8.3. Advanced Functionality Overview

8.3.1. Port-Based VLAN

If the VLAN function is enabled by pulling down the Dis_VLAN strapping pin, the default VLAN membership configuration by internal register is the MII port overlapped with all the other ports to form nine individual VLANs. Via an attached serial EEPROM or via SMI, the default configuration may be modified to allow the input ports to join any of the nine VLAN groups: VLAN A, B, C, D, E, F, G, H, and I. Each input port can be a member of more than one VLAN group.

Port-based VLAN mapping is the simplest implicit mapping rule. Each incoming frame is assigned to a VLAN based on the input port into which it arrived at the switch. It is not necessary to parse and inspect frames in real-time to determine their VLAN mapping. All frames received on a given input port will be forwarded to members of that port's VLAN group. The RTL8309SB supports nine VLAN indexes to individually index received packets to one of the nine VLAN membership registers. These nine groups of VLAN membership registers, VLAN ID [A] membership bit [8:0] ~ VLAN ID [I] membership bit [8:0], determine which ports are members of this VLAN. The RTL8309SB forwards frames to members of this VLAN only (excluding the input port of this frame). VLAN membership registers descript which port are members in a VLAN member set. A port that is not specified in this port's member set should generally not be receiving and/or transmitting frames for that VLAN.

Figure 5 illustrates a typical application. VLAN indexes and VLAN member definitions are set to form three different VLAN groups.

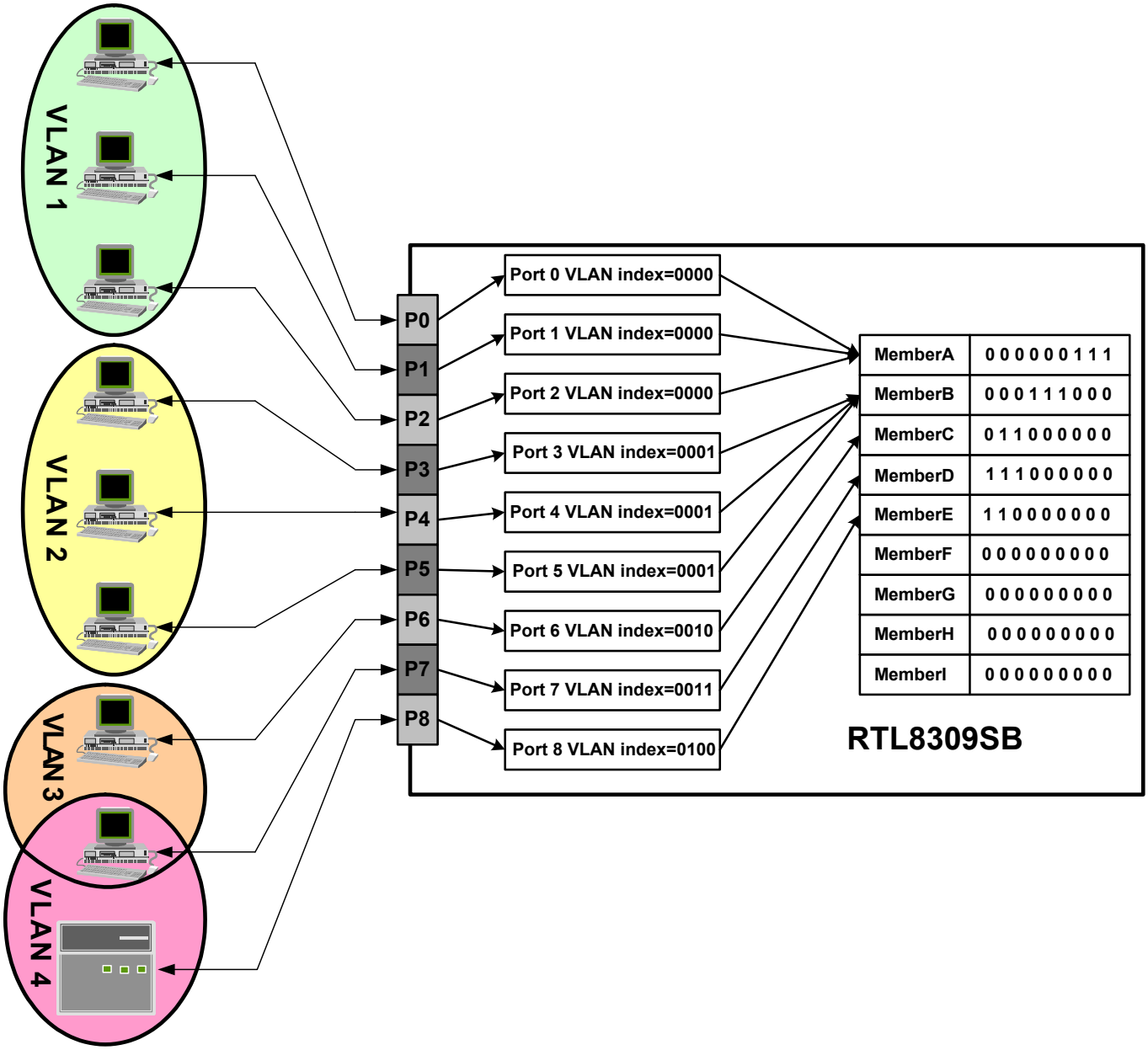

Figure 5. VLAN Grouping Example

In cases where VLAN and trunking are both enabled at the same time, a situation may occur where a packet is forwarded to a trunk but one of the members of this trunk is not in the same VLAN group associated with the source port. In this situation, the VLAN function has higher priority than the trunking operation. The packet will not be forwarded to the port of this trunk.

For non-VLAN tagged frames, the RTL8309SB performs port-based VLAN. It will use Port n VLAN index [3:0] to index to a VLAN membership. The VLAN ID associated with this indexed VLAN membership is the Port VID (PVID) of this port.

8.3.2. IEEE 802.1Q Tagged VID-based VLAN

IEEE 802.1Q tagged-VID based VLAN mapping uses a 12-bit explicit identifier in the VLAN tag to associate received packets with a VLAN. Nine groups of VLAN membership registers, VLAN ID [A] membership [8:0] ~ VLAN ID [I] membership [8:0], consist of ports that are in the same VLAN corresponding to the registers defined in VLAN ID [A] [11:0] ~ VLAN ID [I] [11:0]. If the VID of a VLAN-tagged frame does not hit the VLAN ID [A] [11:0] ~ VLAN ID [I] [11:0], then the RTL8309SB performs port-based VLAN mapping to the member set indexed by the Port n VLAN index [3:0]. Otherwise, the RTL8309SB compares the explicit identifier in the VLAN tag with the nine VLAN registers to determine the VLAN association of this frame, then forwards it to the member set of this VLAN. Two VIDs are reserved for special purposes. One of them is all ones and is currently unused. The other is all zeros and indicates a priority tag, which is treated as an untagged frame.

When 802.1Q tag aware VLAN is enabled, the RTL8309SB performs 802.1Q tag-based VLAN mapping for tagged frames, but performs port-based VLAN mapping for untagged frames. If 802.1Q tag-aware VLAN is disabled, the RTL8309SB performs only port-based VLAN mapping both for non-tagged and tagged frames. Figure 6 illustrates the processing flow when 802.1Q tag aware VLAN is disabled.

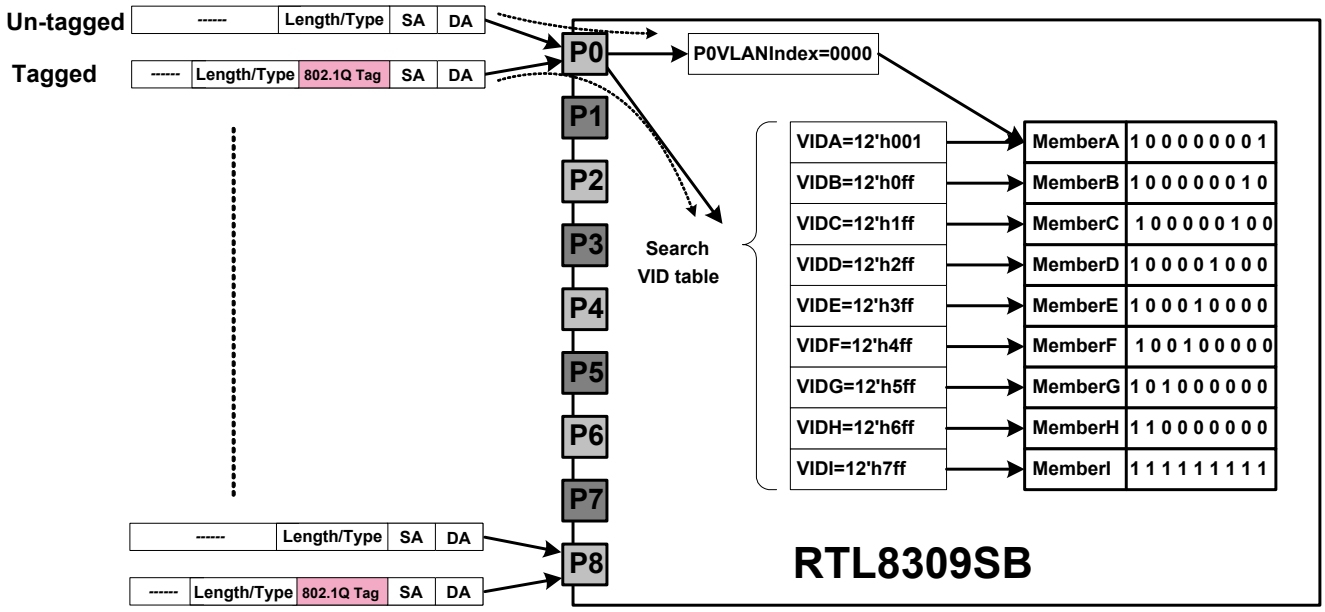

Figure 6. Tagged and Untagged Packet Forwarding When 802.1Q Tag Aware VLAN is Disabled

Two VLAN ingress filtering functions are supported by the RTL8309SB in registers. One is the 'admit VLAN tagged frame' function, which provides the ability to receive VLAN-tagged frames only. Untagged or priority tagged (VID=0) frames will be dropped. The other is the 'ingress member set filtering', which will drop frames if the receive port is not in the member set.

There are also two optional egress filtering functions supported by the RTL8309SB through strapping. One is 'Leaky VLAN', which enables inter-VLAN unicast packet forwarding. That is, if the layer 2 look-up table search has a hit, then the unicast packet will be forwarded to the egress port, ignoring the egress rule. The other is 'ARP VLAN', which broadcasts ARP packets to all other ports, ignoring the egress rule.

8.3.3. QoS Operation

The RTL8309SB can recognize the QoS priority information of incoming packets to give a different egress service priority. The RTL8309SB identifies the packets as high priority based on several types of QoS priority information:

- Port-based priority
- 802.1p/Q VLAN priority tag
- TCP/IP's TOS/DiffServ (DS) priority field
- IP Address

There are two priority queues; a high-priority queue and a low-priority queue. The queue service rate is based on the Weighted Round Robin algorithm. The packet-based service weight ratio of the high-priority queue and low-priority queue can be set to 4:1, 8:1, 16:1 or 'Always high priority first' by hardware pins upon reset, or internal register via SMI after reset.

Port-Based Priority

When port-based priority is applied, packets received from the high-priority port are sent to the high-priority queue of the destination port. High priority ports can be partially set by hardware pins, and wholly configured in internal registers.

802.1p-Based Priority

When 802.1p VLAN tag priority applies, the RTL8309SB recognizes the 802.1Q VLAN tag frames and extracts the 3-bit User Priority information from the VLAN tag. The RTL8309SB sets the threshold of User Priority as 3. Therefore, VLAN tagged frames with User Priority value = 4~7 will be treated as high priority frames, other User Priority values (0~3) as low priority frames (follows 802.1p standard). The threshold value can be modified in internal registers via an SMI interface or configured in EEPROM.

DiffServ-Based Priority

When TCP/IP's TOS/DiffServ(DS) based priority is applied, the RTL8309SB recognizes TCP/IP Differential Services Code Point (DSCP) priority information from the DS-field defined in RFC2474. The DS field byte for the IPv4 is a Type-of-Service (TOS) octet. The recommended DiffServ Code Point is defined in RFC2597 to classify the traffic into different service classes. The RTL8309SB extracts the codepoint value of DS-fields from IPv4 packets and identifies the priority of the incoming IP packet following the definition below:

High priority: where the DS-field = (EF, Expected Forwarding:) 101110
(AF, Assured Forwarding:) 001010; 010010; 011010; 100010
(Network Control:) 110000 and 111000

Differential service code point [A] specified in internal register;

Differential service code point [B] specified in internal register;

Low priority: where the DS-field = other values.

The VLAN tagged frame and 6-bit DS-field in the IPv4 frame format are shown below:

Table 109. 802.1Q VLAN Tag Frame Format

6 bytes	6 bytes	2 bytes	3 bits	
DA	SA	81-00	User-Priority (0~3:Low-pri; 4~7: High-pri)	----

Table 110. IPv4 Frame Format

6 bytes	6 bytes	4 bytes	2 bytes	4 bits	4 bits	6 bits	
DA	SA	802.1Q Tag (optional)	08-00	Version IPv4= 0100	IHL	TOS[0:5]= DS-field	----

IP-Based Priority

When IP-based based priority is applied, any incoming packets with IP priority equal to IP address [A] AND IP mask [A] or IP address [B] AND IP mask [B] will be treated as high priority packets. IP priority [A] and IP priority [B] may be enabled or disabled independently.

Flow Control Auto Turn Off

The RTL8309SB can be configured to turn off 802.3x flow control and backpressure flow control for 1~2 seconds whenever the port receives VLAN-tagged or TOS/DS high priority frames. Flow control is re-enabled when no priority frame is received for a 1~2 second duration. The purpose of this function is to avoid head-of-line blocking on priority classification.

8.3.4. Insert/Remove VLAN Priority Tag

The RTL8309SB supports four types of insertion/removal of VLAN tags in packet, controlled by internal registers on a per-port basis. They are classified as follows:

Type 11: Do not change packets (Default).

Type 10: Insert input port's PVID for non-tagged packets. Do not change packets if they are already tagged.

Type 01: Remove VLAN tags from tagged packets. Do not change packets if they are not tagged.

Type 00: Remove VLAN tags from tagged packets then insert the input port's PVID. For non-tagged packets, insert the input port's PVID.

In Type 10, if Null VID replacement is enabled, this function has higher priority than type 10. If both type 10 is selected and Null VID replacement is enabled, the RTL8309SB inserts a PVID to non-tagged packets and replaces a null VID with a PVID for tagged packets, and does nothing in tagged packets with a non-null VID.

If the tag removed frame is less than 64 bytes, it will be padded with an 0x20 pattern before the packet's CRC field to fit the 64-byte minimum packet length of the IEEE 802.3 spec. The RTL8309SB will recalculate the FCS (Frame Check Sequence) if the frame has been changed.

8.3.5. Port VID (PVID)

In a router application, the router may want to know which input port this packet came from. The RTL8309SB supports Port VID (PVID) for each port to insert a PVID in the VLAN tag on an egress packet. The VID information carried in the VLAN tag will be changed to a PVID. The RTL8309SB also provides an option to admit VLAN-tagged packets with a specific PVID only. When this function is enabled, packets with an incorrect PVID and non-tagged packets will be dropped.

The RTL8309SB uses an internal register, 'Port n VLAN index [3:0]' to index to a VLAN membership. The VLAN ID associated with this indexed VLAN membership is the PVID for this port. Users may select VLAN insert/remove type 10 or 00 to insert a PVID on egress packets.

On 802.1Q tag-based VLANs do not use a port-based VLAN in PVID applications, as the VID information carried in the VLAN tag will be replaced with a PVID.

8.3.6. Port Trunking

The RTL8309SB can combine two UTP ports into one trunking port (with a balancing mechanism). The default configuration is to combine port 0 and 1 as one trunk, even if they are operating with different duplex or speed settings. If port 0 and/or port 1 are assigned as a high priority port, this trunk will also be considered as a high priority trunk when the trunking function is enabled. The RTL8309SB also provides the option to set port 6 and port 7 as a trunk by configuring the 'trunking port assignment' bit in the internal register.

8.3.7. ISP MAC Address Translation

Some Internet Service Providers only provide service to a single pre-registered MAC address. To share the Internet Service with more than one station, the RTL8309SB translates the MAC address of multiple NICs to the ISP registered MAC address.

Figure 7, page 82, illustrates an outbound process. When station G tries to send a packet to the WAN, it broadcasts or unicasts this packet to the CPU port with a NIC MAC address. After the CPU receives this packet, it translates this MAC address to the ISP registered MAC address and stores this information in its mapping table. It then forwards this packet to the WAN port through the CPU port. The RTL8309SB will not learn this packet into it's forwarding table. This is a special learning mechanism, which states that any frame coming from the CPU port with a source MAC address equal to internal register 'ISP MAC [47:0]' will not be learned. This function must be correctly configured in the VLAN configuration, otherwise the RTL8309SB will drop such packets.