> **WARNING**
> All health and safety procedures and recommendations must be followed as detailed in the Horizon Quantum User Manual.
> This product is to be installed and maintained by experienced telecommunications personnel only. Installations must adhere to specifications listed in the Horizon Quantum User Manual.
> Horizon Quantum is to be installed with proper grounding, surge arrestors and -48 VDC power in accordance with instructions contained in the Horizon Quantum User Manual.

Note: Please also refer to Horizon Quantum Quick Reference Guide 83-000071-01

Quantum Layer 2 Switching Overview

DragonWave L2SW is an integrated software feature for the Horizon Quantum that manages the on-board Ethernet switch. It performs Ethernet switching between Ethernet ports at wire-speed and performs Ethernet link management with other IEEE compliant Layer-2 devices. DragonWave L2SW provides the basic bridging functionality and also offers advanced features such as RSTP/MSTP.

L2SW feature functionality is part of Quantum command set, however, the Ethernet switch can be accessed directly and L2SW commands can be executed. See Quantum Product Manual Volume 4 for details.

Licensed Feature Groups

Licensed Feature Group 6 will need to be activated to take advantage of the L2SW feature set. Omni version 1.1.5 and above introduces this new feature group.

To view licensed feature groups:
- CLI command - **get licensed feature groups**
- Web - displayed on Quantum modem home page

Feature Groups available in Omni 1.1.5

XPIC	BAC	RLS,ECFM(802.1ag/Y.1731)
HAAM	DualWirelessPorts	l2switchFeature

L2 Switch Features

DragonWave L2SW functionality in Release 1.01.05 provides basic bridging, Rapid Spanning-Tree (RSTP) Multiple Spanning-Tree (MSTP)

RSTP

Based on the IEEE 802.1w standard this link management protocol provides path redundancy while preventing Layer-2 network loops. RSTP reduces the Layer-2 convergence time from 50 seconds to less than 1 second in comparison to the previous 802.1d spanning-tree standard.

MSTP

MSTP builds upon RSTP and adds additional capabilities by load balancing across more than one instance while providing benefits of reduced processing overhead. DragonWave's current implementation of MSTP has support for up to 16 instances.

Physical Ports

RS232 Serial	2x SFP Optical	6x GigE Ethernet	Status LEDs	IF output to ODU
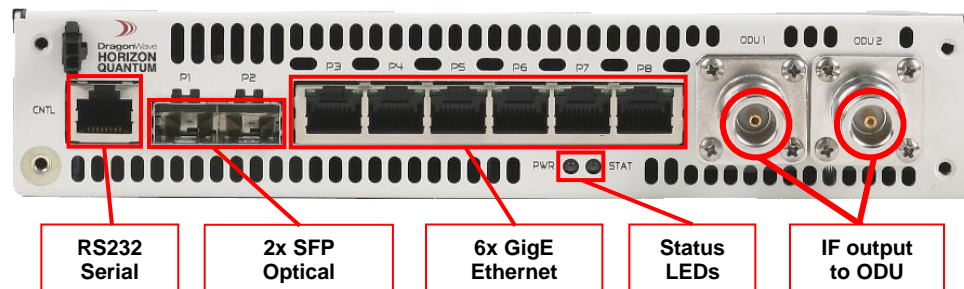
Logical Ports

DP's and IPG's

Data Paths are virtual ports through the RF link. There are 4 data paths (DP1, DP2, DP3, DP4), each with 1GB capacities, that provides network access to/from the Quantum's switch and the modem.

Isolated Port Groups (IPG) allows the creation of multiple switching domains by associating any combination of physical ports (P) and/or Data Paths (DP). There are 5 user-configurable IPG groups (IPG1-IPG5) and 1 non-configurable IPG that contains any unassigned ports (IPG0).

Notes:

- Although each DP is capable of handling 1 Gbps, the cumulative over-the-air throughput is controlled by the radio configuration, including system mode and channel bandwidth. Example: dual modem with system mode of hz50_371_256qam Mbps will result in average of 742Mbps over-the-air throughput.
- The Bandwidth Acceleration feature (BAC) can be used to further increase throughput.

Default IPG Configuration

	Port	Data Path	User Configurable	Note
IPG1	P5	DP1	Yes	
IPG2	P6	DP2	Yes	
IPG3	P7	DP3	Yes	
IPG4	P8	DP4	Yes	
IPG5	P3	None	Yes	Network management interface
IPG0	P1, P2, P4	None	No	Unassigned in default config

Data Ports, IPG's and Data Paths
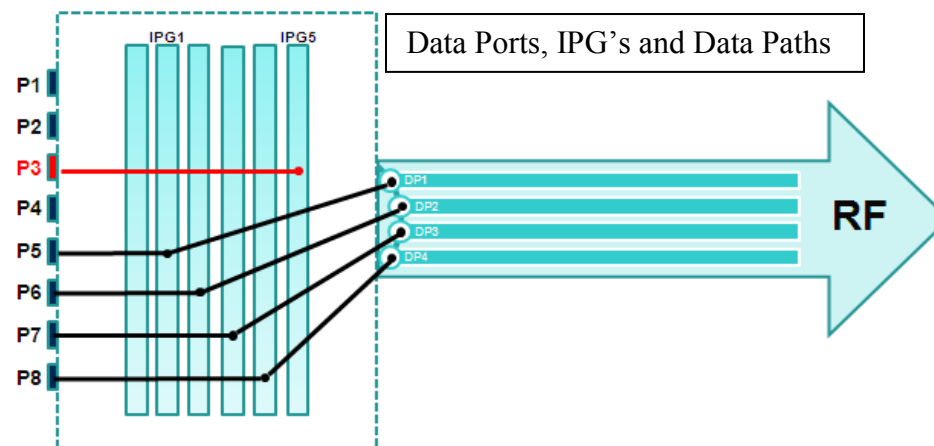
In L2SW switch mode, physical and logical ports are labeled using a "gi" convention denoting Gigabit interfaces.

Quantum to L2SW switch naming conventions

Interface Type	Quantum CLI mode	L2SW CLI mode	User Access
Physical Port	P1 – P8	gi 0/1 – gi 0/8	Yes
RF Data Paths	DP1 – DP4	gi 0/9 – gi 0/12	Yes, but limited
CPU	None	gi 0/13	Yes, but limited
LAG Data Paths (DP1-DP4)	None	po 14	Yes, but limited

General Configuration

Serial Port method: DB9-to-RJ45 serial adapter (DW model 74-000204-01), straight-through Ethernet cable, and HyperTerminal equivalent software using COM Port settings (19200, 8, N, 1).

Ethernet Port method: Plug Ethernet cable to P3 Ethernet port. Telnet to the default IP of 192.168.10.100 (255.255.0.0) or browse to http://192.168.10.100 on the target unit (web GUI needs to be enabled – **set web server on** via CLI). Ensure your device is configured on the same IP subnet.

Default login for both methods is: **energetic** (username) / **wireless** (password). Quantum access levels, Super User, NOC and Admin, are carried over to the L2 switch features and command set.

To access the L2SW command set, enter the CLI command **l2sw**. To return to Quantum command set, enter the CLI command **exit**. While there are two CLI command sets, Quantum & L2SW, many L2SW features and commands can be accessed directly from the Quantum command set.

Most, if not all, commands in the L2SW can be shortened to only a few letters, provided it is unique. Examples:
- "**configure terminal**" can be shortened to "**c t**"
- "**show spanning-tree**" can be shortened to "**sh sp**"

Each command stream has its own MIB, with respective 'save' and 'delete' actions. The commands for both actions are executed at the Quantum CLI level. Both mib's must always be saved.

Action	Quantum MIB	L2SW MIB
Saving configs	**save mib**	**save l2swmib**
Deleting configs	**delete mib both**	**delete l2swmib both**

If executing the **reset system** command, a prompt will be available to save the mib. Answering "y" will save both the mib and l2swmib.

NOTES:

1) **To fully save the system configs (or delete them back to default) BOTH MIBs must be saved/deleted, regardless of whether or not L2SW feature is enabled.**
2) "save/delete mib" saves wireless link configuration, IP address, subnet mask, default gateway. NOTE: "delete mib" does not delete/change the IP, subnet mask or default gateway settings.
3) "save/delete l2swmib" saves/deletes switch configuration (VLAN, port characteristics, IPG, default port priority)

Certain commands will prompt the user with the option to save and apply changes immediately; no "reset system" command is needed. Examples:

set ipg config	**set vlan config**	**set network management interface**
set enet config	**set ip address**	**set default gateway**

> **WARNING**
> All configurations in the L2SW are dynamic and will be effective **immediately** following the "end" command from within the configuration terminal. Proceed with caution when changing switch configurations as they may be service affecting.

Quantum CLI Configuration Level

Configuration Steps for IPG groups

	Command	Note
Step 1	**set ipg config** [*group name*] **enable** [*port list*] **set ipg config** [*group name*] **disable**	Configure an IPG group. *group name* - range is IPG1 to IPG5. *port list* - any combination of P1 to P8 and DP1 to DP4 (separated by commas)
Step 2	**get ipg config**	Display and verify IPG information

Configuration Steps for enet, vlan, & network management interface

Note that VLAN 1 is the default VLAN. Unless there is a specific reason to reassign it, it is recommended that it be left as the default value. VLAN pruning should be employed to avoid excessively large VLAN lists

	Command	Note
Step 1	**set enet config** *(Interactive command)*	Interactive commands that step through the on-screen process. Configures the attributes for ports P1 to P8. Speed, duplex, etc.
Step 2	**set vlan config** *(Interactive command)*	Configures each port, P1 to P8, as access or trunk and assigns a default VLAN id. An 'allowed VLAN list' can be configured on the trunk ports." *Note: it is recommended to configure only the required VLAN range, as excess VLANs will only increase processing and boot-up times.*

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Step 2	**set network management interface** (Interactive command)	**set network management interface** – assigns ports to the network management interface. Any combination of ports (or all of them) can be assigned. For inband management, a DP will also need to be assigned to the management interface (eg. p3,dp1), and it should reside within the same IPG as the assigned physical port. ** If any access ports are included in the network management interface, their default VLAN ID will change to that of the management interface. For example, if the management interface is set to VLAN ID 100 then all access ports will change to VLAN100
Step 4	**get enet config** **get vlan config** **get network management interface**	Display and verify information.

Handling of ECFM and Control/Slow Protocol Packets

When EOAM is enabled, these EOAM packets will be trapped and processed. They generally have EtherType of 0x8809. If they are not enabled, they will be transparently forwarded as normal traffic. When these kinds of packets travel over the air, they are directed to a special queue (Queue "C") and prioritized over other user traffic.

Ring Protection, L2 Switching

Horizon Quantum 1.1.5 and later utilizes a secondary Layer 2 switch shell (L2SW) that controls most switching functions and can be configured to initiate and/or participate in spanning-tree ring protection topology. Both Rapid Spanning Tree Protocol (RSTP) and Multiple Spanning Tree Protocol (MSTP) are supported.

Note: RSTP/MSTP will <u>only</u> affect ports in IPG0. Any ports assigned to an IPG (1-5) will <u>not</u> participate in spanning tree.

Rapid Spanning Tree Protocol (RSTP)

RSTP allows for the fast redirection of traffic in the case of a failure in the default traffic path. One device among the participating nodes will be designated as root. The RSTP algorithm figures out the active path to the root bridge, and puts the other redundancy path to a blocked state. The blocked path will be unblocked when there is a failure in the active path.

Switching times will vary depending on many factors, though generally they will be sub-100ms for smaller rings (8-10 nodes). To have optimal switching time, RLS feature is needed. RLS is used to detect an over-air path failure quickly and inform the RSTP/MSTP algorithm that the wireless path is down. Please refer to Quantum Data Sheets for timing details.

Configuration Steps for RSTP

	Command	Note
Step 1	**l2sw**	Enter L2SW mode from Quantum CLI.
Step 2	**configure terminal**	Enter configuration mode.
Step 3	**spanning-tree mode rst**	Configure for RSTP.
Step 4	**end**	Activate changes and return to L2SW prompt
Step 5	**show spanning-tree**	Display and verify RSTP information.

Multiple Spanning Tree Protocol (MSTP)

MSTP allows for the creation of multiple spanning tree "instances". Each instance is assigned a set of VLAN(s), and will only affect frames that are tagged within that VLAN list. Up to 16 instances can be created, and each one of those instances can be configured with a different root device or path costs.

Configuration Steps for MSTP

	Command	Note
Step 1	**l2sw**	Enter L2SW mode from Quantum CLI.
Step 2	**configure terminal**	Enter configuration mode.
Step 3	**spanning-tree mode mst**	Enable MSTP.
Step 4	**spanning-tree mst config**	Enter MST configuration mode.
Step 5	**instance** [*instance-id*] **vlan** [*vlan-range*]	Map VLANs to an MST instance. *instance-id* - range is 1 to 16. *vlan-range* - range is 1 to 4094. VLAN numbers cannot be duplicated across instances. They can only be mapped to one instance at a time. Any unmapped VLAN will default back to instance 0.
Step 6	**name** [*name*]	Specify the configuration name. The *name* string has a max length of 32 characters and is case sensitive.
Step 7	**revision** [*version*]	*version* - range is 0 to 65535.
Step 8	**end**	Activate changes and return to L2SW prompt
Step 9	**show spanning-tree**	Display and verify MSTP information.
Step 10	**show spanning-tree mst configuration**	Display and verify MSTP config.

(Optional) Configuration Steps for MSTP root-switches (Priority)

Note: By default, all units participating in spanning tree (RSTP or MSTP) have the same default priority value (32768), and in that case root status is assigned to the unit with the lowest value MAC address.

	Command	Note
Step 1	**l2sw**	Enter L2SW mode from Quantum CLI.
Step 2	**configure terminal**	Enter configuration mode.
Step 3	**spanning-tree mst** [*instance-id*] **priority** [*priority-value*]	Sets the switch priority manually. *instance-id* range is 1 to16. *priority-value* range is 0 to 61440 (in increments of 4096). Default priority value is 32768, so anything below this value can make a unit the root switch. **To assign a root value to instance 0 the syntax is**: spanning-tree priority** *priority-value*.
(OR) Step 3	(OR) **spanning-tree mst instance-id** [*instance-id*] **root** [*primary/secondary*]	Sets the switch priority automatically. *instance-id* range is 1 to16. *<primary/secondary>* automatically sets priority values to 24576 or 28672 respectively. **There is no command to automatically configure the primary or secondary root on instance 0. See previous step on manual priority value.
Step 4	**end**	Activate changes and return to L2SW prompt
Step 5	**show spanning-tree**	Display and verify MSTP information.
Step 6	**show spanning-tree mst configuration**	Display and verify MSTP config.

Path Costs

Manual pathcost: By default, when spanning tree is enabled, pathcosts will be assigned to all ports detected by spanning-tree. These pathcosts can be manually changed on a per-interface basis. When enabled, the port-channel's pathcost will be changed automatically based of the number of member ports in the port-channel.

Dynamic pathcost: The path cost of the port / MSTI is dynamically calculated. When enabled, the pathcost of a link will be changed automatically when the link speed changes. Note: This can result in dynamic changes in network topology, and is not recommended for most networks.

Configuration Steps for configuring pathcosts manually

	Command	Note
Step 1	**l2sw**	Enter L2SW mode from Quantum CLI.
Step 2	**configure terminal**	Enter configuration mode.
Step 3	**interface [interface]**	Enter interface level.
Step 4	**spanning-tree cost** *[1-200000]*	Enter a manual cost for the interface.
Step 5	**end**	Activate changes and return to L2SW prompt

Configuration Steps for enabling dynamic pathcost

	Command	Note
Step 1	**l2sw**	Enter L2SW mode from Quantum CLI.
Step 2	**configure terminal**	Enter configuration mode.
Step 3	**spanning-tree pathcost dynamic lag-speed**	Enable dynamic pathcost.
Step 4	**end**	Activate changes, return to L2SW prompt

Troubleshooting

Context sensitive help exists for both Quantum CLI and for L2SW commands. "**? <command>**" and "**<command> ?**" returns a list of commands for that query.
Example: "? vlan" returns all commands that contain 'vlan'.

1st Step: verify the microwave radio link is operating properly.
See Horizon Quantum Quick Reference Guide 83-000071-01-xx-xx or Quantum Product Manuals.

Quantum switch CLI commands:

get ipg config	**get ipg status**
get vlan config	**get vlan status**
get enet config	**get enet status**

L2swSW commands: enter **l2sw** at Quantum CLI command prompt to access L2SW commands.

enter **exit** to return to Quantum CLI commands

Condensed list of useful commands:
Note: for additional detail and command options, please refer to context sensitive help.

show interfaces

show mac-address-table

show vlan

show spanning-tree detail

show spanning-tree root

show spanning-tree interface

monitor session	Configures a destination port and source port for a mirroring session.
show monitor	Displays the mirroring information present in the system.