priorität > IP-DSCP-Mapping



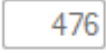
Das Gerät vermittelt IP-Datenpakete anhand des im Datenpaket enthaltenen DSCP-Werts mit hoher oder mit niedriger Priorität.

In diesem Dialog weisen Sie jedem DSCP-Wert eine Verkehrsklasse zu. Die Verkehrsklassen sind den Warteschlangen der Ports (Prioritäts-Queues) fest zugeordnet.

■ Tabelle

Parameter	Bedeutung
DSCP Wert	Zeigt den DSCP-Wert.
Traffic-Class	Legt die Verkehrsklasse fest, die dem DSCP-Wert zugewiesen ist. Mögliche Werte: ► 0..3 0 ist der Warteschlange mit der niedrigsten Priorität zugeordnet. 3 ist der Warteschlange mit der höchsten Priorität zugeordnet.

■ Schaltflächen

	Beendet die Sitzung und trennt die Verbindung zum Gerät.
	Startet das Gerät neu.
	Zeigt die Zeit in Sekunden, nach der das Gerät bei Inaktivität des Benutzers die Sitzung automatisch beendet.
Laden	Lädt die Anzeige der Seite in Ihrem Web-Browser neu.
Schreiben	Überträgt die Änderungen in den flüchtigen Speicher des Gerätes. Um die Änderungen im nicht-flüchtigen lokalen Speicher des Gerätes zu speichern, gehen Sie wie folgt vor: <input type="checkbox"/> Öffnen Sie den Dialog <code>Grundeinstellungen > Laden/Speichern</code> . <input type="checkbox"/> Klicken Sie „Speichern“ im Rahmen „Laden/Speichern“ neben „Aktuelle Konfiguration speichern“.
Hilfe	Öffnet die Online-Hilfe.

■ Werksseitige Zuordnung der DSCP-Werte zu Verkehrsklassen

DSCP-Wert	Traffic Class
0-7	1
8-23	0
24-31	1
32-47	2
48-63	3

10.3.6 Switching > L2-Redundanz > Spanning Tree > Global

Dieser Dialog bietet Ihnen die Möglichkeit, die Einstellungen für das Redundanzverfahren zu konfigurieren und zu überwachen.

Das Gerät unterstützt das in der Norm IEEE 802.1D-2004 definierte Rapid Spanning Tree Protocol (RSTP). Dieses Protokoll ist eine Weiterentwicklung des Spanning Tree Protocols (STP) und zu diesem kompatibel.

Das Spanning Tree Protocol (STP) ist ein Protokoll, das redundante Pfade eines Netzes deaktiviert, um Schleifen (Loops) zu vermeiden. Falls auf der Strecke eine Netzkomponente ausfällt, berechnet das Gerät die neue Topologie und aktiviert diese Pfade wieder.

Das Rapid Spanning Tree Protocol ermöglicht schnelles Umschalten auf eine Neuberechnete Topologie, ohne dabei bestehende Verbindungen zu unterbrechen.

■ Spanning Tree

Parameter	Bedeutung
Funktion	Schaltet die Spanning-Tree-Funktion im Gerät ein/aus. Mögliche Werte: ► An (Lieferzustand) ► Aus Das Gerät verhält sich transparent. Empfangene Spanning-Tree-Datenpakete flutet das Gerät wie Multicast-Datenpakete an den Geräte-Ports.

■ Protokoll-Konfiguration / Information

„Bridge“

Parameter	Bedeutung
Bridge-ID	<p>Zeigt die Bridge-ID des Gerätes. Das Gerät mit der numerisch niedrigsten Bridge-ID übernimmt die Rolle der Root-Bridge im Netz.</p> <p>Mögliche Werte: ► <Bridge-Priorität> / <MAC-Adresse></p>
Priorität	<p>Legt die Bridge-Priorität des Gerätes fest.</p> <p>Mögliche Werte: ► 0 .. 61440 in 4096er-Schritten (Voreinstellung: 32.768)</p> <p>Weisen Sie dem Gerät die numerisch niedrigste Priorität im Netz zu, um es zur Root-Bridge zu bestimmen.</p>
Hello Time [s]	<p>Legt die Zeit in Sekunden fest zwischen dem Senden zweier Konfigurationsmeldungen (Hello-Datenpakete).</p> <p>Mögliche Werte: ► 2)</p> <p>Übernimmt das Gerät die Rolle der Root-Bridge, verwenden die anderen Geräte im Netz den hier festgelegten Wert. Andernfalls verwendet das Gerät den von der Root-Bridge vorgegebenen Wert, siehe Spalte „Root“.</p>
Forward Delay [s]	<p>Legt die Verzögerungszeit für Zustandswechsel in Sekunden fest.</p> <p>Mögliche Werte: ► 4 .. 30 (Voreinstellung: 15)</p> <p>Übernimmt das Gerät die Rolle der Root-Bridge, verwenden die anderen Geräte im Netz den hier festgelegten Wert. Andernfalls verwendet das Gerät den von der Root-Bridge vorgegebenen Wert, siehe Spalte „Root“.</p> <p>Im Protokoll RSTP handeln die Bridges Zustandswechsel ohne vorgegebene Verzögerung aus.</p> <p>Das Protokoll STP verwendet den Parameter, um den Wechsel zwischen den Zuständen <code>disabled</code>, <code>discarding</code>, <code>learning</code>, <code>forwarding</code> zu verzögern.</p>

Parameter	Bedeutung
Die Parameter „Forward Delay“ und „Max Age“ stehen in folgender Beziehung zueinander: $\text{Forward Delay} \geq (\text{Max Age}/2) + 1$ Wenn Sie in die Felder einen Wert einfügen, der dieser Beziehung widerspricht, ersetzt das Gerät diese Werte mit den zuletzt gültigen Werten oder mit der Voreinstellung.	
Max Age	<p>Legt die maximal zulässige Astlänge fest, d. h. die Anzahl der Geräte bis zur Root-Bridge.</p> <p>Mögliche Werte:</p> <p>► 6..40 (Voreinstellung: 20)</p> <p>Übernimmt das Gerät die Rolle der Root-Bridge, verwenden die anderen Geräte im Netz den hier festgelegten Wert. Andernfalls verwendet das Gerät den von der Root-Bridge vorgegebenen Wert, siehe Spalte „Root“.</p> <p>Das Protokoll STP verwendet den Parameter, um die Gültigkeit von STP-BPDUs in Sekunden festzulegen.</p>

„Root“




Parameter	Bedeutung
Bridge-ID	<p>Zeigt die Bridge-ID der gegenwärtigen Root-Bridge.</p> <p>Mögliche Werte:</p> <p>► <Bridge-Priorität> / <MAC-Adresse></p> <p>Die Bridge-ID setzt sich zusammen aus Bridge-Priorität und MAC-Adresse.</p>
Priorität	<p>Zeigt die Bridge-Priorität der gegenwärtigen Root-Bridge.</p> <p>Mögliche Werte:</p> <p>► 0..61440 in 4096er-Schritten</p>
Hello Time [s]	<p>Zeigt die von der Root-Bridge vorgegebene Zeit in Sekunden zwischen dem Senden zweier Konfigurationsmeldungen (Hello-Datenpakete).</p> <p>Mögliche Werte:</p> <p>► 1..2</p> <p>Das Gerät verwendet diesen vorgegebenen Wert, siehe Spalte „Bridge“.</p>

Parameter	Bedeutung
Forward Delay [s]	<p>Zeigt die von der Root-Bridge vorgegebene Verzögerungszeit für Zustandswechsel in Sekunden.</p> <p>Mögliche Werte:</p> <ul style="list-style-type: none"> ▶ 4..30 <p>Das Gerät verwendet diesen vorgegebenen Wert, siehe Spalte „Bridge“.</p> <p>Im Protokoll RSTP handeln die Bridges Zustandswechsel ohne vorgegebene Verzögerung aus.</p> <p>Das Protokoll STP verwendet den Parameter, um den Wechsel zwischen den Zuständen <code>disabled</code>, <code>discarding</code>, <code>learning</code>, <code>forwarding</code> zu verzögern.</p>
Max Age	<p>Zeigt die von der Root-Bridge vorgegebene maximal zulässige Astlänge, d. h. die Anzahl der Geräte bis zur Root-Bridge.</p> <p>Mögliche Werte:</p> <ul style="list-style-type: none"> ▶ 6..40 (Voreinstellung: 20) <p>Das Protokoll STP verwendet den Parameter, um die Gültigkeit von STP-BPDUs in Sekunden festzulegen.</p>

„Topologie“

Parameter	Bedeutung
Bridge ist Root	<p>Zeigt, ob das Gerät gegenwärtig die Rolle der Root-Bridge übernimmt.</p> <p>Mögliche Werte:</p> <ul style="list-style-type: none"> ▶ unmarkiert Gegenwärtig übernimmt ein anderes Gerät die Rolle der Root-Bridge. ▶ markiert Das Gerät übernimmt gegenwärtig die Rolle der Root-Bridge.
Root-Port	<p>Zeigt die Nummer des Geräte-Ports, von dem der aktuelle Pfad zur Root-Bridge führt.</p> <p>Übernimmt das Gerät die Rolle der Root-Bridge, zeigt das Feld den Wert 0.</p>
Anzahl Topologie-änderungen	<p>Zeigt, wie oft das Gerät seit dem Start einen Geräte-Port durch Spanning Tree in den Zustand <code>Forwarding</code> gesetzt hat.</p>
Zeit seit letzter Änderung	<p>Zeigt die Zeit seit der letzten Topologie-Änderung.</p> <p>Mögliche Werte:</p> <ul style="list-style-type: none"> ▶ <Tage, Stunden:Minuten:Sekunden>
Root-Pfadkosten	<p>Zeigt die Pfadkosten für den Pfad, der vom Root-Port des Gerätes zur Root-Bridge des Layer-2-Netzes führt.</p> <p>Mögliche Werte:</p> <ul style="list-style-type: none"> ▶ 0..200000000 <p>Wenn der Wert 0 festgelegt ist, übernimmt das Gerät die Rolle der Root-Bridge.</p>

■ Schaltflächen

	Beendet die Sitzung und trennt die Verbindung zum Gerät.
	Startet das Gerät neu.
	Zeigt die Zeit in Sekunden, nach der das Gerät bei Inaktivität des Benutzers die Sitzung automatisch beendet.
Laden	Lädt die Anzeige der Seite in Ihrem Web-Browser neu.
Schreiben	Überträgt die Änderungen in den flüchtigen Speicher des Gerätes. Um die Änderungen im nicht-flüchtigen lokalen Speicher des Gerätes zu speichern, gehen Sie wie folgt vor: <input type="checkbox"/> Öffnen Sie den Dialog <code>Grundeinstellungen > Laden/Speichern</code> . <input type="checkbox"/> Klicken Sie „Speichern“ im Rahmen „Laden/Speichern“ neben „Aktuelle Konfiguration speichern“.
Hilfe	Öffnet die Online-Hilfe.

10.3.7 Switching > L2-Redundanz > Spanning Tree > Port

Dieser Dialog bietet Ihnen die Möglichkeit, an den Geräte-Ports die Spanning-Tree-Funktion ein-/auszuschalten, Edge-Ports festzulegen sowie die Einstellungen für verschiedene Schutzfunktionen festzulegen.



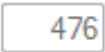
■ Tabelle

Parameter	Bedeutung
Port	Zeigt die Nummer des Geräte-Ports.
Stp	Schaltet die Spanning-Tree-Funktion auf dem Geräte-Port ein/aus. Mögliche Werte: ▶ An (Voreinstellung) ▶ Aus Ist die Spanning-Tree-Funktion im Gerät eingeschaltet und auf dem Geräte-Port ausgeschaltet, sendet der Port keine STP-BPDUs und verwirft empfangene STP-BPDUs.

Parameter	Bedeutung
Port-Priorität	<p>Legt die Priorität des Geräte-Ports fest.</p> <p>Mögliche Werte:</p> <ul style="list-style-type: none"> ▶ 16..240 in 16er-Schritten (Voreinstellung: 128) <p>Der Wert repräsentiert die ersten 4 Bits der Port-ID.</p>
Port-Pfadkosten	<p>Legt die RSTP-Port-Pfadkosten zur Bevorzugung redundanter Pfade fest (entspricht einem Beitrag dieses Ports zu den globalen Root-Pfadkosten).</p> <p>Mögliche Werte:</p> <ul style="list-style-type: none"> ▶ 0..200000000 (Voreinstellung: 0) <p>Wenn der Wert 0 festgelegt ist, ermittelt das Gerät automatisch die Pfadkosten abhängig von der Datenrate.</p>
Port Status	<p>Zeigt den Vermittlungsstatus des Geräte-Ports.</p> <p>Mögliche Werte:</p> <ul style="list-style-type: none"> ▶ discarding Der Geräte-Port ist blockiert und leitet ausschließlich STP-BPDUs weiter. ▶ learning Der Geräte-Port ist blockiert, lernt jedoch die MAC-Adressen empfangener Datenpakete. ▶ forwarding Der Geräte-Port leitet Datenpakete weiter. ▶ disabled Die Spanning-Tree-Funktion ist auf dem Geräte-Port ausgeschaltet. Der Geräte-Port leitet STP-BPDUs weiter. ▶ disconnected Es ist kein Kabel angeschlossen.
Oper Edge Port	<p>Zeigt, ob am Geräte-Port ein Endgerät oder eine STP-Bridge angeschlossen ist.</p> <p>Mögliche Werte:</p> <ul style="list-style-type: none"> ▶ enable Am Geräte-Port ist ein Endgerät angeschlossen. Der Geräte-Port empfängt keine STP-BPDUs. ▶ disable Am Geräte-Port ist eine STP-Bridge angeschlossen. Der Geräte-Port empfängt STP-BPDUs.

Parameter	Bedeutung
Admin Edge Port	<p>Legt fest, ob am Geräte-Port ein Endgerät angeschlossen ist.</p> <p>Mögliche Werte:</p> <ul style="list-style-type: none"> ▶ <code>unmarkiert</code> (Voreinstellung) Am Geräte-Port ist eine STP-Bridge angeschlossen. Nach Aufbau der Verbindung wechselt der Geräte-Port in den Status <code>learning</code>, bevor er ggf. in den Status <code>forwarding</code> wechselt. ▶ <code>markiert</code> Am Geräte-Port ist ein Endgerät angeschlossen. <ul style="list-style-type: none"> – Nach Aufbau der Verbindung wechselt der Geräte-Port in den Status <code>forwarding</code>, ohne zuvor in den Status <code>learning</code> zu wechseln. – Empfängt der Geräte-Port eine STP-BPDU, deaktiviert das Gerät den Port, falls im Dialog <code>Switching > L2-Redundanz > Spanning Tree > Global</code> die BPDU-Guard-Funktion eingeschaltet ist.
Auto Edge Port	<p>Aktiviert/deaktiviert die automatische Erkennung, ob am Port ein Endgerät angeschlossen ist.</p> <p>Diese Einstellung ist ausschließlich dann wirksam, wenn das Kontrollkästchen im Feld „Admin Edge Port“ unmarkiert ist.</p> <p>Mögliche Werte:</p> <ul style="list-style-type: none"> ▶ <code>markiert</code> (Voreinstellung) Nach Aufbau der Verbindung setzt das Gerät den Port nach $1,5 \times \text{„Hello Time [s]“}$ in den Zustand <code>forwarding</code> (in der Voreinstellung $1,5 \times 2 \text{ s}$), falls der Port währenddessen keine STP-BPDU empfängt. ▶ <code>unmarkiert</code> Nach Aufbau der Verbindung setzt das Gerät den Port nach „Max Age“ in den Zustand <code>forwarding</code> (in der Voreinstellung 20 s).

■ Schaltflächen

	Beendet die Sitzung und trennt die Verbindung zum Gerät.
	Startet das Gerät neu.
	Zeigt die Zeit in Sekunden, nach der das Gerät bei Inaktivität des Benutzers die Sitzung automatisch beendet.
Laden	Lädt die Anzeige der Seite in Ihrem Web-Browser neu.
Schreiben	<p>Überträgt die Änderungen in den flüchtigen Speicher des Gerätes. Um die Änderungen im nicht-flüchtigen lokalen Speicher des Gerätes zu speichern, gehen Sie wie folgt vor:</p> <ul style="list-style-type: none"> <input type="checkbox"/> Öffnen Sie den Dialog <code>Grundeinstellungen > Laden/Speichern</code>. <input type="checkbox"/> Klicken Sie „Speichern“ im Rahmen „Laden/Speichern“ neben „Aktuelle Konfiguration speichern“.
Hilfe	Öffnet die Online-Hilfe.

10.4 Diagnose

Die Dialoge dieses Menüs zeigen Informationen zu Zuständen und Ereignissen an, die das Gerät protokolliert hat. Im Service-Fall helfen diese Informationen unserem Support bei der Diagnose.

10.4.1 Diagnose > Alarme (Traps)



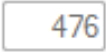
■ Alarme (Traps)

Parameter	Bedeutung
Funktion	<p>Legt fest, ob das Gerät einen SNMP-Trap sendet, wenn es eine Änderung bei den überwachten Funktionen erkennt.</p> <p>Mögliche Werte:</p> <ul style="list-style-type: none"> ▶ An Das Gerät sendet einen SNMP-Trap. ▶ Aus (Voreinstellung) Das Gerät sendet keinen SNMP-Trap. <p>Voraussetzung für das Senden von SNMP-Traps ist, dass Sie die Link-Überwachung im Dialog <i>Grundeinstellungen > Port > Konfiguration</i> einschalten und mindestens 1 SNMP-Manager (Zieladresse) festlegen.</p>
Link Up/Down	An einem Port des Gerätes wurde eine Verbindung mit einem dort angeschlossenen Gerät hergestellt/unterbrochen.
Authentifizierung	Das Gerät hat einen unerlaubten Zugriff zurückgewiesen. Siehe „Gerätesicherheit > SNMP“ auf Seite 78.
Spanning Tree	Die Topologie des Rapid Spanning Tree hat sich geändert.
LLDP	Wird gesendet, wenn sich ein Eintrag in der Tabelle Topologie-Erkennung ändert.

■ Zieladressen

Parameter	Bedeutung
IP-Adresse	Legt die IP-Adresse des SNMP-Managers fest. Mögliche Werte: ▶ <Gültige IPv4-Adresse>
Trap Community	Legt den Namen der Trap Community fest, den das Gerät verwendet, um sich als Quelle des Traps zu identifizieren. Mögliche Werte: ▶ public (Voreinstellung) ▶ Alphanumerische ASCII-Zeichenfolge mit 0..64 Zeichen

■ Schaltflächen

	Beendet die Sitzung und trennt die Verbindung zum Gerät.
	Startet das Gerät neu.
	Zeigt die Zeit in Sekunden, nach der das Gerät bei Inaktivität des Benutzers die Sitzung automatisch beendet.
Laden	Lädt die Anzeige der Seite in Ihrem Web-Browser neu.
Schreiben	Überträgt die Änderungen in den flüchtigen Speicher des Gerätes. Um die Änderungen im nicht-flüchtigen lokalen Speicher des Gerätes zu speichern, gehen Sie wie folgt vor: <input type="checkbox"/> Öffnen Sie den Dialog Grundeinstellungen > Laden/Speichern. <input type="checkbox"/> Klicken Sie „Speichern“ im Rahmen „Laden/Speichern“ neben „Aktuelle Konfiguration speichern“.
Hilfe	Öffnet die Online-Hilfe.

10.4.2 Diagnose > LLDP

Das Gerät bietet Ihnen die Möglichkeit, Informationen über benachbarte Geräte zu sammeln. Dazu nutzt das Gerät das Link Layer Discovery Protocol (LLDP). Mit diesen Informationen ist eine Netzmanagementstation in der Lage, die Struktur Ihres Netzes darzustellen.

Geräte in Netzen versenden Mitteilungen in Form von Paketen, welche auch unter dem Namen „LLDPDU“ (LLDP-Dateneinheit) bekannt sind. Die über LLDPDUs versendeten und empfangenen Daten sind aus vielen Gründen nützlich. So erkennt das Gerät etwa, bei welchen Geräten innerhalb des Netzes es sich um Nachbarn handelt und über welche Ports diese miteinander verbunden sind.

Dieser Dialog bietet Ihnen die Möglichkeit, das Netz darzustellen und die angeschlossenen Geräte mitsamt ihren Funktionsmerkmalen zu ermitteln.

■ LLDP

Parameter	Bedeutung
Funktion	Bei eingeschalteter Funktion ist die Topologie-Erkennung per LLDP auf dem Gerät aktiviert. ▶ An (Voreinstellung) ▶ Aus

■ Topologie-Erkennung

Dieser Rahmen zeigt Ihnen die gesammelten LLDP-Informationen zu den Nachbargeräten an. Mit diesen Informationen ist eine Netzmanagementstation in der Lage, die Struktur Ihres Netzes darzustellen.

Wenn an einem Geräte-Port sowohl Geräte mit als auch ohne aktive Topologie-Erkennungs-Funktion angeschlossen sind, dann blendet die Topologie-Tabelle die Geräte ohne aktive Topologie-Erkennung aus.



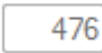
Wenn ausschließlich Geräte ohne aktive Topologie-Erkennung an einem Geräte-Port angeschlossen sind, dann enthält die Tabelle stellvertretend für alle Geräte eine Zeile für diesen Port. Diese Zeile enthält die Anzahl der angeschlossenen Geräte.

Die Weiterleitungstabelle (FDB) enthält MAC-Adressen von Geräten, welche die Topologietabelle aus Gründen der Übersicht ausblendet.

Wenn Sie an Port 1 mehrere Geräte anschließen (z. B. über einen Hub), zeigt die Tabelle pro angeschlossenem Gerät eine Zeile an.

Parameter	Bedeutung
Port	Zeigt die Nummer des Geräte-Ports.
Nachbar-Bezeichner	Zeigt die Chassis-ID des Nachbargerätes. Dies kann z. B. die Basis-MAC-Adresse des Nachbargerätes sein.
Nachbar-IP-Adresse	Zeigt die IP-Adresse, mit der die Management-Funktionen des Nachbargerätes erreichbar sind.
Nachbar-Port-Beschreibung	Zeigt eine Beschreibung für den Geräte-Port des Nachbargerätes.
Nachbar-System-name	Zeigt den Gerätenamen des Nachbargerätes.
Nachbar-System-beschreibung	Zeigt eine Beschreibung für das Nachbargerät.

■ Schaltflächen

	Beendet die Sitzung und trennt die Verbindung zum Gerät.
	Startet das Gerät neu.
	Zeigt die Zeit in Sekunden, nach der das Gerät bei Inaktivität des Benutzers die Sitzung automatisch beendet.
Laden	Lädt die Anzeige der Seite in Ihrem Web-Browser neu.

Schreiben	Überträgt die Änderungen in den flüchtigen Speicher des Gerätes. Um die Änderungen im nicht-flüchtigen lokalen Speicher des Gerätes zu speichern, gehen Sie wie folgt vor: <ul style="list-style-type: none"><input type="checkbox"/> Öffnen Sie den Dialog <code>Grundeinstellungen > Laden/Speichern</code>.<input type="checkbox"/> Klicken Sie „Speichern“ im Rahmen „Laden/Speichern“ neben „Aktuelle Konfiguration speichern“.
Hilfe	Öffnet die Online-Hilfe.

10.4.3 Diagnose > System Log

■ System Information

Dieser Dialog zeigt den aktuellen Betriebszustand einzelner Komponenten im Gerät.

Der Dialog bietet Ihnen die Möglichkeit, die Seite im HTML-Format auf Ihrem PC zu speichern.

■ System Log



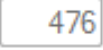
Das Gerät protokolliert wichtige geräteinterne Ereignisse in einer Log-Datei (System Log).

Dieser Dialog zeigt die Log-Datei (System Log) an. Der Dialog bietet Ihnen die Möglichkeit, die Log-Datei im HTML-Format auf Ihrem PC zu speichern.

Die Log-Datei bleibt bis zu einem Neustart des Gerätes erhalten. Nach dem Neustart erstellt das Gerät die Datei neu.

Um die protokollierten Ereignisse aus der Log-Datei zu entfernen, klicken Sie die Schaltfläche „Logdatei löschen“.

■ Schaltflächen

	Beendet die Sitzung und trennt die Verbindung zum Gerät.
	Startet das Gerät neu.
	Zeigt die Zeit in Sekunden, nach der das Gerät bei Inaktivität des Benutzers die Sitzung automatisch beendet.
Laden	Lädt die Anzeige der Seite in Ihrem Web-Browser neu.
Speichern	Öffnet den Dialog „Speichern“. Der Dialog bietet Ihnen die Möglichkeit, die Log-Datei im HTML-Format auf Ihrem PC zu speichern.
Logdatei löschen	Entfernt die protokollierten Einträge aus der Log-Datei.
Hilfe	Öffnet die Online-Hilfe.

A Anhang

A.1 Technische Daten

Switching	
Größe MAC-Adresstabelle (inkl. statische Filter)	1.024
Max. Anzahl statisch konfigurierter MAC- Adressfilter	100
MTU (Max. Länge überlanger Pakete)	1.522 Bytes
Latenz, abhängig von der Port-Datenrate 100 Mbit/s	min. 7 µs max. 9 µs
Max. Anzahl statischer Adresseinträge	100
Max. Anzahl dynamischer Unicast-Einträge	910
Anzahl Warteschlangen	4 Queues
Einstellbare Port-Prioritäten	0 ... 7

A.2 Zugrundeliegende technische Normen

ANSI/TIA-1057	Link Layer Discovery Protocol for Media Endpoint Devices, April 2006
IEEE 802.1AB	Topology Discovery (LLDP)
IEEE 802.1D-1998, IEEE 802.1D-2004	Media access control (MAC) bridges (includes IEEE 802.1p Priority and Dynamic Multicast Filtering, GARP, GMRP)
IEEE 802.1Q-1998	Virtual Bridged Local Area Networks (VLAN Tagging, Port Based VLANs, GVRP)
IEEE 802.1Q-2005	Spanning Tree (STP), Rapid Spanning Tree (RSTP), Multiple Spanning Tree (MSTP)
IEEE 802.3-2002	Ethernet
IEEE 802.3x	Flow Control

A.3 Liste der RFCs

RFC 768	UDP
RFC 783	TFTP
RFC 791	IP
RFC 792	ICMP
RFC 793	TCP
RFC 826	ARP
RFC 951	BOOTP
RFC 1157	SNMPv1
RFC 1155	SMIv1
RFC 1212	Concise MIB Definitions
RFC 1213	MIB2
RFC 1493	Dot1d
RFC 1542	BOOTP-Extensions
RFC 1643	Ethernet-like -MIB
RFC 1757	RMON
RFC 1867	Form-Based File Upload in HTML
RFC 1901	Community based SNMP v2
RFC 1905	Protocol Operations for SNMP v2
RFC 1906	Transport Mappings for SNMP v2
RFC 1907	Management Information Base for SNMP v2
RFC 1908	Coexistence between SNMP v1 and SNMP v2
RFC 1945	HTTP/1.0
RFC 2068	HTTP/1.1
RFC 2131	DHCP
RFC 2132	DHCP-Options
RFC 2233	The Interfaces Group MIB using SMI v2
RFC 2246	The TLS Protocol, Version 1.0
RFC 2271	SNMP Framework MIB
RFC 2346	AES Ciphersuites for Transport Layer Security
RFC 2365	Administratively Scoped Boundaries
RFC 2474	Definition of the Differentiated Services Field (DS Field) in the IPv4 and IPv6 Headers
RFC 2475	An Architecture for Differentiated Service
RFC 2570	Introduction to SNMP v3
RFC 2571	Architecture for Describing SNMP Management Frameworks
RFC 2572	Message Processing and Dispatching for SNMP
RFC 2573	SNMP v3 Applications
RFC 2574	User Based Security Model for SNMP v3
RFC 2575	View Based Access Control Model for SNMP

RFC 2576	Coexistence between SNMP v1, v2 & v3
RFC 2578	SMIv2
RFC 2579	Textual Conventions for SMI v2
RFC 2580	Conformance statements for SMI v2
RFC 2674	Dot1p/Q
RFC 2818	HTTP over TLS
RFC 2851	Internet Addresses MIB
RFC 4188	(Definitions of Managed Objects for Bridges)

A.4 Grundlagen IP-Parameter

A.4.1 IP-Adresse (Version 4)

Die IP-Adressen bestehen aus 4 Bytes. Diese 4 Bytes werden durch einen Punkt getrennt, dezimal dargestellt.

Seit 1992 sind im RFC 1340 5 Klassen von IP-Adressen definiert.

Klasse	Netzadresse	Hostadresse	Adressbereich
A	1 Byte	3 Bytes	0.0.0.0 bis 127.255.255.255
B	2 Bytes	2 Bytes	128.0.0.0 bis 191.255.255.255
C	3 Bytes	1 Byte	192.0.0.0 bis 223.255.255.255
D			224.0.0.0 bis 239.255.255.255
E			240.0.0.0 bis 255.255.255.255

Tab. 2: IP-Adressklassen

Das erste Byte einer IP-Adresse ist die Netzadresse. Der Regulierungsausschuss für die weltweite Zuweisung von Netzadressen ist IANA („Internet Assigned Numbers Authority“). Falls Sie einen IP-Adressenblock benötigen, wenden Sie sich an Ihren Internet Service Provider (ISP). Ihr ISP wendet sich an seine lokale übergeordnete Organisation, um einen IP-Adressenblock zu reservieren:

- ▶ APNIC (Asia Pacific Network Information Center) – Asien/Pazifik
- ▶ ARIN (American Registry for Internet Numbers) – Amerika und Subsahara-Afrika
- ▶ LACNIC (Regional Latin-American and Caribbean IP Address Registry) – Lateinamerika und weitere Karibik-Inseln
- ▶ RIPE NCC (Réseaux IP Européens) – Europa und umliegende Regionen

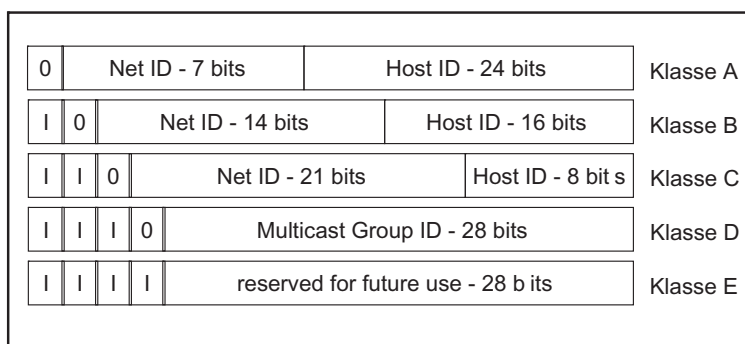


Abb. 3: Bitdarstellung der IP-Adresse

Ist das erste Oktett einer IP-Adresse eine Null, d.h. kleiner als 128, gehört sie der Klasse A an.

Ist das erste Bit einer IP-Adresse eine Eins und das zweite Bit eine Null, d.h. das erste Oktett liegt im Bereich von 128 bis 191, dann gehört die IP-Adresse der Klasse B an.

Sind die ersten beiden Bits einer IP-Adresse eine Eins, d.h. das erste Oktett ist größer als 191, dann handelt es sich um eine IP-Adresse der Klasse C.

Die Vergabe der Hostadresse (host ID) obliegt dem Netzbetreiber. Der Netzbetreiber allein ist für die Einmaligkeit der IP-Adressen, die er vergibt, verantwortlich.

A.4.2 Netzmaske

Router und Gateways unterteilen große Netze in Subnetze. Die Netzmaske ordnet die IP-Adressen der einzelnen Geräte einem bestimmten Subnetz zu.

Die Einteilung in Subnetze erfolgt über die Netzmaske analog zu der Einteilung der Netzadresse (net id) in die Klassen A bis C.

Setzen Sie die Bits der Hostadresse (host id), die die Maske darstellen, auf Eins. Setzen Sie die restlichen Bits der Hostadresse auf Null (vgl. folgende Beispiele).

Beispiel für eine Subnetzmaske:

Dezimale Darstellung

255.255.192.0

Binäre Darstellung

11111111.11111111.11000000.00000000

 Subnetzmaskenbits
Klasse B

Beispiel für IP-Adressen mit Subnetzzuordnung gemäß der Netzmaske:

Dezimale Darstellung

129.218.65.17

 128 < 129 191 > Klasse B

Binäre Darstellung

10000001.11011010.01000001.00010001

 Subnetz 1
Netzadresse

Dezimale Darstellung

129.218.129.17

 128 < 129 191 > Klasse B

Binäre Darstellung

10000001.11011010.10000001.00010001

 Subnetz 2

■ Beispiel für die Anwendung der Netzmaske

In einem großen Netz ist es möglich, dass Gateways oder Router den Management-Agenten von ihrer Managementstation trennen. Wie erfolgt in einem solchen Fall die Adressierung?

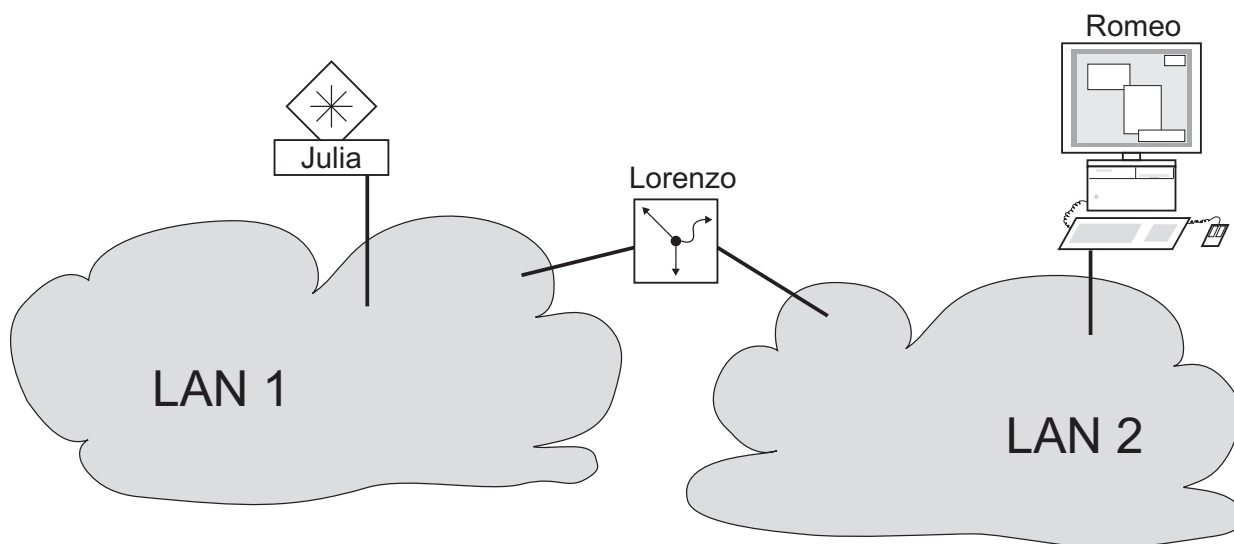


Abb. 4: Management-Agent durch Router von der Managementstation getrennt

Die Managementstation „Romeo“ möchte Daten an den Management-Agenten „Julia“ schicken. Romeo kennt die IP-Adresse von Julia und weiß, dass der Router „Lorenzo“ den Weg zu Julia kennt.

Also packt Romeo seine Botschaft in einen Umschlag und schreibt als Zieladresse die IP-Adresse von Julia und als Quelladresse seine eigene IP-Adresse darauf.

Diesen Umschlag steckt Romeo in einen weiteren Umschlag mit der MAC-Adresse von Lorenzo als Zieladresse und seiner eigenen MAC-Adresse als Quelladresse. Dieser Vorgang ist vergleichbar mit dem Übergang von der Ebene 3 zur Ebene 2 des ISO/OSI-Basis-Referenzmodells.

Nun steckt Romeo das gesamte Datenpaket in den Briefkasten, vergleichbar mit dem Übergang von der Ebene 2 zur Ebene 1, dem Senden des Datenpaketes in das Ethernet.

Lorenzo erhält den Brief, entfernt den äußeren Umschlag und erkennt auf dem inneren Umschlag, dass der Brief für Julia bestimmt ist. Er steckt den inneren Umschlag in einen neuen äußeren Umschlag, schaut in seiner Adressliste, der ARP-Tabelle, nach der MAC-Adresse von Julia und schreibt diese auf den äußeren Umschlag als Zieladresse und seine eigene MAC-Adresse als Quelladresse. Das gesamte Datenpaket steckt er anschließend in den Briefkasten.

Julia empfängt den Brief, entfernt den äußeren Umschlag. Übrig bleibt der innere Umschlag mit Romeos IP-Adresse. Das Öffnen des inneren Umschlages und lesen der Botschaft entspricht einer Übergabe an höhere Protokollschichten des ISO/OSI-Schichtenmodells.

Julia möchte eine Antwort an Romeo zurücksenden. Sie steckt ihre Antwort in einen Umschlag mit der IP-Adresse von Romeo als Zieladresse und ihrer eigenen IP-Adresse als Quelladresse. Doch wohin soll Sie die Antwort schicken? Die MAC-Adresse von Romeo hat sie ja nicht erhalten. Die MAC-Adresse von Romeo blieb beim Wechseln des äußeren Umschlags bei Lorenzo zurück.

Julia findet in der MIB unter der Variablen `hmNetGatewayIPAddr` Lorenzo als Vermittler zu Romeo. So steckt sie den Umschlag mit den IP-Adressen in einen weiteren Umschlag mit der MAC-Zieladresse von Lorenzo.

Nun findet der Brief den gleichen Weg über Lorenzo zu Romeo, so wie der Brief von Romeo zu Julia fand.

A.4.3 Classless Inter-Domain Routing

Die Klasse C mit maximal 254 Adressen war zu klein, und die Klasse B mit maximal 65.534 Adressen war für die meisten Anwender zu groß. Hieraus resultierte eine nicht effektive Nutzung der zur Verfügung stehenden Klasse-B-Adressen.

Die Klasse D enthält reservierte Multicast-Adressen. Die Klasse E ist für experimentelle Zwecke vorgesehen. Ein Gateway, das nicht an diesen Experimenten teilnimmt, ignoriert experimentelle Datagramme mit diesen Zieladressen.

Seit 1993 verwendet RFC 1519 Classless Inter-Domain Routing (CIDR) zur Lösung dieses Sachverhalts. Das CIDR überwindet diese Klassenschranken und unterstützt klassenlose IP-Adressbereiche.

Mit CIDR geben Sie die Anzahl der Bits an, die den IP-Adressbereich kennzeichnen. Hierzu stellen Sie den IP-Adressbereich in binärer Form dar und zählen die Maskenbits zur Bezeichnung der Netzmaske. Die Maskenbits entsprechen der Anzahl der Bits, die in einem bestimmten IP-Bereich für das Subnetz verwendet werden. Beispiel:

IP-Adresse dezimal	Netzmaske dezimal	IP-Adresse binär
149.218.112.1	255.255.255.128	10010101 11011010 01110000 00000001
149.218.112.127		10010101 11011010 01110000 01111111
		————— 25 Maskenbits —————

CIDR-Schreibweise: 149.218.112.0/25

————— Maskenbits

Die Zusammenfassung mehrerer Adressbereiche der Klasse C wird als „Supernetting“ bezeichnet. Mit Supernetting lassen sich Adressbereiche der Klasse B sehr fein untergliedern.

A.5 Grundlagen Dynamic Host Configuration Protocol (DHCP)

Das DHCP (Dynamic Host Configuration Protocol) ist eine Weiterentwicklung von BOOTP und hat dieses abgelöst. DHCP bietet zusätzlich die Konfiguration eines DHCP-Clients über einen Namen anstatt über die MAC-Adresse an.

Dieser Name heißt bei DHCP nach RFC 2131 „Client Identifier“.

Das Gerät verwendet den in der System-Gruppe der MIB II unter sysName eingetragenen Namen als Client Identifier. Diesen Systemnamen können Sie im Dialog *Grundeinstellungen > System* im Feld „Gerätename“ eingeben.

Das Gerät übermittelt dem DHCP-Server seinen Systemnamen. Der DHCP-Server verwendet anschließend den Systemnamen für die Zuweisung einer IP-Adresse als Alternative für die MAC-Adresse.

Neben der IP-Adresse überträgt der DHCP-Server

- ▶ die Netzmaske
- ▶ das Standard-Gateway (falls verfügbar)
- ▶ die TFTP-URL der Konfigurationsdatei (falls verfügbar).

Das Gerät wendet die Konfigurationsdaten auf die entsprechenden Parameter an. Wenn der DHCP-Server die IP-Adresse zuweist, speichert das Gerät die Konfigurationsdaten permanent im nicht-flüchtigen Speicher.

Optionen	Bedeutung
1	Subnet Mask
2	Time Offset
3	Router
4	Time server
12	Host Name

Tab. 3: DHCP-Optionen, die das Gerät anfordert

Optionen	Bedeutung
42	NTP server
61	Client Identifier
66	TFTP Server Name
67	Bootfile Name

Tab. 3: DHCP-Optionen, die das Gerät anfordert

Der Vorteil beim Einsatz von DHCP gegenüber BOOTP ist, dass der DHCP-Server die Gültigkeit der Konfigurationsparameter ("Lease") auf eine bestimmte Zeitspanne einschränken kann (sogenannte dynamische Adressvergabe). Rechtzeitig vor Ablauf dieser Zeitspanne ("Lease Duration"), kann der DHCP-Client versuchen, dieses Lease zu erneuern. Alternativ kann er ein neues Lease aushandeln. Der DHCP-Server weist dann eine beliebige freie Adresse zu.

Um dies zu umgehen, bieten DHCP-Server die explizite Konfigurationsmöglichkeit, einem bestimmten Client anhand einer eindeutigen Hardware-ID dieselbe IP-Adresse zuzuordnen (sogenannte statische Adressvergabe).

A.6 Grundlagen Spanning-Tree-Protokoll

Anmerkung: Das Spanning-Tree-Protokoll ist ein Protokoll für MAC-Bridges (Brücken). Daher verwendet die folgende Beschreibung den Begriff Bridge für TCSESL.

Lokale Netze werden immer größer. Dies gilt sowohl für die geografische Ausdehnung als auch für die Anzahl der Netzteilnehmer. Deshalb ist der Einsatz mehrerer Bridges vorteilhaft, z. B. um:

- ▶ die Netzlast in Teilbereichen zu verringern,
- ▶ redundante Verbindungen aufzubauen und
- ▶ Entfernungseinschränkungen zu überwinden.

Der Einsatz mehrerer Bridges mit mehrfachen, redundanten Verbindungen zwischen den Teilnetzen kann jedoch zu Schleifen (Loops) und zum Verlust der Kommunikation durch das Netz führen. Als Hilfe, um dies zu verhindern, haben Sie die Möglichkeit, Spanning Tree einzusetzen. Spanning Tree erzielt Schleifenfreiheit durch das gezielte Deaktivieren von redundanten Verbindungen. Das gezielte Wieder-Aktivieren einzelner Verbindungen bei Bedarf ermöglicht die Redundanz.

RSTP ist eine Weiterentwicklung des Spanning-Tree-Protokolls (STP) und ist zu diesem kompatibel. Das STP benötigt bei Betriebsunfähigkeit einer Verbindung oder einer Bridge eine Rekonfigurationszeit von max. 30 s. Dies ist für zeitkritische Anwendungen nicht mehr akzeptabel. RSTP erreicht durchschnittliche Rekonfigurationszeiten von unter einer Sekunde. Wenn Sie RSTP in einer Ringtopologie mit 10 bis 20 Geräten einsetzen, können Sie auch Rekonfigurationszeiten im Millisekundenbereich erreichen.

Anmerkung: RSTP löst eine Layer 2-Netztopologie mit redundanten Pfaden in eine Baumstruktur (Spanning Tree) auf, die keine redundanten Pfade mehr enthält. Einer der übernimmt dabei die Rolle der Root-Bridge. Die maximal erlaubte Anzahl der Geräte in einem aktiven Ast von der Root-Bridge bis zur Astspitze können Sie durch die Variable `Max Age` der aktuellen Root-Bridge vorgeben. Der voreingestellte Wert für `Max Age` ist 20, er kann bis auf 40 erhöht werden.

Wenn das als Root arbeitende Gerät ausfällt und ein anderes Gerät dessen Funktion übernimmt, bestimmt die neue Root-Bridge die größtmögliche erlaubte Anzahl der Geräte in einem Ast durch ihre `Max Age`-Einstellung.

Anmerkung: Der RSTP-Standard schreibt vor, dass alle Geräte innerhalb eines Netzes mit dem (Rapid-) Spanning-Tree-Algorithmus arbeiten. Bei gleichzeitigem Einsatz von STP und RSTP gehen in den Netz-Segmenten, die gemischt betrieben werden, die Vorteile der schnelleren Rekonfiguration bei RSTP verloren.

Ein Gerät, das lediglich RSTP unterstützt, arbeitet mit MSTP-Geräten zusammen, indem es sich keiner MST-Region, sondern dem CST (Common Spanning Tree) zuordnet.

A.6.1 Grundlagen

Da RSTP eine Weiterentwicklung des STP ist, gelten alle folgenden Beschreibungen des STP auch für das RSTP.

■ Die Aufgaben des STP

Der Spanning Tree-Algorithmus reduziert Netztopologien, die mit Bridges aufgebaut sind und Ringstrukturen durch redundante Verbindungen aufweisen, auf eine Baumstruktur. Dabei trennt STP die Ringstrukturen nach vorgegebenen Regeln auf, indem es redundante Pfade deaktiviert. Wird ein Pfad unterbrochen, weil eine Netzkomponente betriebsunfähig wird, aktiviert das STP den zuvor deaktivierten Pfad wieder. Dies erlaubt

redundante Verbindungen zur Erhöhung der Kommunikationsverfügbarkeit.

Das STP ermittelt bei der Bildung der Baumstruktur eine Bridge, die die Basis der STP-Baumstruktur repräsentiert. Diese Bridge heißt Root-Bridge.

Merkmale des STP-Algorithmus:

- ▶ automatische Rekonfiguration der Baumstruktur bei Bridge-Ausfällen oder Unterbrechung eines Datenpfades,
- ▶ Stabilisierung der Baumstruktur bis zur maximalen Netzausdehnung,
- ▶ Stabilisierung der Topologie innerhalb einer vorhersehbaren Zeit,
- ▶ durch den Administrator vorbestimmbare und reproduzierbare Topologie,
- ▶ Transparenz für die Endgeräte,
- ▶ geringe Netzlast gegenüber der verfügbaren Übertragungskapazität durch Einrichtung der Baumstruktur.

■ **Die Bridge-Parameter**

Jede Bridge und ihre Verbindungen werden im Kontext von Spanning Tree eindeutig durch die folgenden Parameter beschrieben:

- ▶ Bridge-Identifikation (Bridge-Identifizier),
- ▶ Root-Pfadkosten der Bridge-Ports,
- ▶ Port-Identifikation (Port-Identifizier).

■ **Bridge-Identifikation (Bridge-Identifizier)**

Die Bridge-Identifikation besteht aus 8 Bytes. Die 2 höchstwertigen Bytes sind die Priorität. Die Voreinstellung für die Prioritätszahl ist 32.768 (8000H), jedoch kann der Management-Administrator diese zur Konfiguration des Netzes verändern. Die 6 niederwertigen Bytes der Bridge-Identifikation sind die MAC-Adresse der Bridge. Die MAC-Adresse ermöglicht, dass alle Bridges eine eindeutige Bridge-Identifikation besitzen.

Die Bridge mit dem kleinsten Zahlenwert für die Bridge-Identifikation besitzt die höchste Priorität.



Abb. 5: Bridge-Identifikation, Beispiel (Werte in Hexadezimalschreibweise)

■ Root-Pfadkosten

Jedem Pfad, der 2 Bridges miteinander verbindet, ordnen die Bridges Kosten für die Übertragung (Pfadkosten) zu. Die Bridge bestimmt diesen Wert in Abhängigkeit von der Datenrate ([siehe Tabelle 4](#)). Dabei ordnet sie Pfaden mit niedrigerer Datenrate die höheren Pfadkosten zu.

Alternativ dazu kann auch der Administrator die Pfadkosten festlegen. Dabei ordnet er - wie die Bridge - Pfaden mit niedrigerer Datenrate die höheren Pfadkosten zu. Da er aber diesen Wert letztendlich frei wählen kann, verfügt er hiermit über ein Werkzeug, bei redundanten Pfaden einem bestimmten Pfad den Vorzug zu geben.

Die Root-Pfadkosten sind die Summe aller Einzelpfadkosten der Pfade, die ein Datenpaket zwischen dem angeschlossenen Port einer Bridge und der Root-Bridge passiert.

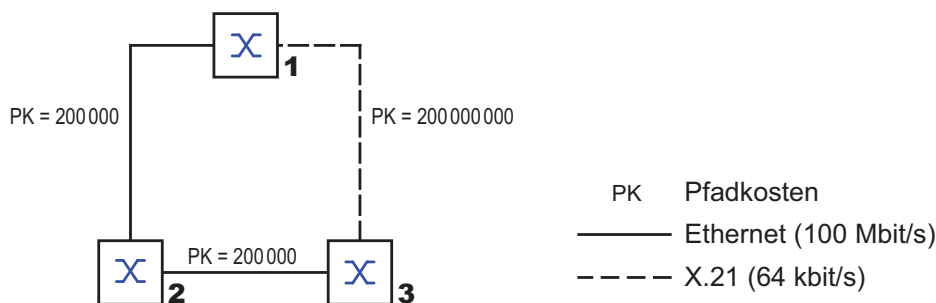


Abb. 6: Pfadkosten

Datenrate	Empfohlener Wert	Empfohlener Bereich	Möglicher Bereich
≤100 Kbit/s	200.000.000 ^a	20.000.000-200.000.000	1-200.000.000
1 Mbit/s	20.000.000 ^a	2.000.000-200.000.000	1-200.000.000
10 Mbit/s	2.000.000 ^a	200.000-20.000.000	1-200.000.000
100 Mbit/s	200.000 ^a	20.000-2.000.000	1-200.000.000

Tab. 4: Empfohlene Pfadkosten beim RSTP in Abhängigkeit von der Datenrate.

Datenrate	Empfohlener Wert	Empfohlener Bereich	Möglicher Bereich
1 Gbit/s	20.000	2.000-200.000	1-200.000.000
10 Gbit/s	2.000	200-20.000	1-200.000.000
100 Gbit/s	200	20-2.000	1-200.000.000
1 Tbit/s	20	2-200	1-200.000.000
10 Tbit/s	2	1-20	1-200.000.000

Tab. 4: Empfohlene Pfadkosten beim RSTP in Abhängigkeit von der Datenrate.

- a. Bridges, die zu IEEE 802.1D-1998 konform sind, und ausschließlich 16 Bit-Werte für Pfadkosten unterstützen, sollten als Pfadkosten den Wert 65.535 (FFFFH) verwenden, wenn Sie sie zusammen mit Bridges benutzen, die 32 Bit-Werte für die Pfadkosten unterstützen.

■ Portidentifikation

Die Portidentifikation besteht aus 2 Bytes. Ein Teil, das niederwertigste Byte, enthält die physikalischen Portnummer. Dies gewährleistet eine eindeutige Bezeichnung des Port dieser Bridge. Der zweite, höherwertige Teil ist die Port-Priorität, die der Administrator festlegt (Voreinstellung: 128). Auch hier gilt: Der Port mit dem kleinsten Zahlenwert für die Portidentifikation besitzt die höchste Priorität.

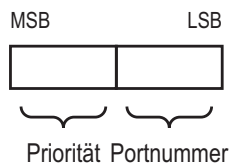


Abb. 7: Portidentifikation

■ Diameter

Die Größen „MaxAge“ und „Diameter“ bestimmen maßgeblich die maximale Ausdehnung eines Spanning-Tree-Netzes.

Die Anzahl der Verbindungen zwischen den am weitesten voneinander entfernten Geräten im Netz heißt Netzdurchmesser (Diameter).

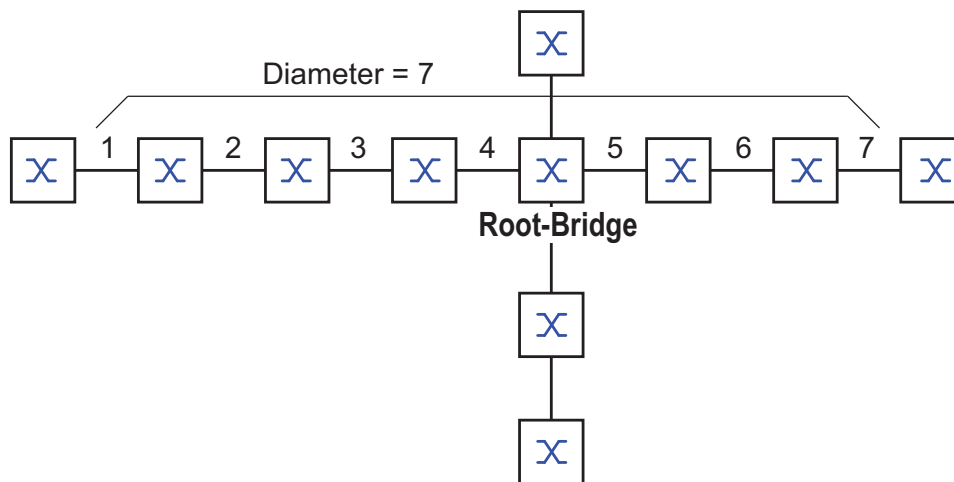


Abb. 8: Definition „Diameter“

Der im Netz erreichbare Netzdurchmesser beträgt $\text{MaxAge} - 1$.
Im Lieferzustand ist $\text{MaxAge} = 20$, der maximal erreichbare $\text{Diameter} = 19$.
Wenn Sie für MaxAge den Maximalwert 40 einstellen, ist der maximal erreichbare $\text{Diameter} = 39$.

■ MaxAge

Die Größen „MaxAge“ und „Diameter“ bestimmen maßgeblich die maximale Ausdehnung eines Spanning-Tree-Netzes.

Jede STP-BPDU enthält einen Zähler „MessageAge“. Der Zähler erhöht sich beim Durchlaufen einer Bridge um 1.

Die Bridge vergleicht vor dem Weiterleiten einer STP-BPDU den Zähler „MessageAge“ mit dem im Gerät festgelegten Wert „MaxAge“:

- ☐ Ist MessageAge < MaxAge, leitet die Bridge die STP-BPDU an die nächste Bridge weiter.
- ☐ Ist MessageAge = MaxAge, verwirft die Bridge die STP-BPDU.

Root-Bridge

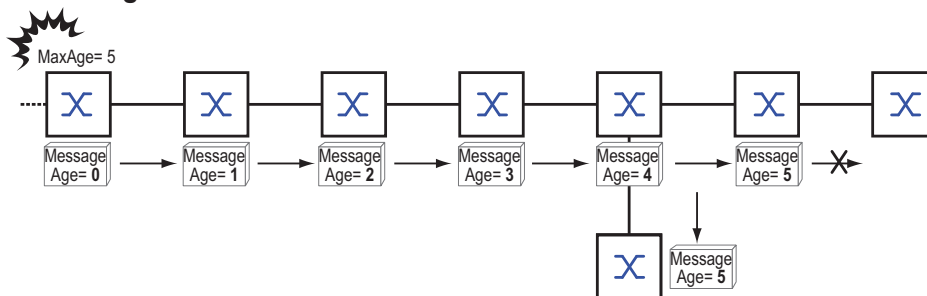


Abb. 9: Übertragung einer STP-BPDU in Abhängigkeit von MaxAge

A.6.2 Regeln für die Erstellung der Baumstruktur

■ Bridge-Information

Zur Berechnung der Baumstruktur benötigen die Bridges nähere Informationen über die anderen Bridges, die sich im Netz befinden.

Um diese Informationen zu erhalten, sendet jede Bridge eine BPDU (Bridge Protocol Data Unit) an andere Bridges.

Bestandteil einer BPDU ist unter anderem die

- ▶ Bridge-Identifikation,
- ▶ Root-Pfadkosten und
- ▶ Port-Identifikation.

(siehe IEEE 802.1D).

■ **Aufbauen der Baumstruktur**

- ▶ Die Bridge mit dem kleinsten Zahlenwert für die Bridge-Identifikation nennt man auch Root-Bridge. Sie bildet die Root (Wurzel) der Baumstruktur
- ▶ Der Aufbau des Baumes hängt von den Root-Pfadkosten ab. Spanning Tree wählt die Struktur so, dass die minimalen Pfadkosten zwischen jeder einzelnen Bridge zur Root-Bridge entstehen.
- ▶ Bei mehreren Pfaden mit gleichen Root-Pfadkosten entscheidet die von der Root weiter entfernte Bridge, welchen Port sie blockiert. Sie verwendet dazu die Bridge-Identifikationen der näher an der Root liegenden Bridges. Die Bridge blockiert den Port, der zu der Bridge mit der numerisch höheren ID führt (eine numerisch höhere ID ist die logisch schlechtere). Haben 2 Bridges die gleiche Priorität, hat die Bridge mit der numerisch größeren MAC-Adresse die numerisch höhere ID, dies ist die logisch schlechtere.
- ▶ Wenn von einer Bridge mehrere Pfade mit den gleichen Root-Pfadkosten zu der selben Bridge führen, zieht die von der Root weiter entfernte Bridge als letztes Kriterium die Port-Identifikation der anderen Bridge heran ([siehe Abbildung 7](#)). Die Bridge blockiert dabei den Port, der zu dem Port mit der schlechteren ID führt. Haben 2 Ports die selbe Priorität, ist die ID mit der höheren Port-Nr. die schlechtere.

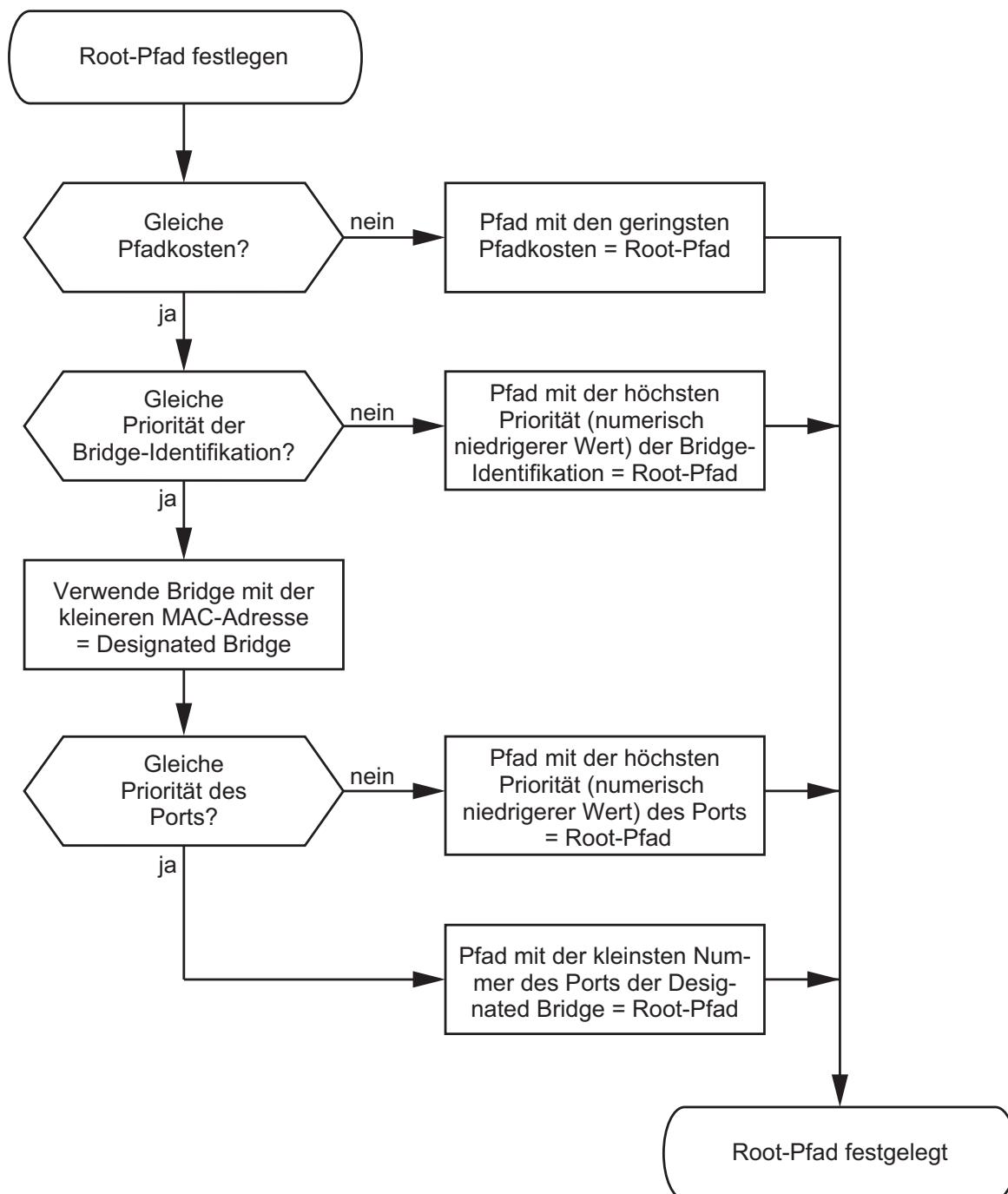


Abb. 10: Flussdiagramm Root-Pfad festlegen

A.6.3 Beispiele

■ Beispiel für die Bestimmung des Root-Pfads

Anhand des Netzplanes (siehe Abbildung 11) kann man das Flussdiagramm (siehe Abbildung 10) zur Festlegung des Root-Pfads nachvollziehen. Der Administrator hat für jede Bridge eine Priorität in der Bridge-Identifikation festgelegt. Die Bridge mit dem kleinsten Zahlenwert für die Bridge-Identifikation übernimmt die Rolle der Root-Bridge, in diesem Fall die Bridge 1. Im Beispiel belasten alle Teilpfade die gleichen Pfadkosten. Das Protokoll blockiert den Pfad zwischen Bridge 2 und Bridge 3, da eine Verbindung von Bridge 3 über Bridge 2 zur Root-Bridge höhere Pfadkosten verursachen würde.

Interessant ist der Pfad von der Bridge 6 zur Root-Bridge:

- ▶ Der Pfad über Bridge 5 und Bridge 3 verursacht die gleichen Root-Pfadkosten wie der Pfad über Bridge 4 und Bridge 2.
- ▶ STP wählt den Pfad über die Bridge, die in der Bridge-Identifikation die niedrigere MAC-Adresse hat (im Bild dargestellt Bridge 4).
- ▶ Zwischen Bridge 6 und Bridge 4 gibt es ebenfalls 2 Pfade. Hier entscheidet die Portidentifikation (Port 1 < Port 3).

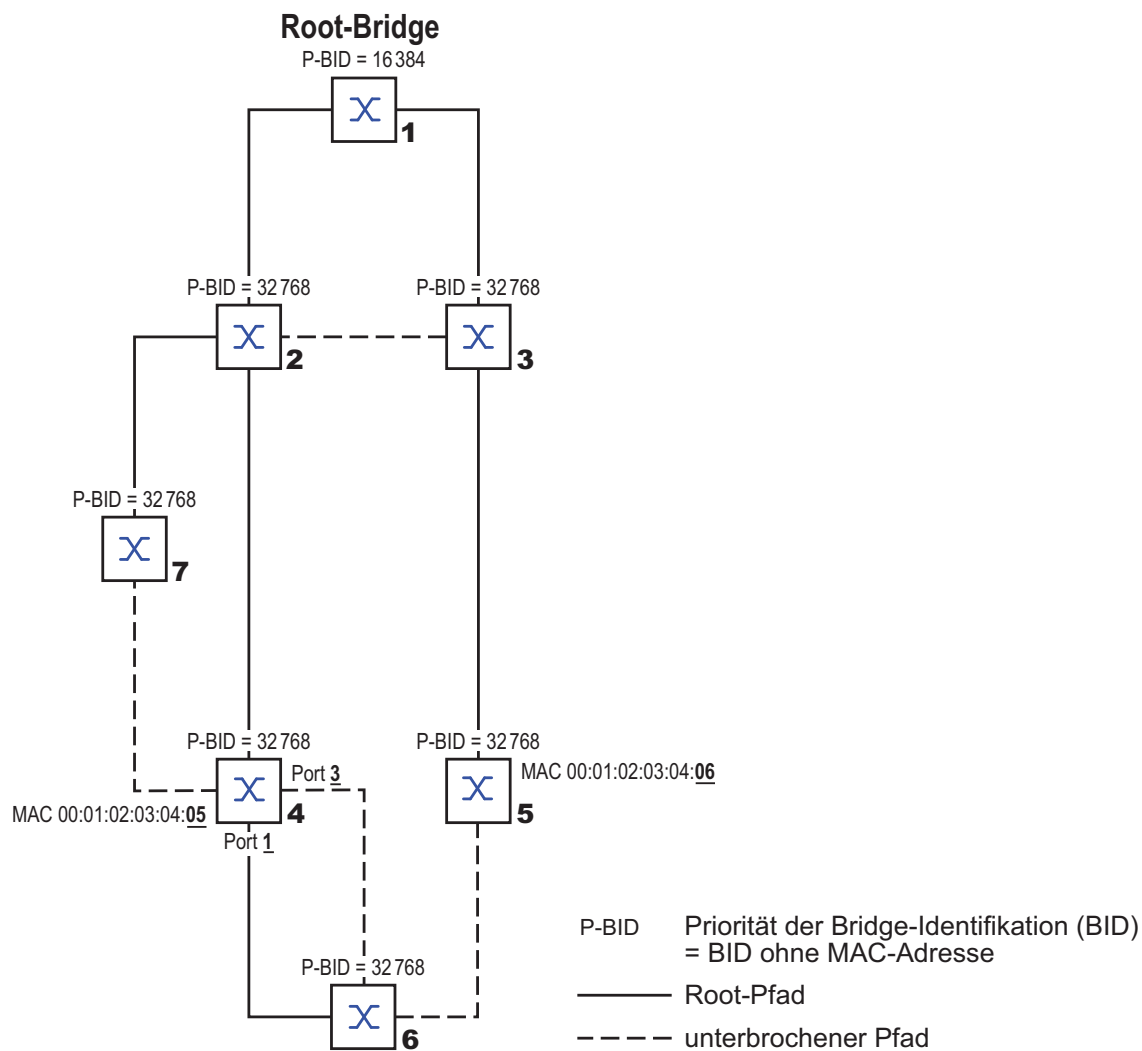


Abb. 11: Beispiel für die Bestimmung des Root-Pfads

Anmerkung: Indem der Administrator für jede Bridge außer der Root-Bridge den im Lieferzustand voreingestellten Wert der Priorität in der Bridge-Identifikation belässt, bestimmt allein die MAC-Adresse in der Bridge-Identifikation, welche Bridge bei Ausfall der momentanen Root-Bridge die Rolle der neuen Root-Bridge übernimmt.

■ Beispiel für die Manipulation des Root-Pfads

Anhand des Netzplanes (siehe [Abbildung 12](#)) kann man das Flussdiagramm (siehe [Abbildung 10](#)) zur Festlegung des Root-Paths nachvollziehen. Der Administrator hat folgendes getan:

- Für jede Bridge außer Bridge 1 und Bridge 5 hat er den im Lieferzustand voreingestellten Wert von 32.768 (8000H) belassen und
- der Bridge 1 hat er den Wert 16.384 (4000H) zugewiesen und damit zur Root-Bridge bestimmt.
- Der Bridge 5 hat er den Wert 28.672 (7000H) zugewiesen.

Das Protokoll blockiert den Pfad zwischen Bridge 2 und Bridge 3, da eine Verbindung von Bridge 3 über Bridge 2 zur Root-Bridge höhere Pfadkosten bedeutet.

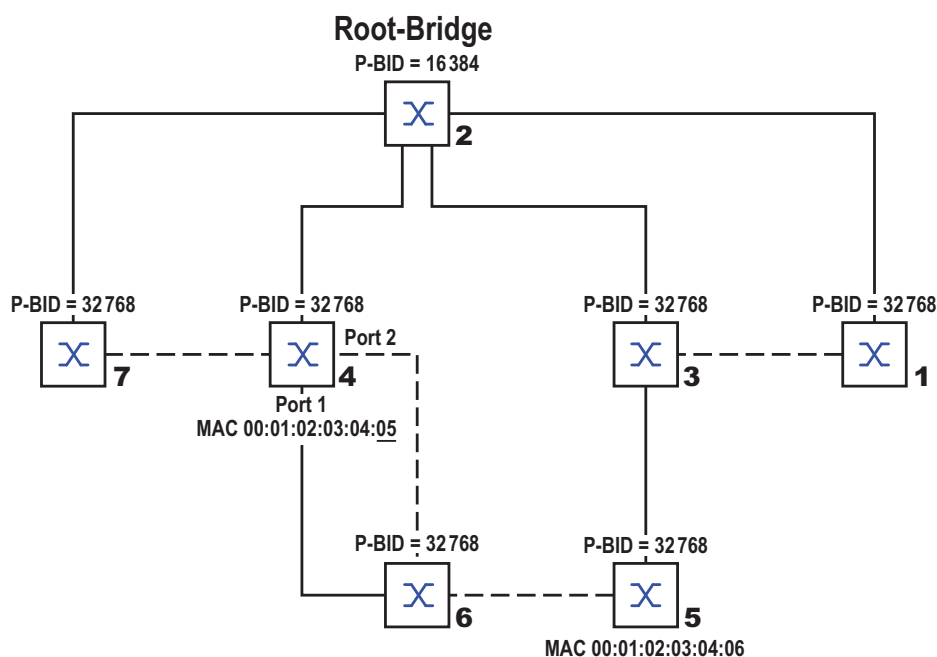
Interessant ist der Pfad von der Bridge 6 zur Root-Bridge:

- Die Bridges wählen den Pfad über Bridge 5, da der Zahlenwert 28.672 für ihre Priorität in der Bridge-Identifikation kleiner ist als der Zahlenwert 32.768.



■ Beispiel für die Manipulation der Baumstruktur

Der Management-Administrator des Netzes stellt bald fest, dass diese Konfiguration mit Bridge 1 als Root-Bridge (siehe auf Seite 125 „Beispiel für die Bestimmung des Root-Pfads“) ungünstig ist. Auf den Pfaden zwischen Bridge 1 zu Bridge 2 und Bridge 1 zu Bridge 3 summieren sich die Kontrollpakete, die die Root-Bridge zu allen anderen Bridges sendet. Konfiguriert der Management-Administrator die Bridge 2 als Root-Bridge, dann verteilt sich die Belastung der Teilnetze durch Kontrollpakete wesentlich besser. Hieraus entsteht die dargestellte Konfiguration (siehe Abbildung 13). Die Pfadkosten der meisten Bridges zur Root-Bridge sind kleiner geworden.



P-BID Priorität der Bridge-Identifikation (BID)
= P-BID ohne MAC-Adresse

—— Root-Pfad

— — — — unterbrochener Pfad

Abb. 13: Beispiel für die Manipulation der Baumstruktur

A.6.4 Das Rapid Spanning Tree Protokoll

Das RSTP behält die Berechnung der Baumstruktur vom STP unverändert bei. RSTP ändert lediglich Parameter und fügt neue Parameter und Mechanismen hinzu, die die Rekonfiguration beschleunigen, falls eine Verbindung oder eine Bridge ausfällt.

Eine zentrale Bedeutung erfahren in diesem Zusammenhang die Ports.

■ Port-Rollen

RSTP weist jedem Bridge-Port eine der folgenden Rollen zu ([siehe Abbildung 14](#)):

► Root-Port:

Dies ist der Port, an dem eine Bridge Datenpakete mit den niedrigsten Pfadkosten von der Root-Bridge empfängt.

Existieren mehrere Ports mit gleich niedrigen Pfadkosten, dann entscheidet die Bridge-Identifikation der zur Root führenden Bridge (Designated Bridge), welchem ihrer Ports die weiter von der Root entfernte Bridge die Rolle des Root-Ports gibt.

Hat eine Bridge mehrere Ports mit gleich niedrigen Pfadkosten zur selben Bridge, entscheidet die Bridge anhand der Portidentifikation der zur Root führenden Bridge (Designated Bridge), welchen Port sie lokal als Root-Port wählt ([siehe Abbildung 10](#)).

Die Root-Bridge selbst besitzt keinen Root-Port.

► Designierter Port (Designated-Port):

Die Bridge in einem Netzsegment, die die niedrigsten Root-Pfadkosten hat, ist die designierte Bridge (Designated Bridge).

Haben mehrere Bridges die gleichen Root-Pfadkosten, übernimmt die Bridge mit der zahlenmäßig kleinsten Bridge-Identifikation die Rolle der designierten Bridge. Der designierte Port an dieser Bridge ist der Port, der ein von der Root-Bridge wegführendes Netzsegment verbindet. Ist eine Bridge mit mehr als einem Port mit einem Netzsegment verbunden (z. B. über einen Hub), gibt sie ihrem Port mit der besseren Port-Identifikation die Rolle des Designated Ports.

- ▶ **Edge-Port¹:**
Jedes Netzsegment, in dem sich keine weitere RSTP-Bridge befindet, ist mit genau einem designierten Port verbunden. Dieser designierte Port ist dann gleichzeitig ein Edge-Port, wenn er keine BPDUs (Spanning Tree Bridge Protocol Data Units) empfangen hat.
- ▶ **Alternativer Port (Alternate-Port):**
Dies ist ein blockierter Port, der beim Ausfall der Verbindung zur Root-Bridge die Aufgabe des Root-Ports übernimmt. Der alternative Port hilft, die Verbindung der Bridge zur Root-Bridge sicherzustellen.
- ▶ **Ersatzport (Backup-Port):**
Dies ist ein blockierter Port, der als Ersatz zur Verfügung steht, falls die Verbindung zum designierten Port dieses Netzsegmentes (ohne RSTP-Bridges, z. B. ein Hub) ausfällt.
- ▶ **Deaktivierter Port (Disabled-Port):**
Dies ist ein Port, der innerhalb des Spanning-Tree-Protokolls keine Rolle spielt, also abgeschaltet ist oder keine Verbindung hat.

1. Ein Edge-Port ist ein Endgeräte-Port am „Rand“ (engl. „Edge“) eines geschalteten Netzes.

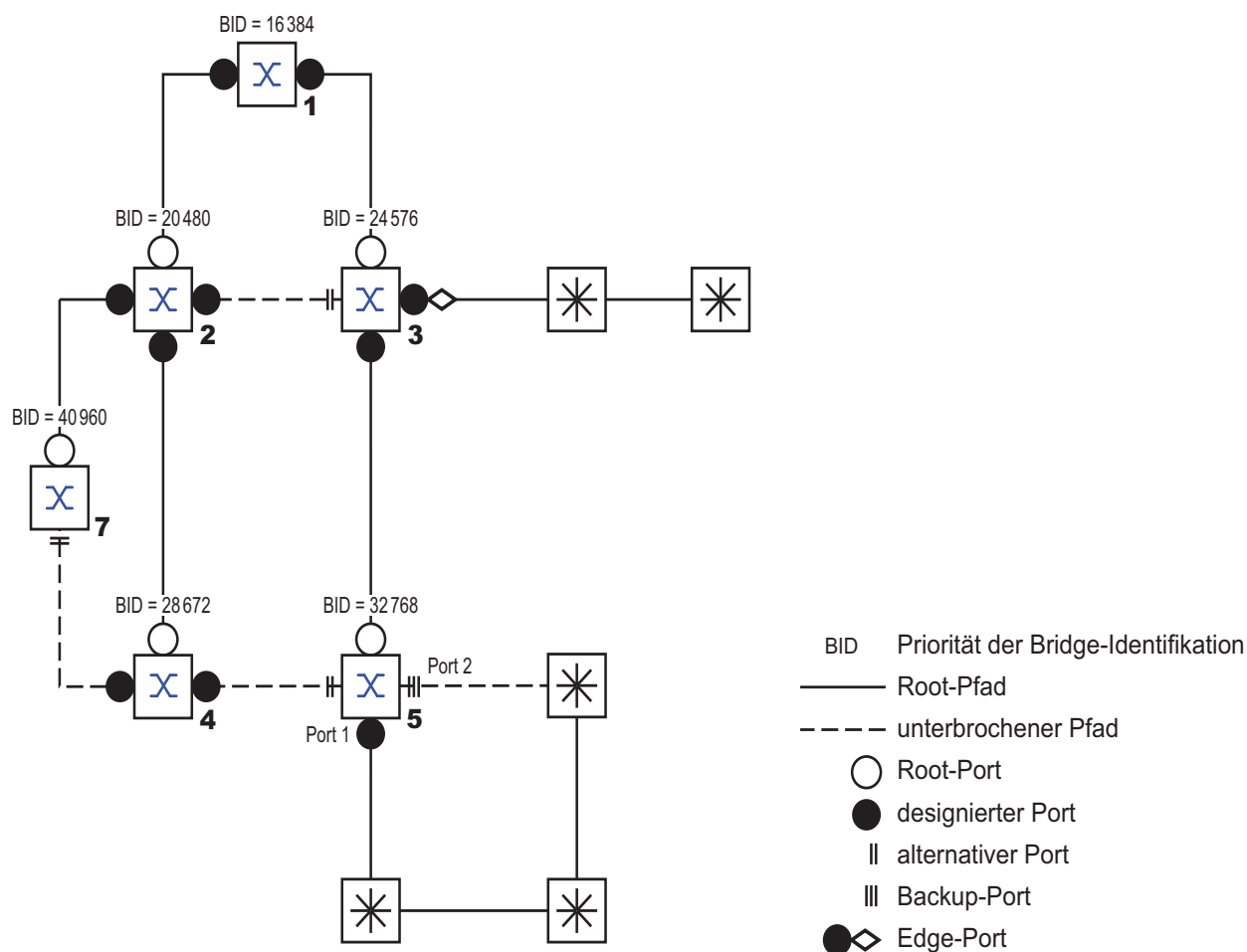


Abb. 14: Port-Rollen-Zuordnung

Port-Status

In Abhängigkeit von der Baumstruktur und dem Status der ausgewählten Verbindungswege weist RSTP den Ports ihren Status zu.

STP Port Status	Administrative Bridge Port-Status	MAC Operational	RSTP Port-Status	Aktive Topology (Port Rolle)
DISABLED	Disabled	FALSE	Discarding ^a	Excluded (Disabled)
DISABLED	Enabled	FALSE	Discarding ^a	Excluded (Disabled)
BLOCKING	Enabled	TRUE	Discarding ^b	Excluded (Alternate, Backup)
LISTENING	Enabled	TRUE	Discarding ^b	Included (Root, Designated)
LEARNING	Enabled	TRUE	Learning	Included (Root, Designated)
FORWARDING	Enabled	TRUE	Forwarding	Included (Root, Designated)

Tab. 5: Beziehung zwischen Port-Status-Werten bei STP und RSTP

- a. Die dot1d-MIB zeigt „Disabled“ an
- b. Die dot1d-MIB zeigt „Blocked“ an

Bedeutung der RSTP-Port-Status:

- ▶ Disabled: Port gehört nicht zur aktiven Topologie
- ▶ Discarding: kein Address Learning in FDB, kein Datenverkehr außer STP-BPDUs
- ▶ Learning: Address Learning aktiv (FDB), kein Datenverkehr außer STP-BPDUs
- ▶ Forwarding: Address Learning aktiv (FDB), Senden und Empfangen aller Frame-Typen (nicht ausschließlich STP-BPDUs)

■ **Spanning Tree Priority Vector**

Um den Ports Rollen zuzuteilen, tauschen die RSTP-Bridges Konfigurationsinformationen untereinander aus. Diese Informationen heißen "Spanning Tree Priority Vector". Sie sind Teil der RST BPDUs und enthalten folgende Informationen:

- ▶ Bridge-Identifikation der Root-Bridge
- ▶ Root-Pfadkosten der sendenden Bridge
- ▶ Bridge-Identifikation der sendenden Bridge
- ▶ Portidentifikation des Ports, durch den die Nachricht gesendet wurde
- ▶ Portidentifikation des Ports, durch den die Nachricht empfangen wurde

Auf Basis dieser Informationen sind die am RSTP beteiligten Bridges in der Lage, selbständig Port-Rollen zu bestimmen und den Port-Status ihrer lokalen Ports zu definieren.

■ Schnelle Rekonfiguration

Warum kann RSTP schneller als STP auf eine Unterbrechung des Root-Pfades reagieren?

- ▶ Einführung von Edge-Ports:
Bei einer Rekonfiguration setzt RSTP einen Edge-Port nach Ablauf von 3 Sekunden (Voreinstellung) in den Vermittlungsmodus und wartet dann "Hello Time" ab, um sich zu vergewissern, dass keine BPDU-sendende Bridge angeschlossen ist.
Wenn der Anwender sicherstellt, dass an diesem Port ein Endgerät angeschlossen ist und bleibt, entstehen im Rekonfigurationsfall an diesem Port keine Wartezeiten
- ▶ Einführung von alternativen Ports:
Da schon im regulären Betrieb die Portrollen verteilt sind, kann eine Bridge nach dem Verlust der Verbindung zur Root-Bridge vom Root-Port zu einem alternativen Port umschalten.
- ▶ Kommunikation mit Nachbar-Bridges (Punkt-zu-Punkt-Verbindungen):
Die dezentrale, direkte Kommunikation zwischen benachbarten Bridges erlaubt ohne Wartezeiten eine Reaktion auf Zustandsänderungen der Spanning-Tree-Topologie.
- ▶ Adresstabelle:
Beim STP bestimmt das Alter der Einträge in der FDB über die Aktualisierung der Kommunikation. Das RSTP löscht sofort und gezielt die Einträge der Ports, die von einer Umkonfiguration betroffen sind.
- ▶ Reaktion auf Ereignisse:
Ohne Zeitvorgaben einhalten zu müssen, reagiert RSTP sofort auf Ereignisse wie Verbindungsunterbrechung, Verbindung vorhanden, u.a.

Anmerkung: Die Kehrseite dieser schnellen Rekonfiguration ist die Möglichkeit, dass Datenpakete während der Rekonfigurationsphase der RSTP-Topologie dupliziert und/oder mit vertauschter Reihenfolge beim Empfänger ankommen können. Wenn Sie dies in Ihrer Anwendung nicht akzeptieren können, dann benutzen Sie das langsamere Spanning Tree Protokoll oder wählen Sie eines der anderen in diesem Buch beschriebenen, schnelleren Redundanzverfahren.

■ STP-Kompatibilitätsmodus

Der STP-Kompatibilitätsmodus bietet Ihnen die Möglichkeit, RSTP-Geräte in Netzen mit Alt-Installationen zu betreiben. Erkennt ein RSTP-Gerät ein älteres STP-Gerät, schaltet es am betreffenden Port den STP-Kompatibilitätsmodus ein.

A.7 Grundlagen Topologie-Erkennung

IEEE 802.1AB beschreibt das Link Layer Discovery Protocol (LLDP). Das LLDP ermöglicht dem Anwender eine automatische Topologie-Erkennung seines LANs.

Geräte mit aktivem LLDP:

- ▶ senden ihre Verbindungs- und Verwaltungsdaten an die angrenzenden Geräte des gemeinsamen LANs. Die Bewertung der Geräte erfolgt, wenn die LLDP-Funktion beim empfangenden Gerät aktiviert ist.
- ▶ empfangen eigene Verbindungs- und Management-Informationen von angrenzenden Geräten des gemeinsamen LANs, sofern diese auch das LLDP aktiviert haben.
- ▶ erzeugen eine Datenbank mit Management-Informationen und Objektdefinitionen über angrenzende Geräte, die auch das LLDP aktiviert haben.

Als zentrales Element enthält die Verbindungsinformation die genaue, eindeutige Kennzeichnung des Verbindungsendpunktes: MAC (Dienstzugangspunkt) Diese setzt sich zusammen aus einer netzweit eindeutigen Gerätekennung und einer für dieses Gerät eindeutigen Port-Kennung.

Inhalt der Verbindungs- und Management-Informationen:

- ▶ Chassis-Kennung (dessen MAC-Adresse)
- ▶ Port-Kennung (dessen Port-MAC-Adresse)
- ▶ Beschreibung des Ports
- ▶ Systemname
- ▶ Systembeschreibung
- ▶ Unterstützte Systemfunktionen
- ▶ Momentan aktive Systemfunktionen
- ▶ Interface-ID der Management-Adresse
- ▶ VLAN-ID des Ports
- ▶ Status der Auto-Negotiation am Port
- ▶ Einstellung für Medium-/Halb- und Voll-Duplex sowie für die Port-Geschwindigkeit
- ▶ Information über die im Gerät installierten VLANs (VLAN-Kennung und VLAN-Namen; unabhängig davon, ob der Port VLAN-Mitglied ist).

Diese Informationen kann eine Netzmanagementstation von Geräten mit aktivem LLDP abrufen. Mit diesen Informationen ist die Netzmanagementstation in der Lage, die Topologie des Netzes darzustellen.

802.1d-Geräte blockieren in der Regel die spezielle zum Informationsaustausch verwendete Multicast-LLDP-IEEE-MAC-Adresse. Nicht-LLDP-Geräte verwerfen aus diesem Grund LLDP-Pakete. Wird ein nicht-LLDP-fähiges Gerät zwischen 2 LLDP-fähigen Geräten positioniert, lässt das nicht-LLDP-fähige Gerät den Informationsaustausch zwischen 2 LLDP-fähigen Geräten nicht zu.

Die Management Information Base (MIB) für ein LLDP-fähiges Gerät enthält die LLDP-Informationen in der LLDP-MIB.

A.8 Grundlagen Priorisierung des Datenverkehrs

A.8.1 Beschreibung Priorisierung

Zur Priorisierung des Datenverkehrs sind im Gerät Verkehrsklassen („Traffic Classes“) vordefiniert. Höhere Verkehrsklassen priorisiert das Gerät gegenüber niedrigeren Verkehrsklassen.

Um verzögerungsempfindlichen Daten einen optimierten Datenfluss zu bieten, weisen Sie diesen Daten höhere Verkehrsklassen zu. Weniger verzögerungsempfindlichen Daten weisen Sie entsprechend niedrigere Verkehrsklassen zu.

■ Den Daten Verkehrsklassen zuweisen

Das Gerät ordnet eingehenden Daten automatisch Verkehrsklassen zu (Verkehrsklassifizierung). Das Gerät berücksichtigt folgende Klassifizierungskriterien:

- ▶ Methode, gemäß derer das Gerät die Zuordnung empfangener Datenpakete zu den Verkehrsklassen durchführt:
 - ▶ `trustDot1p`: Das Gerät verwendet die im VLAN-Tag enthaltene Priorität des Datenpaketes.
 - ▶ `trustIpDscp`: Das Gerät verwendet die im IP-Header enthaltene QoS-Information (ToS/DiffServ).
 - ▶ `untrusted`: Das Gerät ignoriert mögliche Prioritätsinformationen innerhalb der Datenpakete und verwendet direkt die Priorität des Empfangsports.
- ▶ Die Priorität, die dem Empfangsport zugewiesen ist.

Beide Klassifizierungskriterien sind konfigurierbar.

■ Die Verkehrsklassen priorisieren

Zur Priorisierung von Verkehrsklassen verwendet das Gerät die Methode „Strict“.

Wenn kein Versand von Daten einer höheren Verkehrsklasse mehr stattfindet oder die betreffenden Daten noch in der Warteschlange stehen, sendet das Gerät Daten der entsprechenden Verkehrsklasse. Wenn alle Verkehrsklassen nach der Methode „Strict“ priorisiert sind, blockiert das Gerät bei hoher Netzlast die Daten niedrigerer Verkehrsklassen möglicherweise permanent.

A.8.2 Behandlung empfangener Prioritätsinformationen

Anwendungen kennzeichnen Datenpakete mit folgenden Priorisierungsinformationen:

- ▶ VLAN-Priorität nach IEEE 802.1Q/ 802.1D (Layer 2)
- ▶ Type-of-Service (ToS) oder DiffServ (DSCP) bei VLAN Management IP-Paketen (Layer 3)

Das Gerät bietet folgende Möglichkeiten, diese Prioritätsinformation auszuwerten:

- ▶ `trustDot1p`

Das Gerät ordnet VLAN-getaggte Datenpakete entsprechend ihrer VLAN-Priorität den unterschiedlichen Verkehrsklassen zu. Die entsprechende Zuordnung ist konfigurierbar. Das Gerät ordnet Datenpaketen, die es ohne VLAN-Tag empfängt, die Priorität des Empfangsports zu.

- ▶ `trustIpDscp`

Das Gerät ordnet IP-Pakete gemäß dem DSCP-Wert im IP-Header den unterschiedlichen Verkehrsklassen zu, auch wenn das Paket zusätzlich VLAN-getagged war. Die entsprechende Zuordnung ist konfigurierbar. Nicht-IP-Pakete priorisiert das Gerät entsprechend der Priorität des Empfangsports.

- ▶ `untrusted`

Das Gerät ignoriert die Prioritätsinformationen in Datenpaketen und weist den Paketen die Priorität des Empfangsports zu.

A.8.3 VLAN-Tagging

Für die Funktionen VLAN und Priorisierung sieht die Norm IEEE 802.1Q die Einbindung eines VLAN-Tags in den MAC-Datenrahmen vor. Das VLAN-Tag besteht aus 4 Bytes und steht zwischen dem Quelladressfeld („Source Address Field“) und dem Typfeld („Length/Type Field“).

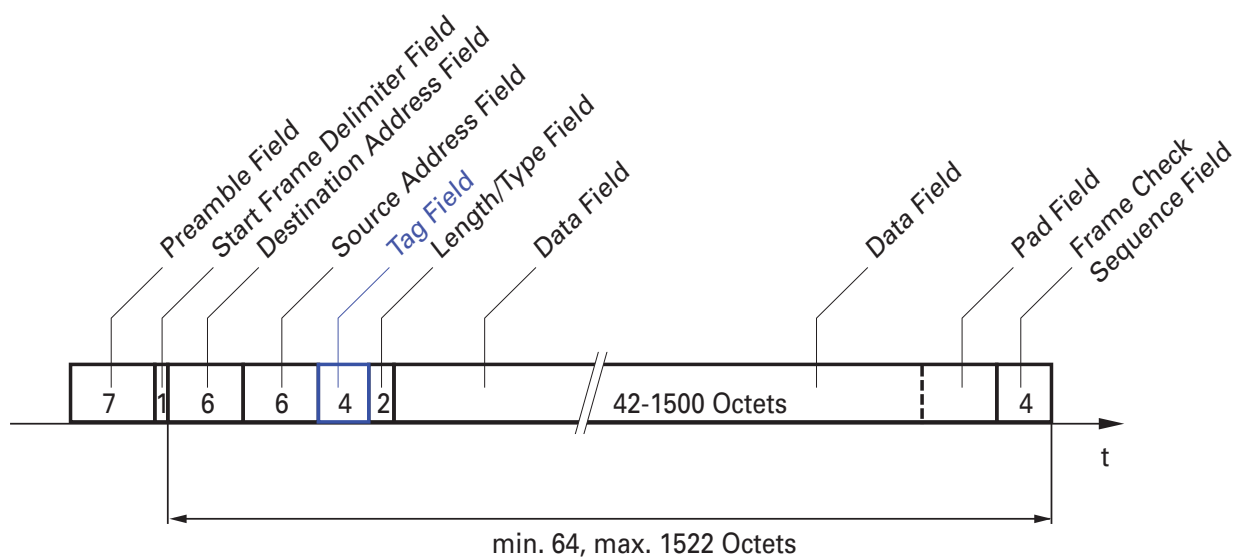


Abb. 15: Ethernet-Datenpaket mit Tag

Das Gerät wertet bei Datenpaketen mit VLAN-Tags die Prioritätsinformation aus.

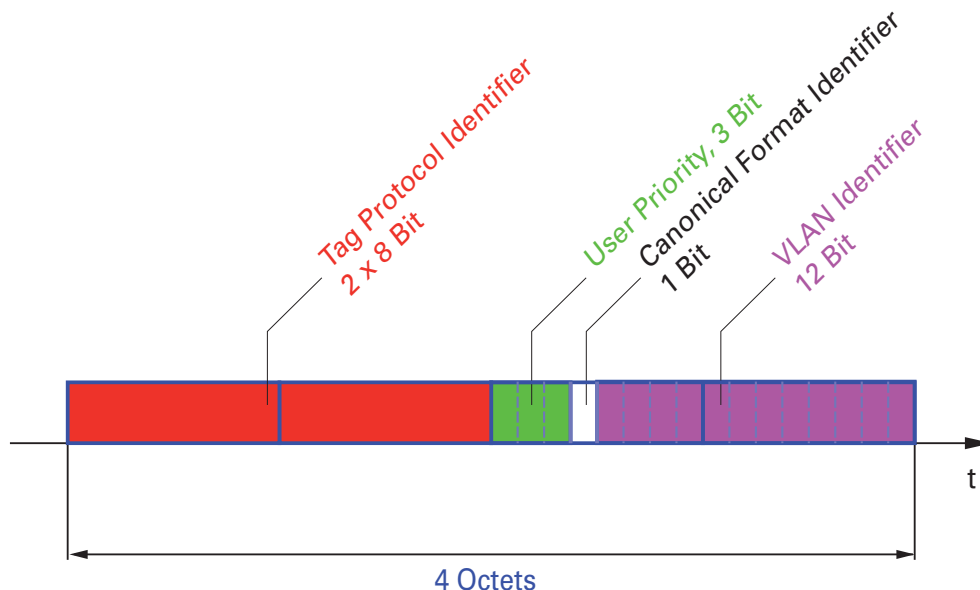


Abb. 16: Aufbau der VLAN-Markierung

Ein Datenpaket, dessen VLAN-Markierung eine Prioritätsinformation, aber keine VLAN-Information (VLAN-Kennung = 0) enthält, bezeichnet man als „Priority Tagged Frame“.

Anmerkung: Netzprotokolle und Redundanzmechanismen nutzen die höchste Verkehrsklasse 7. Wählen Sie für Anwendungsdaten deshalb niedrigere Verkehrsklassen.

Beachten Sie beim Einsatz der VLAN-Priorisierung folgende Besonderheiten:

- ▶ Eine Ende-zu-Ende-Priorisierung erfordert die durchgängige Übertragung der VLAN-Tags im gesamten Netz. Voraussetzung ist, dass jede beteiligte Netzkomponente VLAN-fähig ist.
- ▶ Router haben keine Möglichkeit, über Port-basierte Router-Interfaces Pakete mit VLAN-Tag zu empfangen und zu senden.

A.8.4 Handhabung der Verkehrsklassen

■ **Beschreibung Strict-Priority**

Bei Strict-Priority vermittelt das Gerät zuerst die Datenpakete mit höherer Verkehrsklasse (höherer Priorität), bevor es ein Datenpaket mit der nächst niedrigeren Verkehrsklasse vermittelt. Ein Datenpaket mit der niedrigsten Verkehrsklasse (niedrigsten Priorität) vermittelt das Gerät demnach erst, wenn keine anderen Datenpakete mehr in der Warteschlange stehen. In ungünstigen Fällen sendet das Gerät keine Pakete mit niedriger Priorität, wenn an diesem Port ein hohes Aufkommen von höherprioriem Verkehr zum Senden ansteht.

Bei verzögerungsempfindlichen Anwendungen wie VoIP oder Video ermöglicht Strict-Priority das unmittelbare Senden hochpriorer Daten.

A.9 Grundlagen Flusskontrolle

Treffen in der Sendewarteschlange eines Ports sehr viele Datenpakete gleichzeitig ein, führt dies möglicherweise zum Überlaufen des Portspeichers. Beispielsweise passiert dies dann, wenn das Gerät Daten an einem Gigabit-Port empfängt und diese an einen Port mit niedrigerer Bandbreite weiterleitet. Das Gerät verwirft überschüssige Datenpakete.

Der in der Norm IEEE 802.3 beschriebene Flusskontrollmechanismus sorgt dafür, dass keine Datenpakete durch Überlaufen eines Portspeichers verloren gehen. Kurz bevor ein Portspeicher vollständig gefüllt ist, signalisiert das Gerät den angeschlossenen Geräten, dass es keine Datenpakete von ihnen mehr annimmt.

- ▶ Im Vollduplex-Betrieb sendet das Gerät ein Pause-Datenpaket.
- ▶ Im Halbduplex-Betrieb simuliert das Gerät eine Kollision.

Die folgende Abbildung zeigt die Wirkungsweise der Flusskontrolle. Die Workstations 1, 2 und 3 wollen zur gleichen Zeit viele Daten an die Workstation 4 übertragen. Die gemeinsame Bandbreite der Workstations 1, 2 und 3 ist größer als die Bandbreite von Workstation 4. So kommt es zum Überlaufen der Empfangs-Warteschlange von Port 4. Der linke Trichter symbolisiert diesen Zustand.

Wenn an den Ports 1, 2 und 3 des Gerätes die Funktion Flusskontrolle eingeschaltet ist, reagiert das Gerät, bevor der Trichter überläuft. Der Trichter auf der rechten Seite veranschaulicht die Ports 1, 2 und 3, die zwecks Kontrolle der Übertragungsgeschwindigkeit eine Nachricht an die übertragenden Geräte senden. Als Resultat hiervon wird der Empfangsport nicht länger überfordert und ist in der Lage, den eingehenden Verkehr zu verarbeiten.

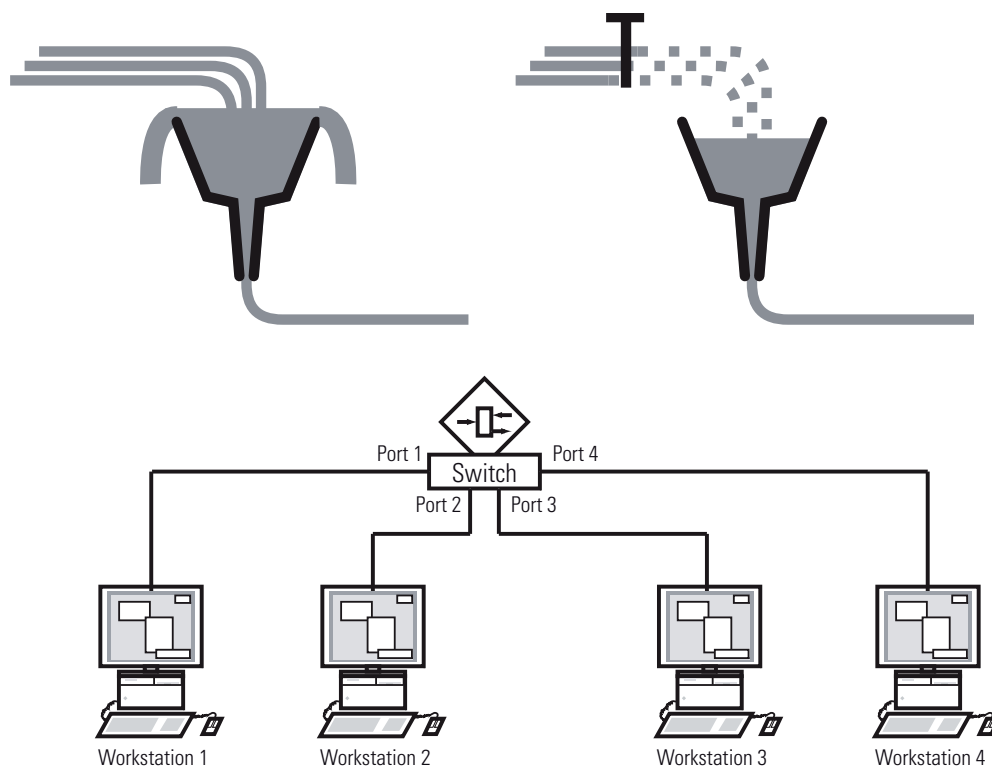


Abb. 17: Beispiel für Flusskontrolle

A.9.1 Halbduplex- oder Vollduplex-Verbindung

■ Flusskontrolle bei Halbduplex-Verbindung

Im Beispiel besteht zwischen der Arbeitsstation 2 und dem Gerät eine Halbduplex-Verbindung.

Bevor die Sende-Warteschlange von Port 2 überläuft, sendet das Gerät Daten zurück an Arbeitsstation 2. Arbeitsstation 2 erkennt eine Kollision und unterbricht den Sendevorgang.

■ Flusskontrolle bei Vollduplex-Verbindung

Im Beispiel besteht zwischen der Arbeitsstation 2 und dem Gerät eine Vollduplex-Verbindung.

Bevor die Sende-Warteschlange von Port 2 überläuft, sendet das Gerät eine Aufforderung an Arbeitsstation 2, beim Senden eine kleine Pause einzulegen.

A.10 Grundlagen Management Information BASE (MIB)

Die Management Information Base (MIB) ist als abstrakte Baumstruktur angelegt.

Die Verzweigungspunkte sind die Objektklassen. Die „Blätter“ der MIB tragen die Bezeichnung generische Objektklassen.

Die Instanzierung der generischen Objektklassen, das heißt, die abstrakte Struktur auf die Realität abzubilden, erfolgt z.B. durch die Angabe des Ports oder der Quelladresse (Source Address), soweit dies zur eindeutigen Identifizierung nötig ist.

Diesen Instanzen sind Werte (Integer, TimeTicks, Counter oder Octet String) zugeordnet, die gelesen und teilweise auch verändert werden können. Die Object Description oder der Object-ID (OID) bezeichnet die Objektklasse. Mit dem Subidentifizier (SID) werden sie instanziiert.

Beispiel:

Die generische Objektklasse

hm2PSSState (OID = 1.3.6.1.4.1.248.11.11.1.1.1.1.2)

ist die Beschreibung der abstrakten Information „Netzteilstatus“. Es lässt sich daraus noch kein Wert auslesen, es ist ja auch noch nicht bekannt, welches Netzteil gemeint ist.

Durch die Angabe des Subidentifiers (2) wird diese abstrakte Information auf die Wirklichkeit abgebildet, instanziiert, und bezeichnet so den Betriebszustand des Netzteils 2. Diese Instanz bekommt einen Wert zugewiesen, der gelesen werden kann. Damit liefert die Instanz „get

1.3.6.1.4.1.248.11.11.1.1.1.1.2.1“ als Antwort „1“, das heißt, das Netzteil ist betriebsbereit.

Definition der verwendeten Syntaxbegriffe:

Integer	Ganze Zahl im Bereich von -2^{31} - $2^{31}-1$
IP-Adresse	xxx.xxx.xxx.xxx (xxx = ganze Zahl im Bereich von 0-255)
MAC-Adresse	12-stellige Hexzahl nach ISO/IEC 8802-3
Object Identifier	x.x.x.x... (z. B. 1.3.6.1.4.1.248...)
Octet String	ASCII-Zeichen-Kette

Definition der verwendeten Syntaxbegriffe:

PSID	Spannungsversorgungsidentifikation (Nummer des Netzteils)
TimeTicks	Stop-Uhr, verronnene Zeit = Zahlenwert/100 in Sekunden Zahlenwert = ganze Zahl im Bereich von $0-2^{32}-1$
Timeout	Zeitwert in hundertstel Sekunden Zeitwert = ganze Zahl im Bereich von $0-2^{32}-1$
Typfeld	4-stellige Hexzahl nach ISO/IEC 8802-3
Zähler	Ganze Zahl ($0-2^{32}-1$), deren Wert beim Auftreten bestimmter Ereignisse um 1 erhöht wird.

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dhcp 4.1-ESV-R4

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e2fsprogs 1.42.2

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expat 2.1.0

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gcc-library 4.7.2

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That's all there is to it!

gcc-runtime-library 4.7.2

GCC RUNTIME LIBRARY EXCEPTION

Version 3.1, 31 March 2009

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jquery 1.8.2

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json-c 0.9

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libcurl 7.40.0

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libwebui

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Version 2.1, February 1999

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libevent 2.0.14

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libiconv 1.14

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libnl 1.1.4

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lua 5.1.4

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lua-cjson 2.1.0

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luafilesystem 1.5.0

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mootools 1.4.5

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mootools-more 1.4.0.1

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ncurses 5.7

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net-snmp 5.7.2

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open-ldp 0.9.46

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sprintf.js 0.0.7

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u-boot 2012.04.01

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uClibc 0.9.33.2

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xz 5.0.3

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A.12 Abkürzungen

ACL	Access Control List
BOOTP	Bootstrap Protocol
CLI	Command Line Interface
DHCP	Dynamic Host Configuration Protocol
EAM	Memory Backup Adapter
FDB	Forwarding Database
GUI	Grafische Benutzeroberfläche
HTTP	Hypertext Transfer Protocol
HTTPS	Hypertext Transfer Protocol Secure
ICMP	Internet Control Message Protocol
IEEE	Institute of Electrical and Electronics Engineers
IP	Internet Protocol
LED	Light Emitting Diode
LLDP	Link Layer Discovery Protocol
LWL	Lichtwellenleiter
MAC	Media Access Control
MIB	Management Information Base
MRP	Media Redundancy Protocol
MSTP	Multiple Spanning Tree Protocol
NMS	Netzmanagementsystem
NTP	Network Time Protocol
PC	Personal Computer
PTP	Precision Time Protocol
QoS	Quality of Service
RFC	Request For Comment
RM	Redundancy Manager
RSTP	Rapid Spanning Tree Protocol
SCP	Secure Copy
SFP	Small Form-factor Pluggable
SFTP	SSH File Transfer Protocol
SNMP	Simple Network Management Protocol
SNTP	Simple Network Time Protocol
TCP	Transmission Control Protocol
TFTP	Trivial File Transfer Protocol
TP	Twisted Pair
UDP	User Datagram Protocol
URL	Uniform Resource Locator
UTC	Coordinated Universal Time
VLAN	Virtual Local Area Network