

Profibus & Profinet in Factory Automation

Using Industrial Ethernet Networks for

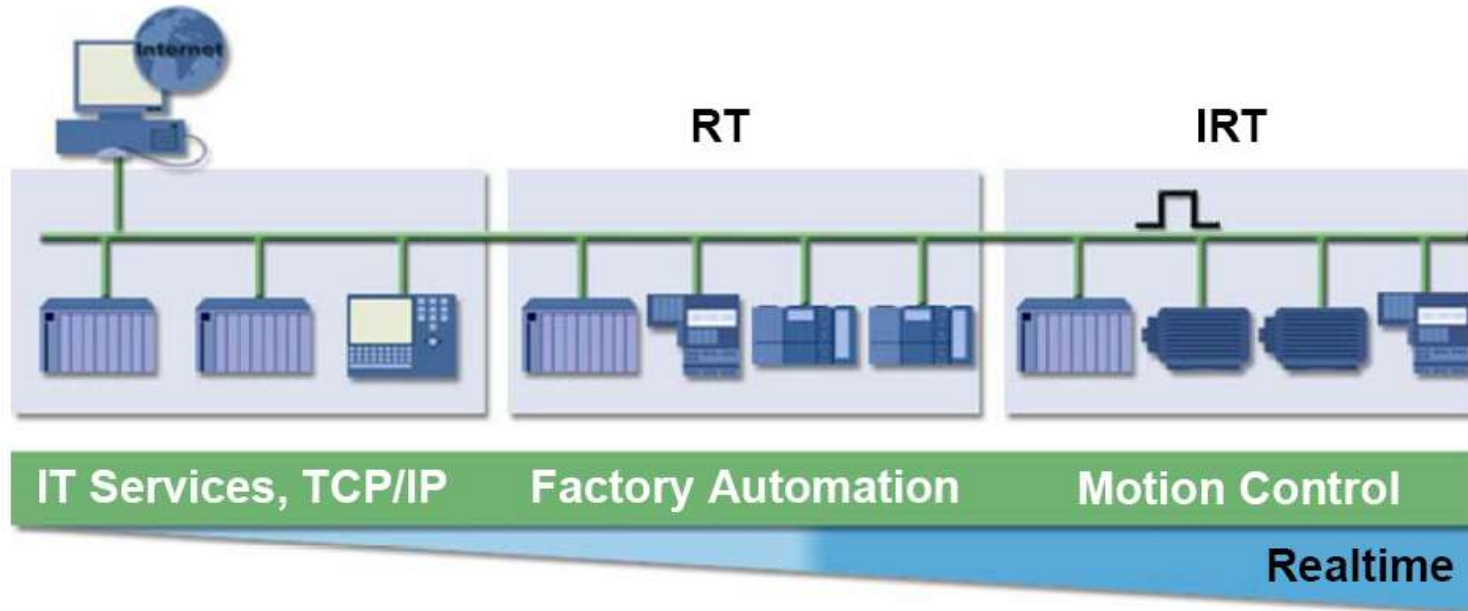


Alan Bollard

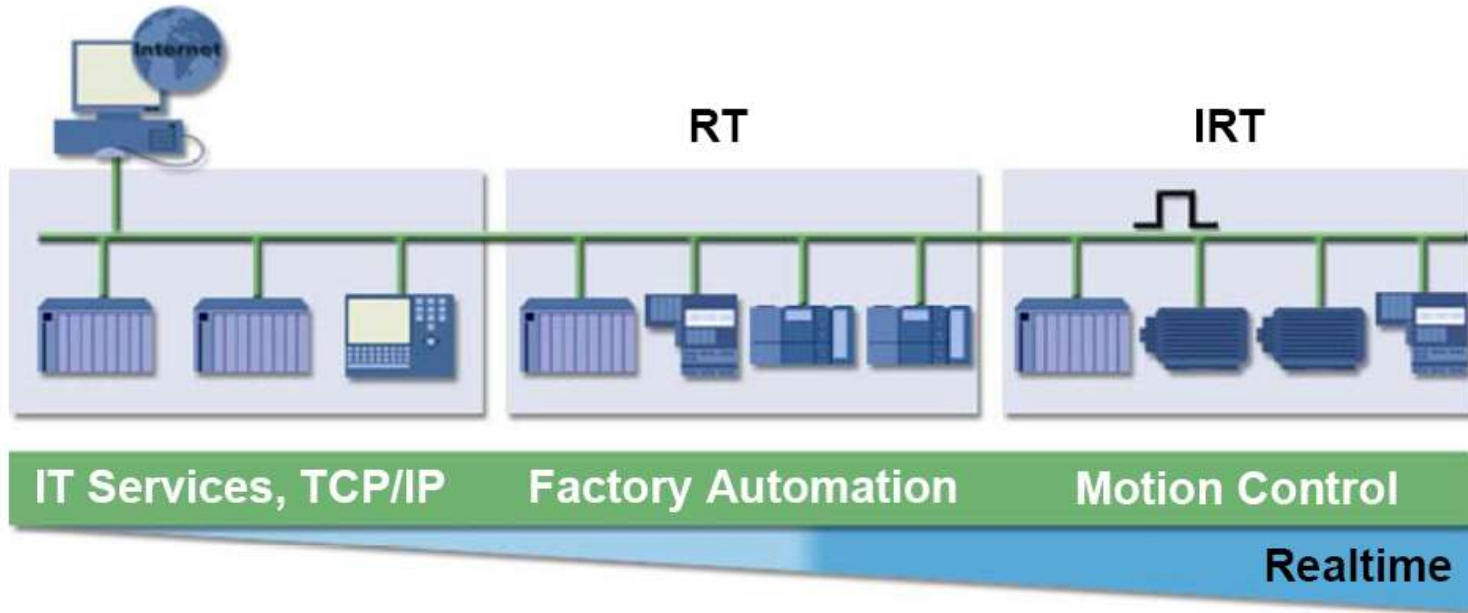
Managing Director

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Can I use ordinary Ethernet Switches for Profinet?



Profinet communications use IEEE 802.3 Ethernet packets
Profinet can be used for many different applications



IT Communications

RT – Real Time

IRT – Isochronous Real Time

<100ms cycle

<10ms cycle, low jitter

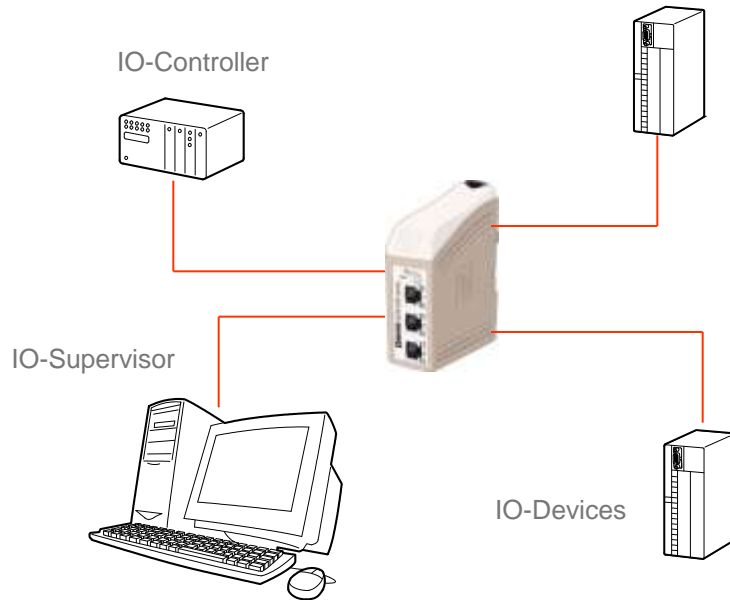
<1ms, less <1uS jitter

Standard Switches

Standard Switches

Special Switches

Any simple unmanaged switch can be used to create a Profinet IO network



Except very old types – Switch must be transparent to large frames

Standard Ethernet Packets have a maximum length on 1518 bytes

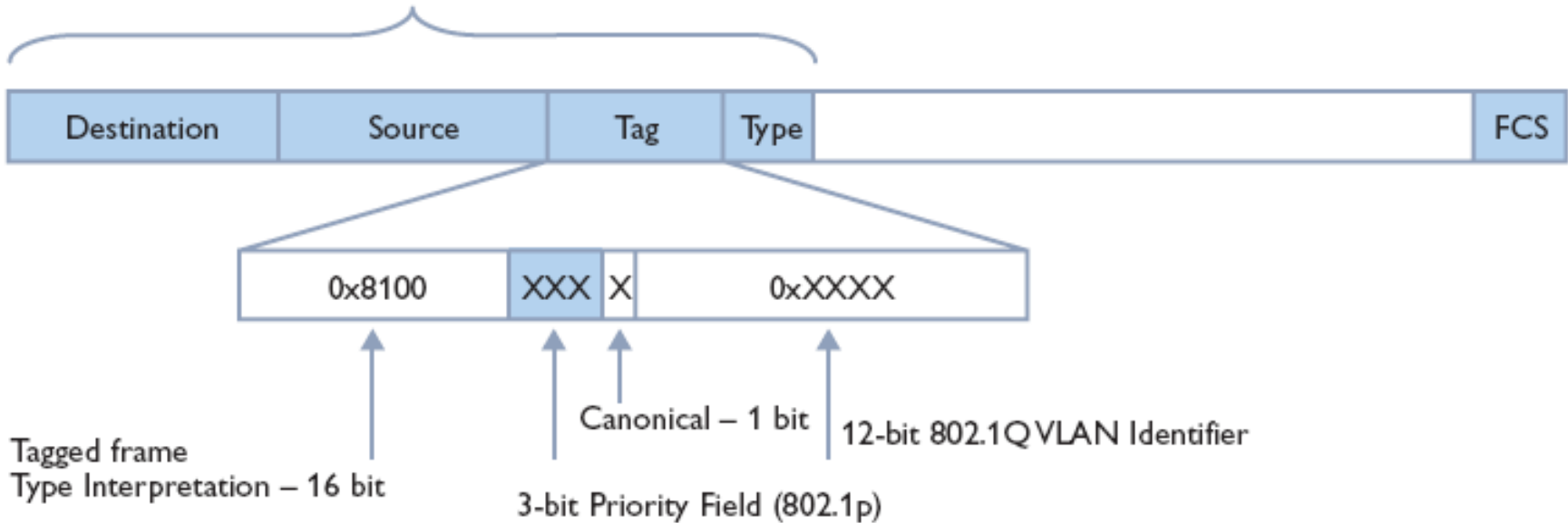


A switch is a store and forward device – all packets received are checked before forwarding

Any packet greater than the maximum length will be rejected

Profinet IO uses the IEEE 802.1Q packet structure

Layer 2 priority with 802.1p



Priority field – 0-7 : Profinet uses level 6

Type field for Profinet 0x8892

Packet sizes can now reach 1522 bytes

Priority	Traffic Type
0	Best Effort
1	Background
2	Spare
3	Excellent Effort
4	Controlled Load
5	Video
6	Voice
7	Network Control



Type field indicating 802.1Q

Priority Tag

VLAN ID

Type Field indicating Profinet

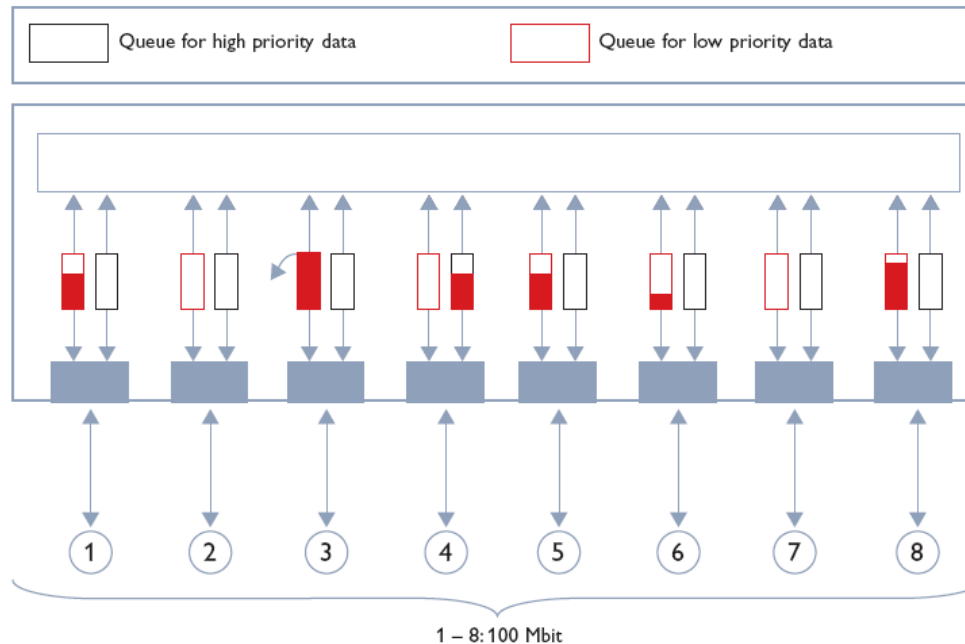
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Frame 23 (64 bytes on wire (64 bytes captured)
Arrival Time: Mar 16, 2006 21:08:09.415475000
Time delta from previous packet: 0.126966000 seconds
Time since reference or first frame: 9.698024000 seconds
Frame Number: 23
Packet Length: 64 bytes
Capture Length: 64 bytes
Protocols in frame: eth:vlan:pn_rt:pn_io
Ethernet II, Src: 192.168.0.100 (08:00:06:6b:a5:2d), Dst: 192.168.0.101 (08:00:06:6b:f9:81)
Destination: 192.168.0.101 (08:00:06:6b:f9:81)
Source: 192.168.0.100 (08:00:06:6b:a5:2d)
Type: 802.1Q Virtual LAN (0x8100)
802.1Q Virtual LAN
110. .... = Priority: 6
...0 .... = CFI: 0
... 0000 0000 0000 = ID: 0
Type: PROFINet (0x8892)
PROFINET cyclic Real-Time, RTC1, ID:0xc000, Len: 40, Cycle:16384 (Valid,Primary,Ok,Stop)
FrameID: 0xc000 (0xC000-0xFAFF: Real-Time(class=1): Cyclic)
CycleCounter: 16384
DataStatus: 0x25 (Frame: Valid and Primary, Provider: Ok and Stop)
00. .... = Reserved (should be zero): 0x00
...1. .... = StationProblemIndicator (1:Ok/0:Problem): 0x01
...0 .... = ProviderState (1:Run/0:Stop): 0x00
... 0... = Reserved (should be zero): 0x00
... 1... = DataValid (1:Valid/0:Invalid): 0x01
... 0.0. = Reserved (should be zero): 0x00
... ..1 = State (1:Primary/0:Backup): 0x01
TransferStatus: 0x00 (OK)
PROFINET IO Cyclic Service Data Unit: 40 bytes
IOxS: 0x00 (bad)
... ..0 = Extension (1:another IOxS follows/0:no IOxS follows): 0x00
...0 000. = Reserved (should be zero): 0x00
...00. .... = Instance (only valid, if DataState is bad): detected by subslot (0x00)
0... .. = DataState (1:good/0:bad): 0x00
Data: 39 bytes (including GAP and RTCPadding)
0000 08 00 06 6b f9 81 08 00 06 6b a5 2d 81 00 c0 00   ...k.....k.-....
0010 88 92 c0 00 00 00 00 00 00 00 00 00 00 00 00   .....
0020 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00   .....
0030 00 00 00 00 00 00 00 00 00 00 00 00 40 00 25 00   .....@.%

```

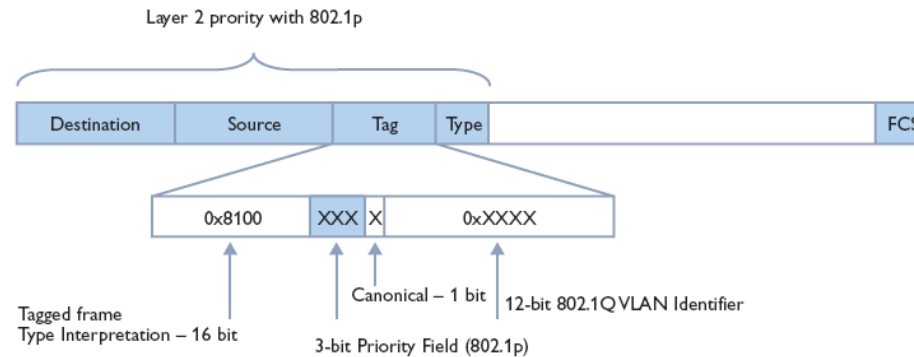
In order to effectively use prioritisation the switch must support 802.1Q

Normally this is a function available in managed switches



To utilise the prioritisation Ethernet switches must have a number of priority queues

On busy networks where ports can have different bandwidths Head of Line Blocking (HOL) Prevention is important
High priority packets can get stuck in the input buffer



Because Profinet uses 802.1Q there must be a VLAN identifier

A Virtual LAN allows one physical network to become a number of virtual networks

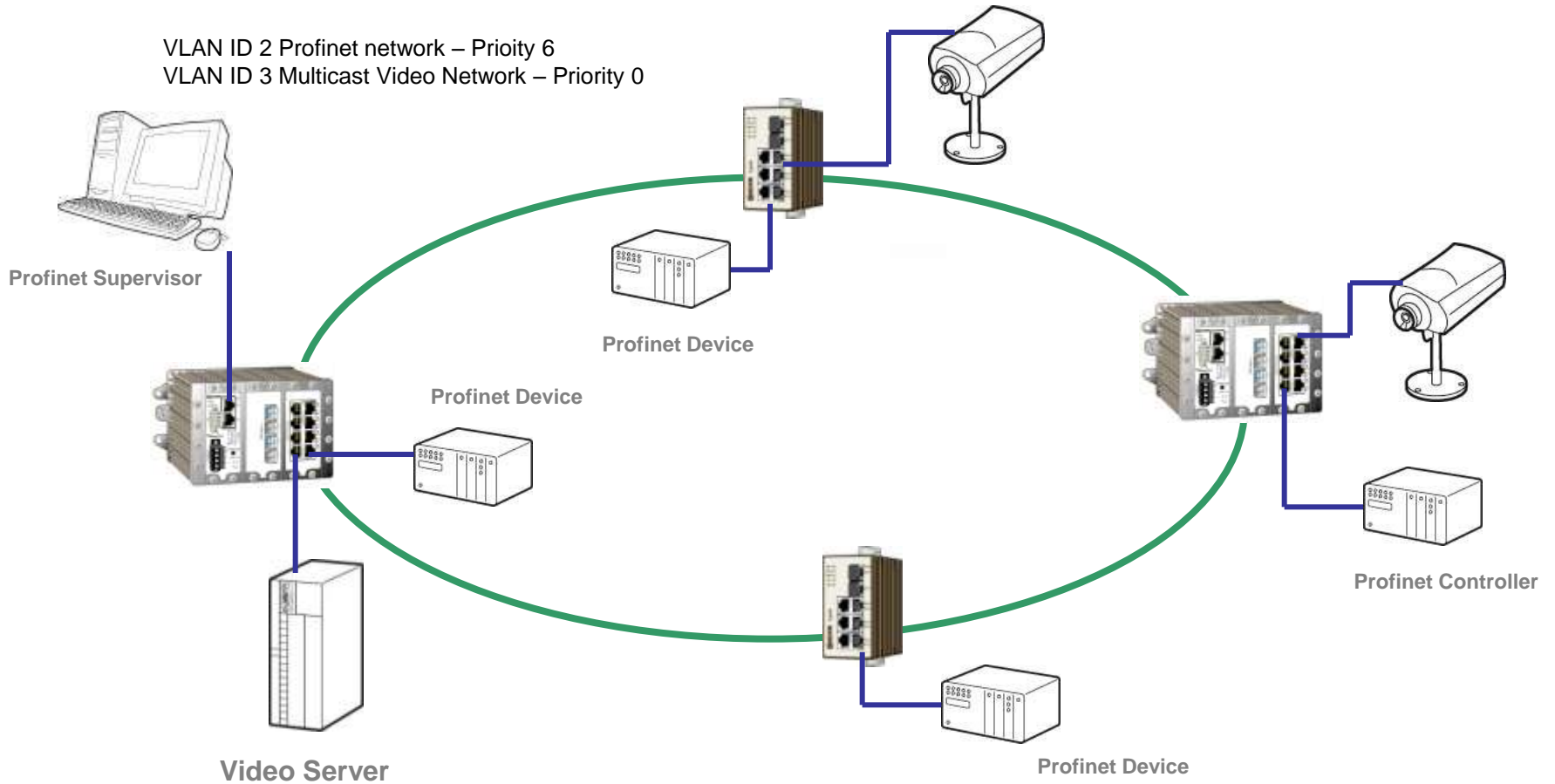
Virtual LANs are used for security and bandwidth management

If a switch port is set up to support a particular VLAN ID only traffic destined for that VLAN will be passed to that port.

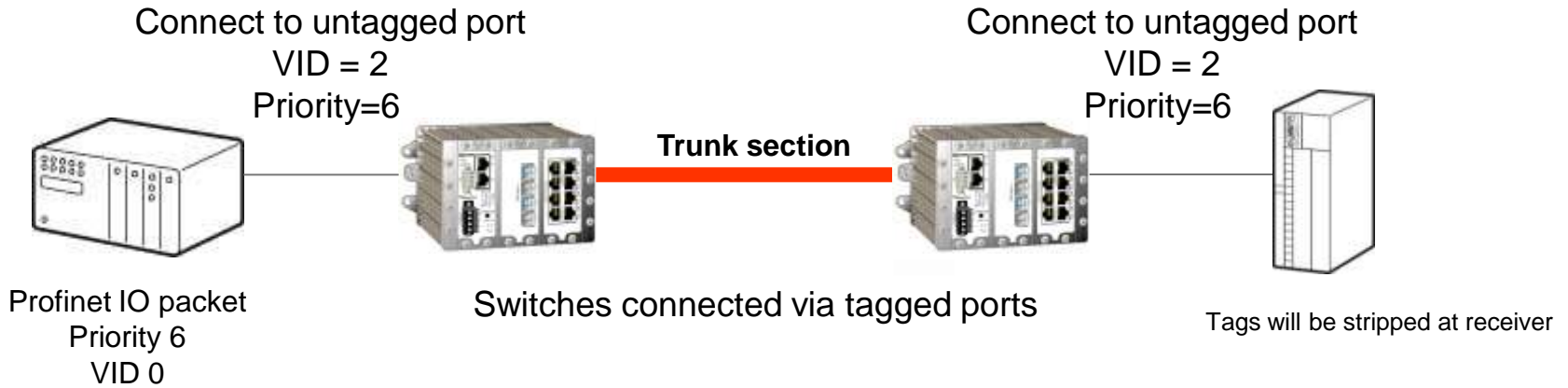
If Profinet is required to operate within a VLAN environment the Identifier can be set by the switch

Example of Shared Network

VLAN ID 2 Profinet network – Priority 6
VLAN ID 3 Multicast Video Network – Priority 0



Use of VLANs ensures no multicast flooding of Profinet devices



vlan2

VID	2								Slot 1
Enabled	<input checked="" type="checkbox"/>								
Name	vlan2								
Priority	6								
IGMP	<input checked="" type="checkbox"/>								
	Port	1/1	1/2					Slot 2	
	Tagged	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>						
	Untagged	<input type="checkbox"/>	<input type="checkbox"/>						
	Forbidden	<input type="checkbox"/>	<input type="checkbox"/>						
	Port	2/1	2/2	2/3	2/4	2/5	2/6	2/7	2/8
	Tagged	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
	Untagged	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>
	Forbidden	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

- Data entering an untagged port has a VLAN tag added,
- Data entering a Tagged port should be Tagged
- Data leaving an untagged port will have its tag removed

Apply Cancel

Simple Profinet IO networks can be run using ordinary unmanaged switches.

To ensure real time performance on shared networks the Ethernet switch must support 802.1Q with strict priority queues

If IRT is to be used only use specially designed switches

If VLANs are to be used, switches must be set up correctly