

OVERVIEW

To maintain Quality of Service (QoS) for VoIP, it is required that the network be designed to prioritize voice traffic over data traffic as voice quality is very sensitive to packet loss, delay and jitter over the network. Depending on the size of the implementation, a Virtual Local Area Network (VLAN) partition may be required. VIPedge utilizes 802.1Q - the networking standard which supports Virtual LANs over Ethernet.

VLANs work well in network environments with 100 or more hosts/ devices. To limit the broadcast domain and minimize the impact of data traffic on voice traffic for these larger deployments, a separate voice VLAN and data VLAN may be created.

Every IP5000 series IP telephone (IPT) has a built-in Ethernet switch and is capable of partitioning the switch ports into different domains by partitioning the telephone and PC ports into different VLANs using VLAN "tagging" (see "Example of Network with VLAN Support" on Page 1-1). IPT ports are controlled using IPedge programming.

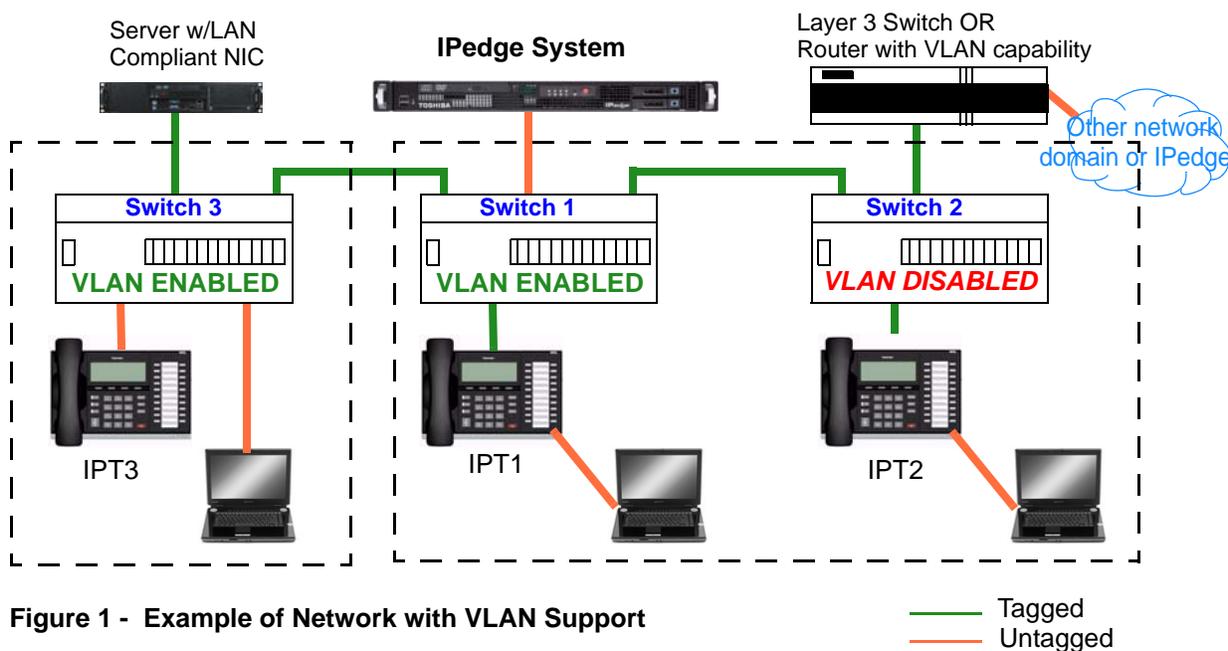


Figure 1 - Example of Network with VLAN Support

Partitioning IPT and PC ports using VLAN

Using VLAN enables the partitioning of telephony and data devices into separate logical LAN networks by isolating PC broadcast packets from the telephone port to maintain voice quality. This method also maintains data security by isolating the telephone network (voice) from the data network (PC).

For example, when the PC and telephone ports on IPT1 are partitioned using VLAN, frames from Switch1 are transferred by the IPT1 switch following the VLAN Identifier (VID) of each frame. If VID of a frame is equal to Phone VID (PVID), the frame is transferred only to the telephone port; if equal to the PC port VID, the frame is transferred only to PC port.

VLAN Preparation for IT Personnel

If multiple VLANs are used for IPTs, ensure that a VLAN capable router and/or Layer 3 switches are used and enable VLAN tagging and priority on the Ethernet switch.

CAUTION! The base stations must be enabled for VLAN prior to the router/switch or EVERY base station will need to manually reset.

The IPT VLAN feature may be enabled using either IPT “Local Mode” (3 + 6 + 9 + Hold) or Enterprise Manager.

VLAN-enabled IPT switch operation

Access Port

- **Basic operation for ingress frames** – When port type is set to “Access”, all incoming frames are permitted to receive from this port regardless of tag header presence. Any untagged or priority-tagged frame is classified to a VLAN group, which has a PVID of this port, by ingress rule checking. The frame is filtered based on the destination MAC address and VID associated with the frame to determine port(s) to where this frame should be forwarded. If no ports are available for egress, the frame is discarded.
- **Basic operation for egress frames** – When port type is set to “Access”, only frames with matching PVID of this port may be forwarded to this port for egress. A frame is transmitted after the tag header is removed.

Trunk Port

- **Basic operation for ingress frames** – When port type is set to “Trunk”, only VLAN-tagged frames with a VLAN ID are permitted to receive packets from this port. Any un-tagged or priority-tagged frames received on the trunk port are discarded. On receive, all information in the tag header is preserved. The frame is then filtered based on both destination MAC address and tag header VID to determine port(s) to where this frame should be forwarded.
- **Basic operation for egress frames** – When port type is set to “Trunk”, VLAN-tagged frames with any VLAN ID may be transmitted through this port - no egress filtering is applied. If an untagged frame is forwarded to this port, a tag header with VID associated with the frame by ingress rule checking is inserted into the frame before transmission. If a priority-tagged frame is forwarded to this port, the original tag header will be replaced with new tag header with VID associated with the frame as well.

IPT Frames

- **Basic operation for frames originating from or destined for the IPT** – When VLAN is enabled, all frames routed to the IPT application are filtered using the Phone VID. Only frames matching the Phone VID are forwarded to the IPT application while others are discarded. Frames originating from the IPT application contain a tag header with phone VID and user priority (via system programming) and will be added into those frames by the software.

The Table below (see [“Decision table for action to be taken for frames”](#) on [Page 1-3](#)) shows the action the switch will take for frames and forwarding

ports if the action is forward. These decisions are based on incoming port, frame type, destination MAC address and Frame VID.

Table 1-1 Decision table for action to be taken for frames

Incoming Port	Link type of Incoming	Frame type	Destination MAC	VID	Action	Forwarding Port	
PC	Access	Untagged	Phone	N/A	Drop		
			LAN	N/A	Forward	LAN	
			Unknown	N/A	Forward	LAN	
			Broadcast	N/A	Forward	LAN	
		VLAN-tagged	Phone	Phone	Phone	Forward	Phone
				PC		Drop	
				Others		Drop	
			LAN	Any	Forward	LAN	
			Unknown	Phone	Forward	Phone	
				PC	Forward	LAN	
				Others	Forward	LAN	
			Broadcast	Phone	Forward	Phone	
	PC	Forward		LAN			
	Others	Forward		LAN			
	Trunk	Untagged	Any	N/A	Drop		
		VLAN-tagged	Phone	Phone	Phone	Forward	Phone
				PC		Drop	
				Others		Drop	
			LAN	Any	Forward	LAN	
			Unknown	Phone	Forward	Phone	
				PC	Forward	LAN	
				Others	Forward	LAN	
			Broadcast	Phone	Forward	Phone	
		PC		Forward	LAN		
Others		Forward		LAN			

Table 1-1 Decision table for action to be taken for frames (continued)

Incoming Port	Link type of Incoming	Frame type	Destination MAC	VID	Action	Forwarding Port			
LAN	-	Untagged	Any	N/A	Drop				
		VLAN-tagged	Phone	Phone	Phone	Forward	Phone		
				PC	PC	Drop			
				Others	Others	Drop			
			PC(Access)	Phone	Phone	Drop			
				PC	PC	Forward	PC(Access)		
				Others	Others	Drop			
			PC(Trunk)	Phone	Phone	Forward	PC(Trunk)		
				PC	PC	Forward	PC(Trunk)		
				Others	Others	Forward	PC(Trunk)		
			Unknown	Phone	Phone	Forward	PC(Trunk)		
				PC	PC	Forward	PC(Access), PC(Trunk)		
				Others	Others	Forward	PC(Trunk)		
			Broadcast	Phone	Phone	Forward	PC(Trunk)		
				PC	PC	Forward	PC(Access), PC(Trunk)		
				Others	Others	Forward	PC(Trunk)		
			Phone	-	VLAN-tagged	PC(Access)	Phone	Drop	
						PC(Trunk)	Phone	Forward	PC(Trunk)
						LAN	Phone	Forward	LAN
		Unknown				Phone	Forward	PC(Trunk), LAN	
		Broadcast				Phone	Forward	PC(Trunk), LAN	

VLAN Tagging

The IPedge system supports 802.1Q Virtual Local Area Network (VLAN) technologies. For sites that have thousands of IP devices, VLANs may be used to separate the network virtually rather than physically, to prevent the broadcast and other traffic from one virtual LAN (typically a data LAN) from impairing the performance of equipment on another virtual LAN (for example, a VoIP LAN) even though the devices are plugged into the same physical network.

VLAN for the IP Telephone (IPT) and data port may be programmed manually using the base station or remotely via Enterprise Manager. There are no settings to set on the IPedge server, however, ensure that the data switch port connected to the IPedge server is configured to be in the same VLAN ID as the IPTs. For IPT configuration, broadcast mode is not recommended for large deployments (100+ phones).

With or without VLANs, 802.1p and Diffserv protocols may be used to provide Quality of Service for voice by allowing voice packets to be prioritized over data packets.

To provide additional prioritization for voice services, it is possible to enable 802.1p in conjunction with 802.1Q (VLANs). This is currently a system wide setting in IPedge. However, this will enable 802.1p on remote phones requiring the switches are all locations where remote phones are deployed to support 802.1p.

Note: When using 802.1Q or 802.1p it is important to ensure that all the network of the ethernet switches and routers are capable of supporting one or both protocols.

Reasons a company might want VLANs

- **Security** – Separating systems that have sensitive data from the rest of the network decreases the chances that people will gain access to information they are not authorized to see.
- **Projects/Special Applications** – Managing a project or working with a specialized application may be simplified by using a VLAN that brings all the required nodes together.
- **Performance/Bandwidth** – Careful monitoring of network use enables the network administrator to create VLANs that reduce the number of router hops and increase the apparent bandwidth for network users.
- **Access Lists** – Provides the network administrator with a way to control who sees the different types of network traffic. An access list is a table the network administrator creates that lists which addresses have access to that network.
- **Broadcasts/Traffic flow** – Since a principle element of a VLAN is the fact that it does not pass broadcast traffic to nodes that are not part of the VLAN, it automatically reduces broadcast traffic.

VLAN Tagging

Local Administration from the IP Telephone (IPT)

Once the IPT is connected to the IPedge system, “3-6-9-Hold” programming may be used to configure/change the VLAN ID. The built-in PC and telephone ports may be tagged for the VLAN feature to be enabled.

Note: If this system is not using VLAN tags or is using only the default (VID = 1) value, these steps are not required.

1. Press 3+6+9+Hold simultaneously. The display will show “IP Programming Mode Select =”
2. Press 2, press Hold, then press the soft key Scrl until function key (FK) FK21 is indicated.
3. Press FK21 for VLAN Enable/Disable; 1 = Enable VLAN, 2 = Disable VLAN. Change to 1 (Enable), then press Hold.
4. Press FK22 to enter the VLAN ID (1 ~ 4094) for this phone (Default is 1) then press Hold.
5. Press FK23 to set the PC Port Type, 1 = Access; 2 = Trunk, then press Hold.
6. Press FK24 to enter the PC Port VLAN ID (1~ 4094 (Default=1) then press Hold.
7. When all the above changes have been made, press Hold again until the display returns to “IP Programming Mode Select =” then lift and re-seat the handset to reset the telephone.

Notes:

- After a change is made, the FK LED will turn green.
- When VLAN feature is enabled, LAN Port Type is fixed as “Trunk”.
- PC Port Type is “Access”.
- VLAN-untagged devices (e.g. PC) **must not** be connected to the LAN port for VLAN-tagged frames to work properly.
- **Default values for PC port VID and Phone VID are to be determined.**
- The PC port should be configured for the appropriate port type for the device attached to that port. The table below shows the selection for various types of devices (See “[Guideline for Port Type Selection](#)” on [Page -6](#)).

Table 0-1 Guideline for Port Type Selection

Attached Device	Port Type
PC/Server	Access
PC/Server with IEEE802.1Q compliant NIC	Trunk

PROGRAMMING

IP Telephone (IPT) programming for Virtual Local Area Network (VLAN) tagging may be performed using either IPT “Local Mode” (3-6-9-hold feature) or Enterprise Manager. This procedure is outlined below.

Note: The 3+6+9+Hold procedure is described in [“VLAN Tagging” on page -6](#)

Once the network and VLANs are set up and VLAN IDs are established for the IPTs, setup VLAN parameters using the VLAN Tagging wizard in Enterprise Manager.

CAUTION! When VLAN feature is set to Enable – If the infrastructure is not properly configured, the IPTs will be in a VLAN and remain offline until VLAN is enabled, unless the IPedge system is set to communicate with the VLAN of those IPTs. If your customer does not have this properly configured, **DO NOT ENABLE VLAN** or the system will drop all of the IPTs. This will require manually disabling VLAN at each base station system wide and starting the process over.

1. Select Station > IPT VLAN.

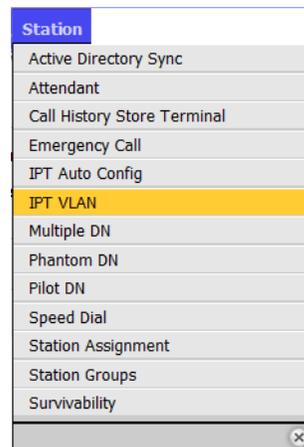


Figure 1 - Station IPT VLAN Drop down Menu

Important! The Administrator must ensure that the VLAN IDs are already configured on all 802.1Q supported switches.

2. Select the appropriate VLAN Directory Number (DN) and corresponding server from the list.
3. Click the Edit icon.



- The VLAN Parameters administration screen displays.

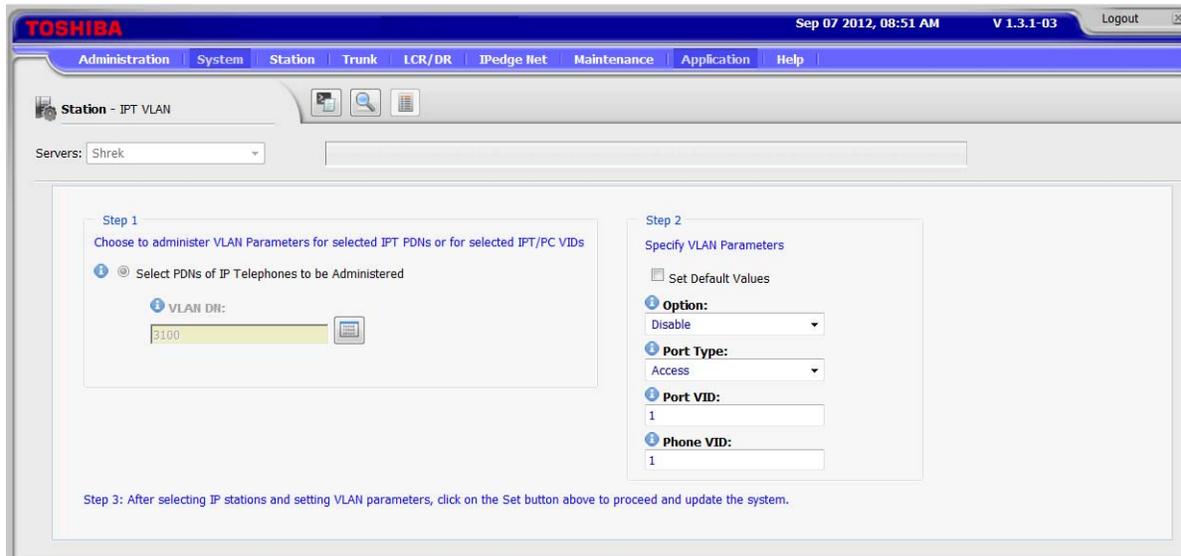


Figure 2 - Station-IPT VLAN Screen

- Click Select IPT DN icon next to the VLAN DN field.



- The IP Station VLAN Dialog box displays. Select a single IP station or multiple stations, then click OK.

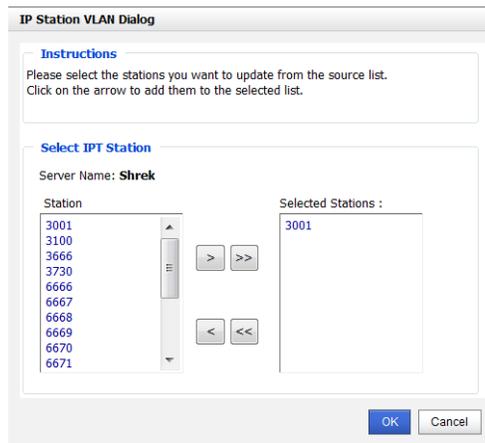


Figure 3 - IP Station VLAN Dialog box

- Select VLAN parameters or check the “Set Default Values” box. This information should be provided by your network administrator.

- VLAN Feature: Enable

Important! When VLAN feature is set to Enable – If the infrastructure is not properly configured, the IPTs

will be in a VLAN and remain offline until VLAN is enabled, unless the IPedge system is set to communicate with the VLAN of those IPTs. If your customer does not have this properly configured, **DO NOT ENABLE VLAN** or the system will drop all of the IPTs. This will require manually disabling VLAN at each base station system wide and starting the process over.

- PC port type: "Access" (assuming other port is PC)
 - "Trunk" for any IPT
 - PC Port VID
 - Phone VID
8. Click the Set button to start the process for setting VLAN tagging. The VLAN Table View may be used to collect information about current IPTs and the related firmware version for VLAN tagging and features.

Note: If the IPT is not in an idle state when the request is submitted (e.g. call processing state, etc.), the request is rejected.

CAPACITY

IPedge

- -EC Server 60200 stations
- -EM Server 1000 stations
- -EP Server 40 stations

VIPedge

- -60 simultaneous calls
- -60 SIP trunk channels on 2 channel groups

AVAILABILITY

- VIPedge systems and IP5000-series telephones

RESTRICTION

- Only operational IP telephones may be configured using Enterprise Manager.
- Automatic tag VLAN configuration is not supported e.g. GVRP (GARP VLAN Registration Protocol).

HARDWARE

- IP5000 Telephones
- IPedge servers
- Ethernet switch supporting 802.1Q VLAN tagging
- 802.1Q compliant routers

FEATURE INTERACTION

Priority Control – IPedge has priority control feature based on 802.1p user priority field. This feature and 802.1Q VLAN tagging share the same tag header.

The table below represents how the tag header in the frames originating from the telephone is encoded based on 802.1Q/p configuration.

Table 0-1 Encoding rules for frames originating from a phone

802.1p	VLAN	Frame type	802.1p User priority	VID
Disabled	Disabled	untagged	N/A	N/A
Enabled	Disabled	priority-tagged	0 (Best effort) or 6 (Voice)	0
Disabled	Enabled	VLAN-tagged	0 (Best effort)	Phone VID (1 ~ 4094)
Enabled	Enabled	VLAN-tagged	0 (Best effort) or 6 (Voice)	Phone VID (1 ~ 4094)

The table below shows how the tag header in the frames received on the Access port (to be transmitted from the Trunk port) is encoded based on IEEE802.1Q/p configuration.

Table 0-2 Encoding rules for frames received on Access port

802.1p	VLAN	Frame type	802.1p User Priority	VID
Disabled	Disabled	untagged	N/A	N/A
Enabled	Disabled	untagged	N/A	N/A
Disabled	Enabled	VLAN-tagged	0 (Best effort)	PVID of Access port (1 ~ 4094)
Enabled	Enabled	VLAN-tagged	0 (Best effort)	PVID of Access port (1 ~ 4094)