Technical Guide

OpenFlow®

Feature Overview and Configuration Guide

Introduction

OpenFlow is a network protocol closely associated with Software-Defined Networking (SDN). SDN is a network architecture that allows network administrators to control traffic from a centralized SDN **controller**. A characteristic of popular SDN scenarios is the decoupling of the network control function (control plane) from the forwarding function (data plane). OpenFlow is a protocol for the **control plane** (which is centralized on the SDN controller) to communicate with the data plane (which is distributed among the network nodes) in an SDN network.

You could say that OpenFlow is a foundational element for building SDN solutions. Using OpenFlow a switch can be configured to operate with similar results to a traditional switch, without having to manually re-configure the switch if the network changes.

The AT-Secure Enterprise SDN Controller (**AT-SESC**) is a component of the Allied Telesis SDN offering. AT-SESC is an SDN **controller**, that uses OpenFlow to control AlliedWare Plus™ switches.

The following AlliedWare Plus products can be configured as OpenFlow switches:

- x930 Series
- x510 Series
- x510L Series
- x510DP Series
- DC2552XS/L3
- x310 Series
- x230 Series

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OpenFlow Support Details

Controllers

The AT-SESC SDN Controller is available to control AlliedWare Plus OpenFlow switches, in all markets with a variety of applications.

AlliedWare Plus OpenFlow switches can also be used with third-party SDN controllers that support version 1.0 and **1.3** of the OpenFlow protocol.

Flow numbers

x230 and x310 Series

When using an x230 Series or x310 Series switch with AT-SESC, you should only connect one end user device to each OpenFlow port. When using an x230 Series or x310 Series switch with **other** controllers, we recommend you apply the same limit of one end-user device per OpenFlow port.

x930 and x510 Series and DC2552XS/L3

When using an x930 Series, x510 Series, or DC2552XS/L3 switch, the maximum number of simultaneous active flows depends on the sizes of the products' hardware flow tables. This is because active flows use ACLs.

The following table shows the maximum number of flow table entries available on each switch series:

SWITCH SERIES	MAXIMUM NUMBER OF FLOW TABLE ENTRIES	APPROXIMATE MAXIMUM NUMBER OF END-USER DEVICES
x930	2037	1000
x510	245	120
DC2552XS/L3	245	120
x310	117	57
x230	117	57

When using AT-SESC, note that connections to end-user devices need two flow table entries. Therefore, the maximum number of devices you can connect is approximately half the number of flow table entries.

Also note that some SDN applications may require three or more flow table entries, per device, and that flow table entries may be used by other protocols. Both these factors may reduce the number of simultaneous flows that the switch can process.

x510-52 Series and x310-50 Series switches

From software version **5.4.6-2.1** onwards, all ports on the x510-52 Series and x310-50 Series switches can be configured as OpenFlow ports.

On software versions prior to 5.4.6-2.1, you can choose ports from either port set 1 or port set 2, as shown in the following table:

MODEL NAMES	PORT SET 1	PORT SET 2
AT-x510-52GTX AT-x510-52GPX AT-x510L-52GT AT-x510L-52GP AT-x510DP-52GTX	1.0.1-1.0.24 1.0.50 1.0.52	1.0.25-1.0.48 1.0.49 1.0.51
AT-x310-50FT AT-x310-50FP	1.0.1-1.0.24 1.0.49 1.0.50	1.0.25-1.0.48 1.0.51 1.0.52

Incompatibilities with other features

Due to the way in which OpenFlow works, there is no guarantee that any legacy feature will work in conjunction with OpenFlow. In particular you cannot use OpenFlow together with the following features:

- VCStack
- Mirroring, on OpenFlow ports
- Changing the egress queue or the internal priority of matching traffic on the ports connected to the OpenFlow controller. Therefore, you cannot use the **remark** command on ports configured as OpenFlow ports.

Registering the OpenFlow License Key

Before configuring AlliedWare Plus switches as OpenFlow-capable switches, you must obtain and register an OpenFlow license key.

Version **5.4.6-2** onwards adds support for OpenFlow subscription licenses. To see the available licenses, check your device's data sheet, which is available at alliedtelesis.com.

Registering the OpenFlow license key activates the OpenFlow feature on the switch.

```
awplus# license update file <bin name>
```

As with most licensed features, it is required that the switch is rebooted before using the feature.

Software extensions

Version **5.4.6-2.x** onwards supports three extensions to OpenFlow:

1. OpenFlow is supported on all ports of 52-port x510 and x310 Series switches.
2. Support for LAG ports has been added. You can create a static channel group on 2 to 8 switch ports, and configure that static channel group to run OpenFlow.
3. The licensing of OpenFlow has been modified in two ways. First, a new license called SES has been added for CentreCom switches that operate in conjunction with SESC, the Allied Telesis OpenFlow controller. Second, OpenFlow licenses are now managed through the Allied Telesis Download Centre.

Configuring the Switch as an OpenFlow Switch

This section includes a list of common terms, configuration guidelines, and the commands used when configuring a switch as an OpenFlow switch. It also provides an overview of what happens in an OpenFlow switch with flowcharts outlining the general steps to consider when configuring an OpenFlow-controlled switch.

Common terms

Here is a brief description of some of the terms used in an OpenFlow scenario:

- **Hairpin link** - a hairpin link is where two ports in the switch are directly connected to each other. One of the ports is an OpenFlow port, the other a legacy port. This allows traffic to traverse between the OpenFlow controlled data plane and the legacy controlled data plane. The two ports used by the hairpin link can be referred to as hairpin ports.
- **Legacy port** - a legacy port is a port on the switch that is not controlled by OpenFlow, but instead by all the current (legacy) control protocols.
- **AMF Link** - an AMF link connects AMF capable devices, allowing them to join the AMF network.
- **Management port** - a management port cannot be an OpenFlow port, and is useful as a port used just for managing the device.

Commands

The commands that are used for configuring and monitoring OpenFlow are listed in the following table:

Command	Purpose
openflow	Specifies a port to be under OpenFlow control
openflow controller	Specifies the OpenFlow controller.
openflow version	Changes the supported OpenFlow version number on the switch.
openflow native vlan	Specifies a native VLAN for the data plane ports.
show openflow config	Displays the OpenFlow configuration from the configuration database.
show openflow coverage	Displays the counters from the OpenFlow module in software.
show openflow flows	Displays the entries of the flow table on the switch.
show openflow rules	Displays the software flow table and rules set by the OpenFlow controller.
show openflow status	Displays the status of each data plane port and OpenFlow protocol messages.

Configuration guidelines

Configuring a switch as an OpenFlow switch

- Obtain an OpenFlow license.
- Disable VCStacking.
- Disable RSTP and IGMP Snooping TCN Query Solicitation.
- Reboot the switch if you change the configuration on the data plane ports after enabling the OpenFlow feature.
- Some ports on an AlliedWare Plus switch can be OpenFlow ports, which are controlled by the SDN controller; while the other ports can remain as legacy ports. A switch with at least one OpenFlow port is called an OpenFlow switch.
- If you have both OpenFlow and legacy ports, they need to have different native VLANs. You can change the native VLAN for either the OpenFlow or the legacy ports.

Configuration flowcharts

The following two charts illustrate the general steps to consider when configuring an OpenFlow-controlled switch.

Figure 1: Configuring an OpenFlow-controlled switch - part 1

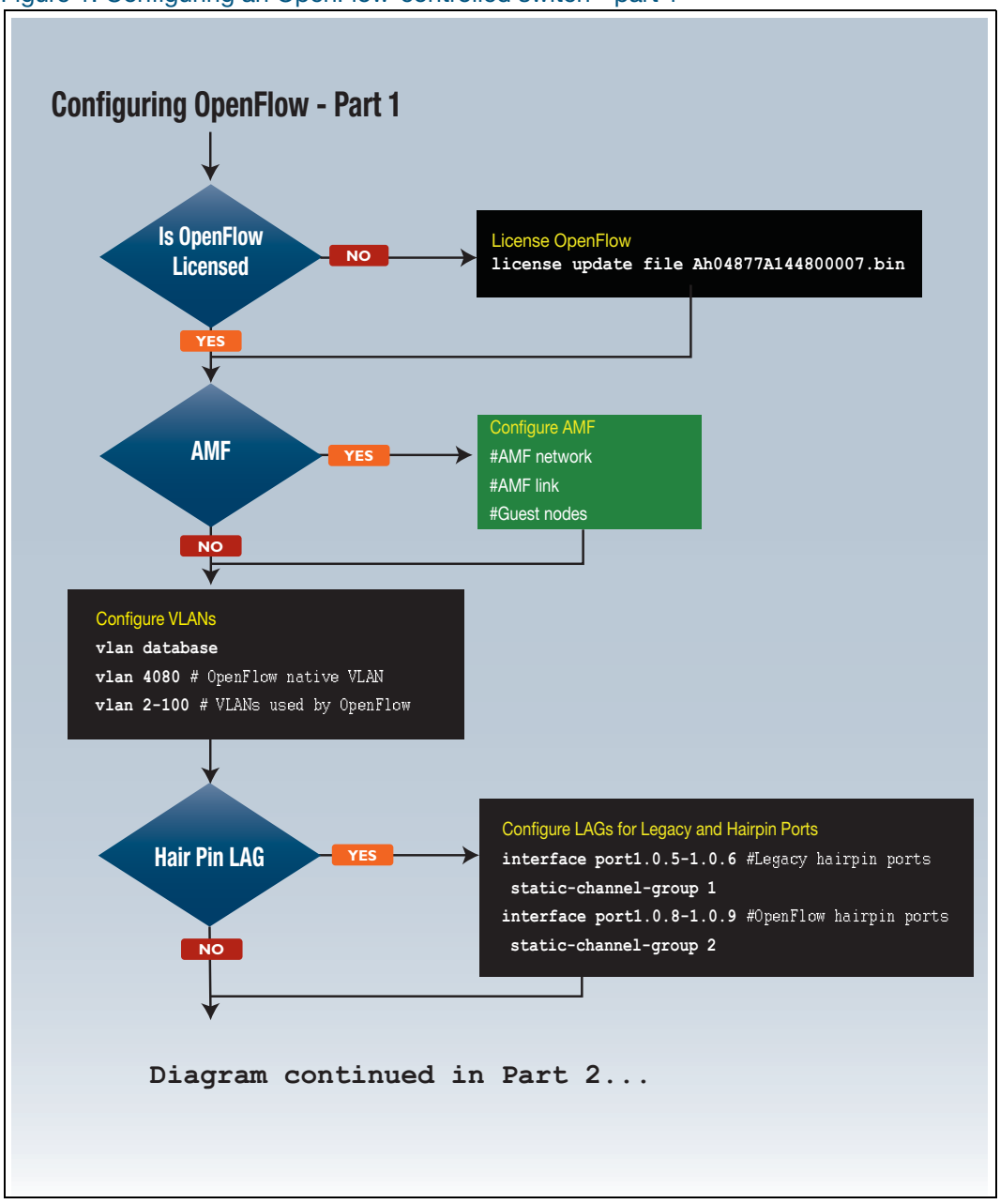
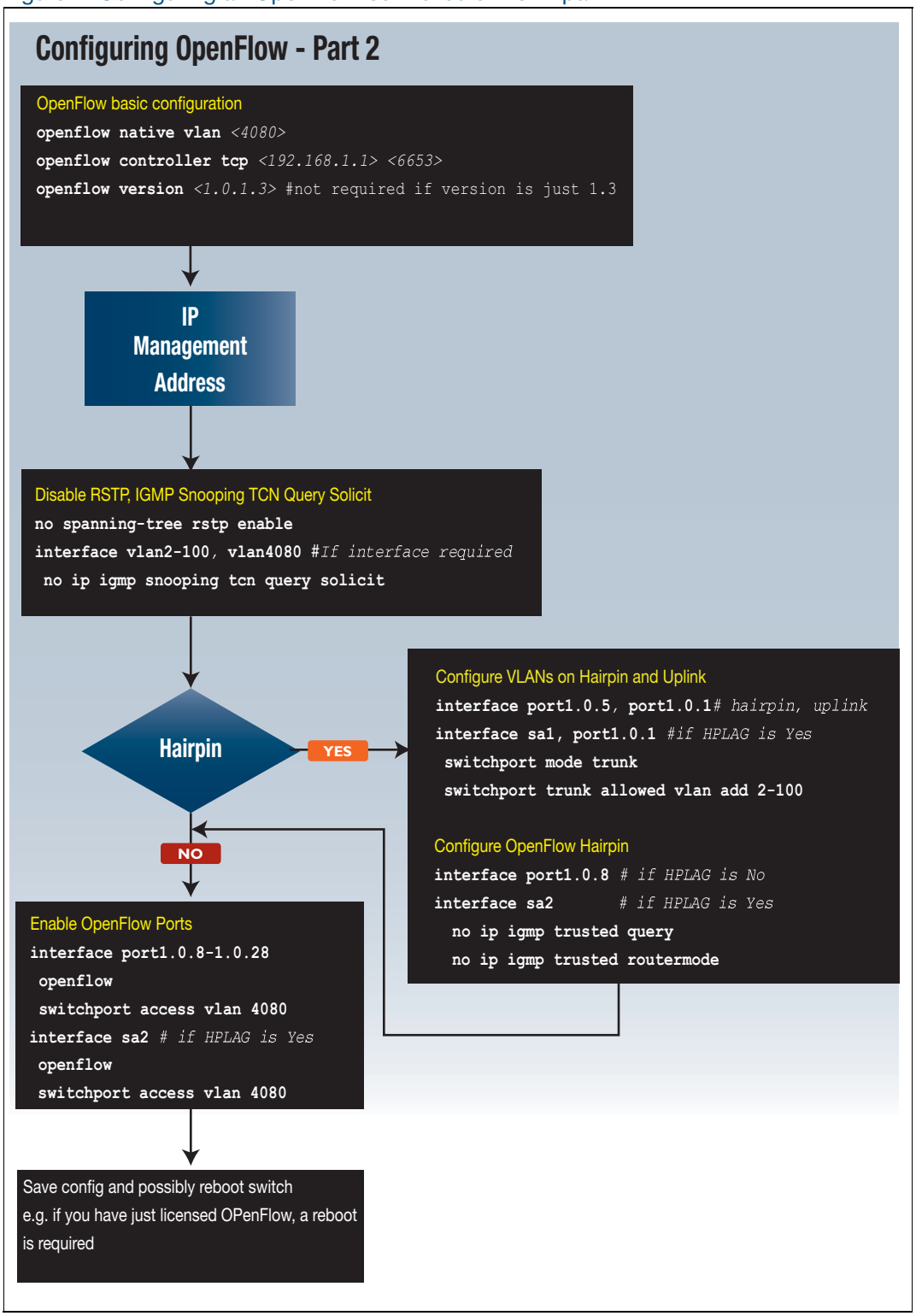


Figure 2: Configuring an OpenFlow-controlled switch - part 2



Communication and Packet Processing

There are two main things that occur in an OpenFlow-controlled switch—communication with the Controller and packet processing:

1. **Communication with the Controller**

- The switch has a Controller configured, and continuously attempts to connect to the Controller.
- The Controller will ask the switch for status and statistics
- The Controller inserts OpenFlow **flows** on to the switch. These contain matches and actions (rules) that tell the switch what to do with packets. For example, a default rule might drop packets or send them to the Controller.

2. **Packet processing**

Packets are processed either by:

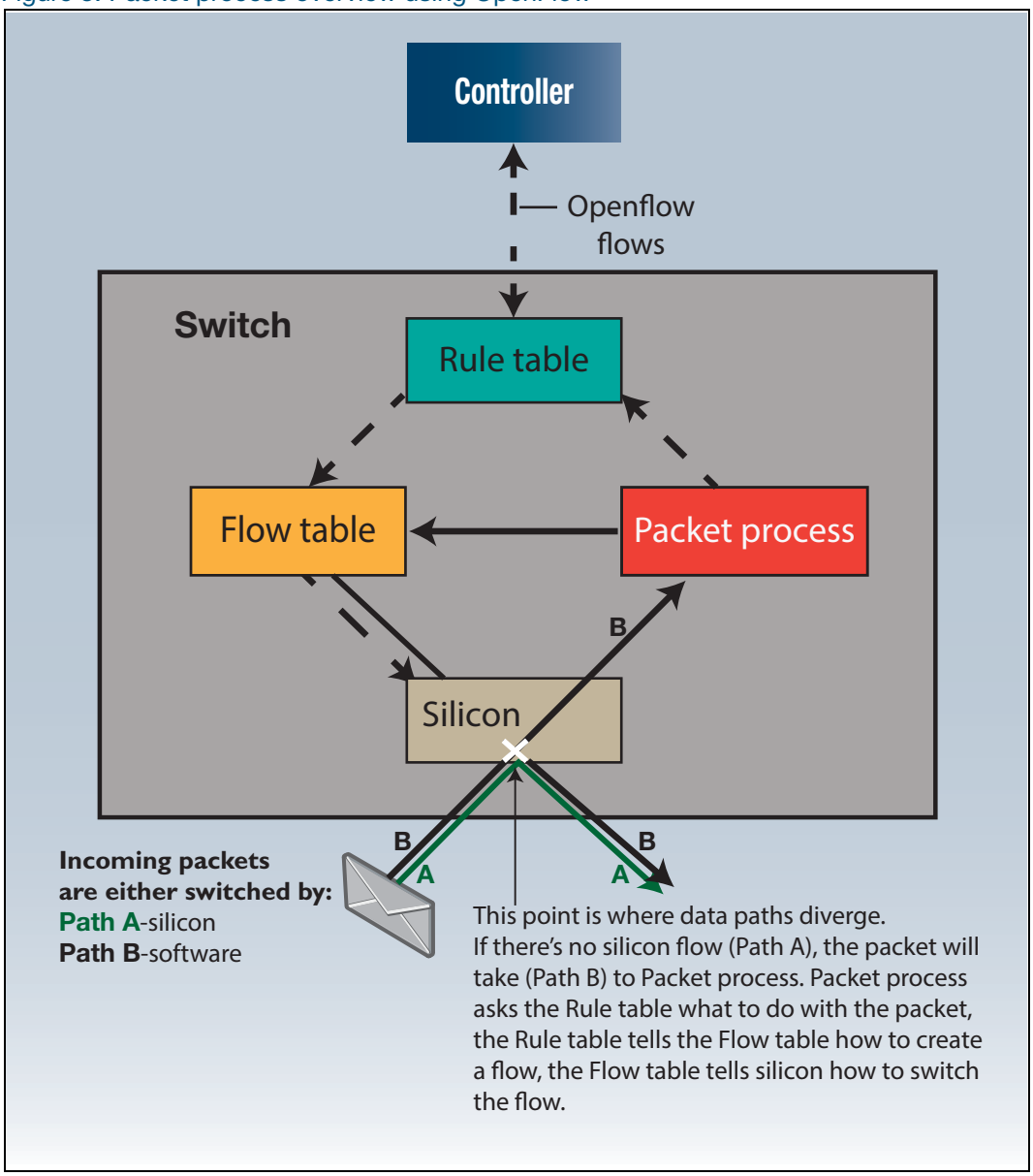
- Flows - as defined by the rules inserted by the Controller.

OR

- CPU - software switched. Packets are passed through the rule tables and the net result (match and actions) for the packet's flow is discovered:
  - the flow is inserted into a software flow table (separate from the rule table)
  - packets are also software switched
  - if possible, the flow is added to a table in the switch silicon
  - subsequent packets in this flow will be switched by the hardware
  - if the flow cannot be added to the silicon, packets for the flow will be processed in software. The reasons for this include:
    1. the flow table in silicon is full
    2. actions cannot be executed by the silicon
    3. chosen not to be processed
- If the default rule is to drop, the flow can be added to silicon (to drop)
- if the default rule is to send to the Controller, then the packet will be sent to the CPU

The following chart helps illustrate the points outlined above:

Figure 3: Packet process overview using OpenFlow



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