RedFox

The Industrial Routing Switch

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Westermo Worldwide...

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Specifications are subject to change without notice due to continuous product development and improvement.

Westermo was established in the early 1970s. The head office is located 150 km (93.2 miles) southwest of Stockholm in Sweden. Over the past three decades Westermo has grown with subsidiaries being established in Sweden, UK, Germany, France, Singapore and sales partners appointed in over 30 Countries worldwide.

Today the Westermo brand name is synonymous with Robust Industrial Data Communications.

Our 35 years of experience in the industrial marketplace goes far beyond our own products. We understand the problems that can occur in applications installed in the toughest industrial environments and therefore we can offer you the most effective and economical solutions.

All our products are specifically designed to operate reliably in harsh industrial environments and in applications requiring the highest levels of reliability and availability.

Let Westermo be your first choice for robust industrial data communication solutions.

RedFox –
The Industrial Routing Switch

The RedFox is a high performance industrial Ethernet switch with enhanced routing functionality, in a single robust unit. A single RedFox allows you to build cost effective, secure and reliable networks that would previously have required several different units. The feature-rich firmware and highly specified hardware provide flexibility and enhanced performance when building complex networks.

For mission critical applications our unique FRNT technology is the fastest protocol on the market for re-configuring large networks in the event of link or hardware failure. Gbit support on ring as well as drop ports along with bandwidth control techniques like VLANs and IGMP snooping allow RedFox to be optimised to perform with even the most bandwidth hungry applications such as video.

Advanced routing functions and firewall settings allow the RedFox to segregate networks and ensure that mission critical industrial networks are protected. The RedFox is also able to provide secure remote access to these networks across insecure connections by acting as a VPN endpoint.

The RedFox Team

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Proven Robust Design

Lennart Liljeström
Hardware Architect

"Designing a product to function in the most testing environments is a tough challenge, but the applications where RedFox has already been used proves how robust the product really is."

The RedFox was initially developed for a number of extreme applications in the defence, rail, aerospace and sub-sea markets. The resulting new product, RedFox Industrial, is thus based on a proven design that far exceeds normal industrial requirements. The RedFox technology has therefore been tested to the limit on mission critical applications for a number of years.

The ultra robust RedFox has a heavy-duty aluminium enclosure for maximum strength and heat dissipation with fixings to allow the unit to be mounted on a DIN rail or be connected directly onto a wall. This rugged casing also makes the unit resilient to extreme levels of electromagnetic interference.

The design of the electronics is critical to ensure long life in extreme operating environments. Only industrial grade components are used which gives the RedFox an MTBF of 600 000 hours. The designers were also careful to avoid fragile or sensitive components to ensure the PCBs could withstand significant shock and vibration testing. As well as all this the hardware is designed and tested to dissipate heat so effectively that the operating temperature specification of –40°C to +70°C is achieved with no internal fans.

The isolated power supply has an operating voltage range spanning from 16 VDC to 60 VDC and can be fed from two separate supplies of differing voltages making RedFox easy to power in the industrial environment as well as providing yet another level of resilience to the user.

A powerful industrially rated CPU and ECC internal memory have also been specified to ensure ultimate reliability. All these features ensure that RedFox can be used in just about any operating environment.

Extensive Standard Compliance

Westermo have always designed equipment for industrial environments. More than 30 years of experience in this area has taught us how to design our products to function in the most severe operating conditions.
The RedFox has gone through extensive testing both by Westermo and approved test houses. The units are designed and type tested based on:

- Electromagnetic Compatibility, EMC (2004/108/EC)
- Immunity for residential, commercial and light-industrial environments (EN 61000-6-1)
- Immunity for industrial environments (EN 61000-6-2)
- Emission standard for industrial environments (EN 61000-6-4)
- Information technology equipment – Immunity (EN 55024)
- Railway applications – Electromagnetic compatibility – Emission and immunity of the signalling and telecommunications apparatus (EN 50121-4)
- Radio frequency devices (FCC part 15 Class A)
- MTBF calculated according to MIL-HDBK- 217F
- Degree of protection according to IEC529 (IP)
- Isolation test, all interfaces tested according to EN60950
- Vibration test according to IEC 60068-2-6
- Shock test according to IEC 60068-2-27
- Temperature / Humidity / Altitude according to Westermo environmental specifications.

Pierre Öberg
R&D manager

"In today's world meeting the specifications for particular industries is vital, it has always been our goal to ensure RedFox could meet the toughest environmental standards."

This room is ideally suited for measuring emissions as the cone shape structure provides absolute electromagnetic silence.

Routing for Industrial Applications

Bo Jansson
Product Manager

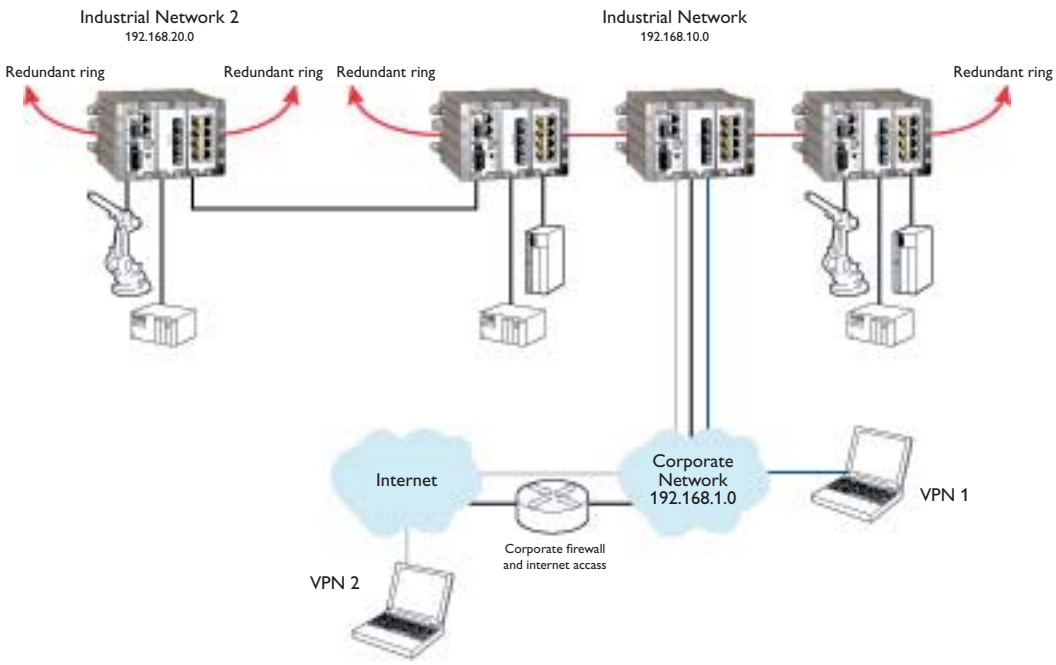
"It has become clear that the next generation of industrial switches must support routing functionality to be able to cope with the latest market requirements."

As well as being a state of the art layer 2 switch RedFox also doubles up to provide router functionality. Routing is becoming an essential function for infrastructure and factory automation networks. These networks are becoming more complicated with the boundary between LAN and WAN becoming less clear making security and network segmentation critical.

Providing static routing and firewall functions the RedFox can become the boundary between different networks providing simple segregation to ensure dataflow is controlled between networks and accidental as well as deliberate data incursions are prevented.

The RedFox is an ideal solution to isolate the corporate IT environment from an industrial automation network where there are sharply differing requirements. Not only can the RedFox form part of an FRNT redundant ring in the automation network it can also act as firewall to the corporate network. If, as is often the case the corporate network is connected to the Internet then the ability of RedFox to act as a VPN end point allows engineers the ability to remotely and securely access the automation network from anywhere in the world.

RedFox also supports Network Address Translation (NAT) and port forwarding, so could also be used as the boundary between public IP addresses on the Internet and hidden private IP addresses in a local secure network.



Complex Industrial Networks

Industrial networks have particular requirements that make them differ from normal IT networks. Network resilience is critical with downtime of even a fraction of a second being an issue. RedFox supports STP (Spanning Tree Protocol) and RSTP (Rapid STP), but also FRNT (Fast Reconfiguration of Network Topology) our own unique protocol that provides almost seamless network reconfiguration.

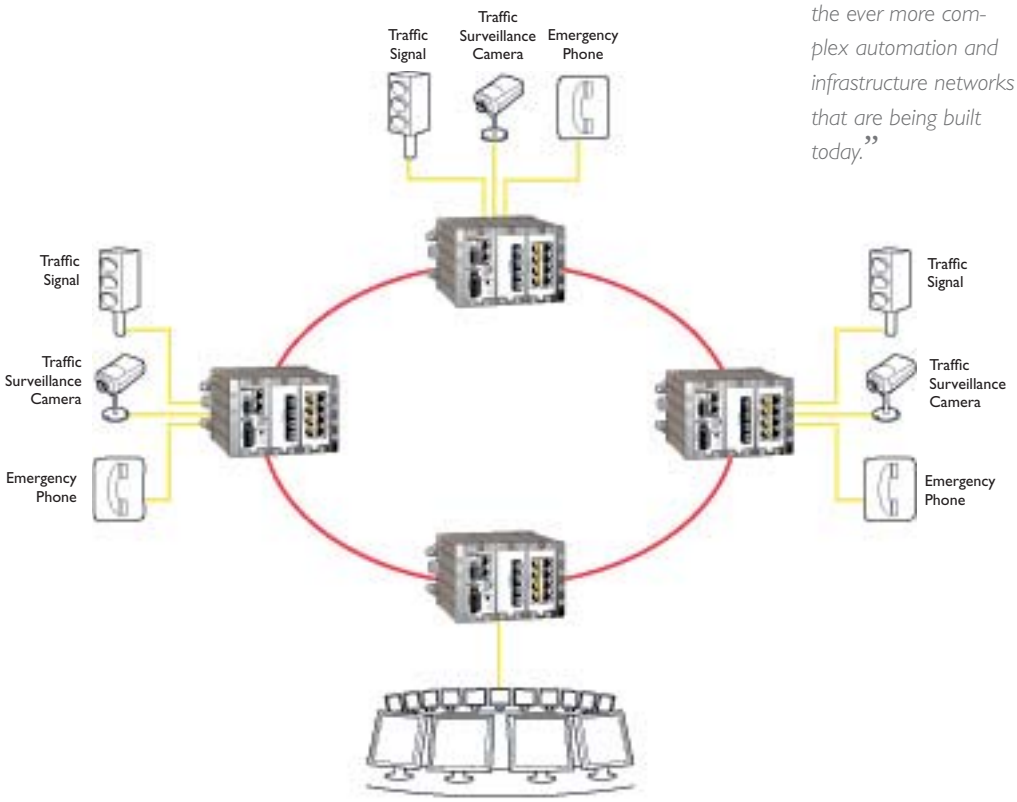
The industrial environment can also see unusual volumes of certain types of data, for instance multicast packets are common in IP based industrial automation protocols and video applications. This class of traffic can cause significant problems with switches and even worse problems with ring redundancy, so RedFox supports IGMP Snooping with special extensions for FRNT.

Virtual LANs have now become vitally important in segregating networks and RedFox offers advanced VLAN support allowing data traffic to be segmented at a port level and via VLAN tagging.

Industrial applications often demand real-time class communications and RedFox offers switching functions that can ensure Ethernet can be used in all but the most rigorous real time applications. Methods to prioritise packets based on Layer-2 and Layer-3 information are supported as well as techniques such as head of line blocking prevention to stop data bottlenecks developing in the network.

Dr. Jon-Olov Vatn
Communication Design Architect

"We have developed unique functionality like FRNT and implemented IGMP Snooping and VLANs to ensure that RedFox can operate in the ever more complex automation and infrastructure networks that are being built today."



Up to 8 Gbit ports, or up to 18 Fast Ethernet ports.

Network Security

Raimo Haukilahti
Project manager

"The kinds of networks that RedFox has been designed to run in are mission critical therefore it is vital that we can provide security to prevent both malicious and accidental network failures."

Today with the advent of the Internet most networks are in some way connected together. Although this makes it possible to communicate freely across the world and to have access to any information you need at your fingertips it also creates great risk. When we use our networks to control important manufacturing processes, monitor water levels in reservoirs or run our power stations we can not afford to allow unauthorised users access to these networks. It is not just malicious incursions that must be prevented; statistically more networks are compromised by accidental means. To prevent this from happening RedFox offers several layers of security.

RedFox itself has an inbuilt firewall so can be used as a barrier between internal departments of a company or as a barrier to the Internet.
Traffic crossing this threshold can be carefully controlled to protect the mission critical network.

If NAT (Network Address Translation) is used RedFox will hide the IP address of any device in the protected network whilst it communicates with device in an unsecured network meaning that the IP address of a particular device can never be found and attacked.

RedFox can act as a VPN server allowing IPsec tunnels to be set up between remote users and a local secure network. RedFox can encrypt the data packets using 256 bit AES – a level that to date has not been cracked.

Even with these levels of security it is critical that management of RedFox can not be compromised to allow other security features to be changed or the network to be maliciously reconfigured. To this end it is possible to disable the web configuration pages and SNMP if necessary. The CLI is secured using SSH (Secure Shell Protocol) so it is encrypted between the management station and switch.

Network Configuration – *Made Easy*

One of Westermo's clear mission statements is Industrial Data Communications 'Made Easy' which is why huge effort has been made to make the RedFox easy to use. The RedFox is a state of the art Layer2 switch which means that it actually needs no configuration out of the box to allow a simple network to be created.

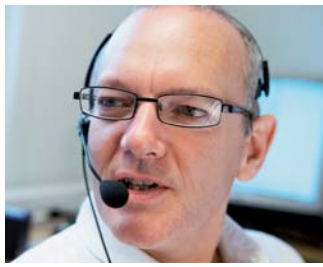
The next level of configuration is our auto-discovery IP-Config tool that allows the IP address, subnet mask and gateway address to be set up. Once the IP address is set then the easy to use web interface allows you to set up many of the most common configurations in just a few minutes. An FRNT ring, VLANs or a basic firewall are only a few clicks away.

The RedFox is a powerful device and is capable of being finetuned for the most rigorous applications. This tuning is achieved using the RedFox Command Line Interface (CLI), which has been developed to be as intuitive as possible.

Building up a live configuration is often difficult in complex networking devices where a reboot is often necessary to test a new function. The RedFox has been developed to allow 'running changes' which means that fine tuning can be achieved quickly and with the option to revert back to the start point at any time. Once the optimum solution is proved this can be saved as the boot configuration so that when ever the unit is re-powered it will revert to those settings.

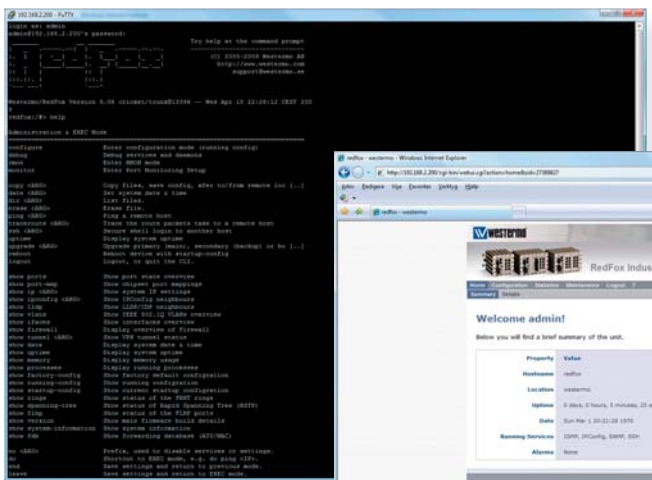
RedFox features USB port that can access a standard memory stick so a copy of the operating configuration can be backed up and reloaded into a replacement RedFox to allow quick and simple maintenance by unskilled staff.

RedFox is designed to form part of significant multi-vendor networks that will often need to be centrally managed. RedFox fully supports SNMP (Simple Network Management Protocol) hence providing yet another way for it to be configured and monitored.

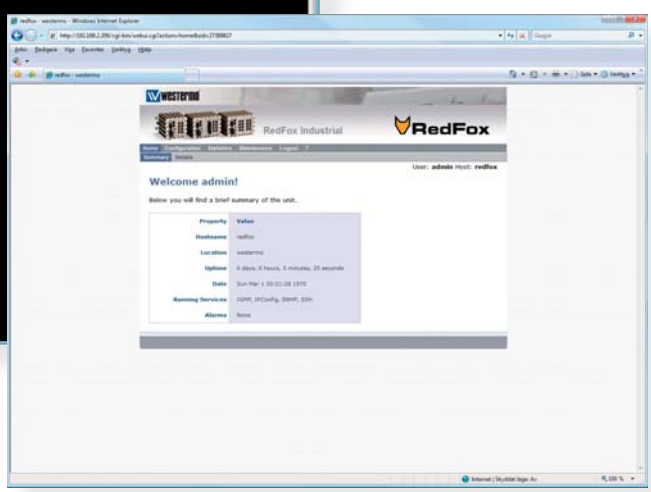


Ray Lock
Technical Director

"The RedFox multilayered configuration ensures that when you first start to use the product there are simple and intuitive tools, but once you become familiar with the product the CLI gives you amazing flexibility to be able to fine tune."



RedFox Command Line Interface



RedFox Graphical User Interface

RedFox Industrial Series for Extreme Environments

The RedFox Industrial includes a collection of high performance industrial Ethernet switches with enhanced routing functionality designed to build cost effective, secure and reliable networks. The product range offers a number of Ethernet interface combinations, which gives you the ability to select the perfect routing switch for your application providing optimum functionality at the best value.

Ethernet technologies	IEEE 802.3 for 10BaseT
	IEEE 802.3u for 100BaseTX and 100BaseFX
	IEEE 802.3ab for 1000BaseT
	IEEE 802.3z for 1000BaseX
Resiliency and high availability	Fast Reconfiguration of Network Topology (FRNT)
	FRNT Link Health Protocol (FLHP)
	IEEE 802.1D Spanning Tree Protocol (STP)
	IEEE 802.1w Rapid STP (RSTP)
Layer-2 Switching	IEEE 802.1Q Static VLAN and VLAN Tagging
	IEEE 802.3x Flow Control
	IGMPv2/v3 snooping
Layer-2 QoS	IEEE 802.1p Class of Service Flexible classification (VLAN tag, VLAN ID, IP DSCP/ToS, Port ID)
IP Routing and Firewall	Static IP routing
	Firewall, NAT, Port Forwarding
Manageability	Management interfaces • *Web interface* • *Command Line Interface (CLI) via console port and SSHv2* • *Westermo IPConfig tool* Syslog SNMPv1/v2c SNMP MIB support • *RFC1213 MIB-2* • *RFC2863 Interface MIB (ifXTable)* • *RFC2819 RMON MIB (etherStatsTable)* • *RFC4188 Bridge MIB* • *RFC4318 RSTP MIB* • *RFC4363 Q-BRIDGE MIB (dot1qVlan and dot1qVlanStaticTable)* • *RFC4836 MAU MIB (dot3IfMauBasicGroup and dot3IfMauAutoNegGroup)* • *RFC4133 Entity MIB (entityPhysical)* • *WESTERMO PRIVATE MIB* SNTP client DHCP client DHCP server Digital I/O Port Monitoring IEEE 802.1ab Link Layer Discovery (LLDP)

RFI-10

Port configuration:

10 x 10/100/BaseTX

RFI-18

Port configuration:

18 x 10/100/BaseTX

RFI-14-F4G

Port configuration:

10 x 10/100/BaseTX

4 x SFP, Gbit support*

RFI-18-F4G-T4G

Port configuration:

10 x 10/100/BaseTX

4 x SFP, Gbit support*

4 x 1000BaseTX

** SFP transceivers are purchased separately. See page 18 for more information on available transceivers.*

The Industrial
for Extreme

POWERFUL CPU

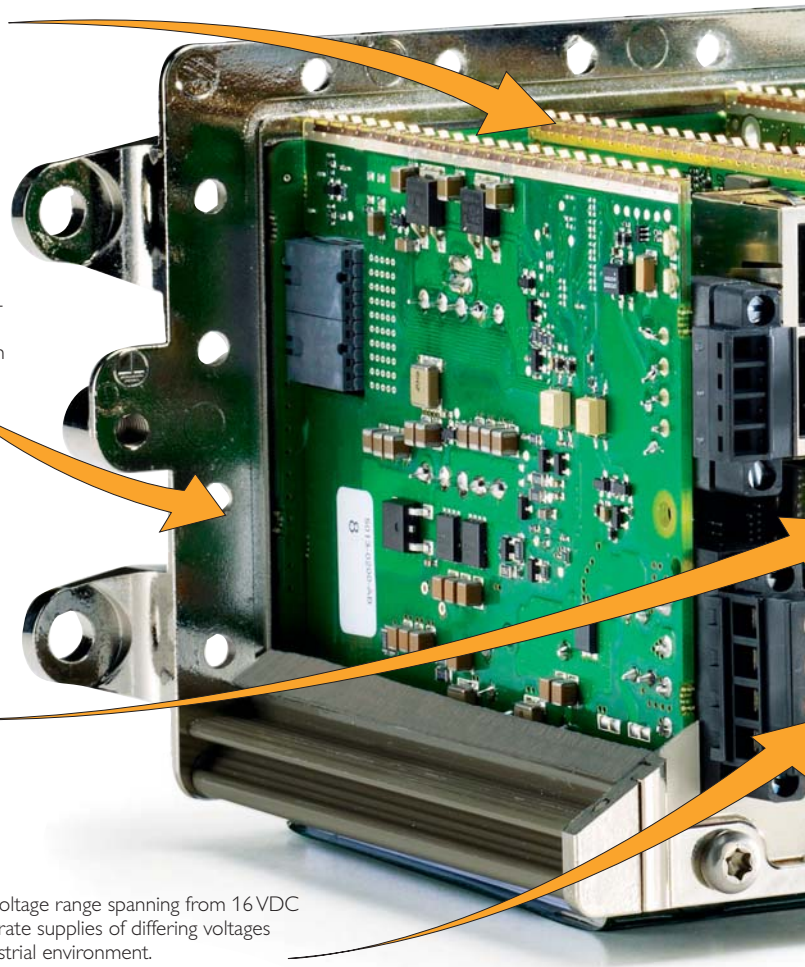
An industrially rated CPU and ECC internal memory have been specified to ensure ultimate reliability.

ROBUST DESIGN

Heavy-duty aluminium enclosure for maximum strength and heat dissipation with fixings to allow the unit to be mounted on a DIN rail or be connected directly onto a wall.

SIMPLE BACKUP

USB port that can access a standard memory stick to allow quick and simple operating configuration back up.



WIDE INPUT RANGE

Isolated power supply with an operating voltage range spanning from 16 VDC to 60 VDC and can be fed from two separate supplies of differing voltages making RedFox easy to power in the industrial environment.

RFI-10
10 x 10/100/BaseTX

RFI-18
18 x 10/100/BaseTX

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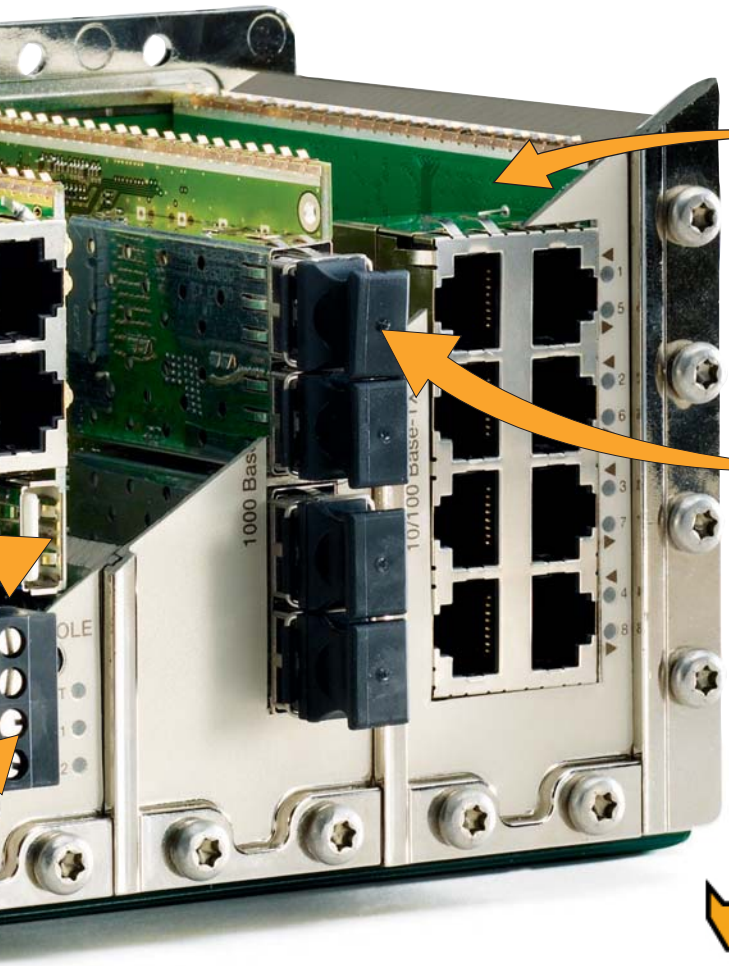
Routing Switch
Environments



EMC IMMUNITY

The rugged casing makes the unit resilient to extreme levels of electromagnetic interference.

HIGH-SPEED

Gbit support on ring as well as drop ports along with bandwidth control techniques allow RedFox to be optimised to perform with even the most bandwidth hungry applications.

Scale 1:1

RedFox
www.redfoxindustrial.com

RFI-14-F4G
10 x 10/100/BaseTX
4 x SFP, Gbit support

RFI-18-F4G-T4G
10 x 10/100/BaseTX
4 x SFP Gbit support
4 x 1000BaseTX

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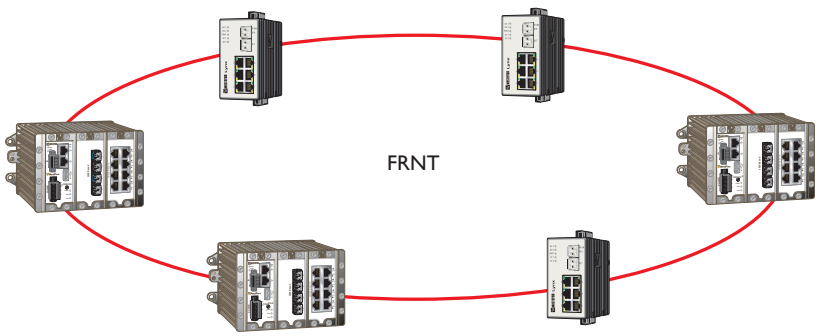
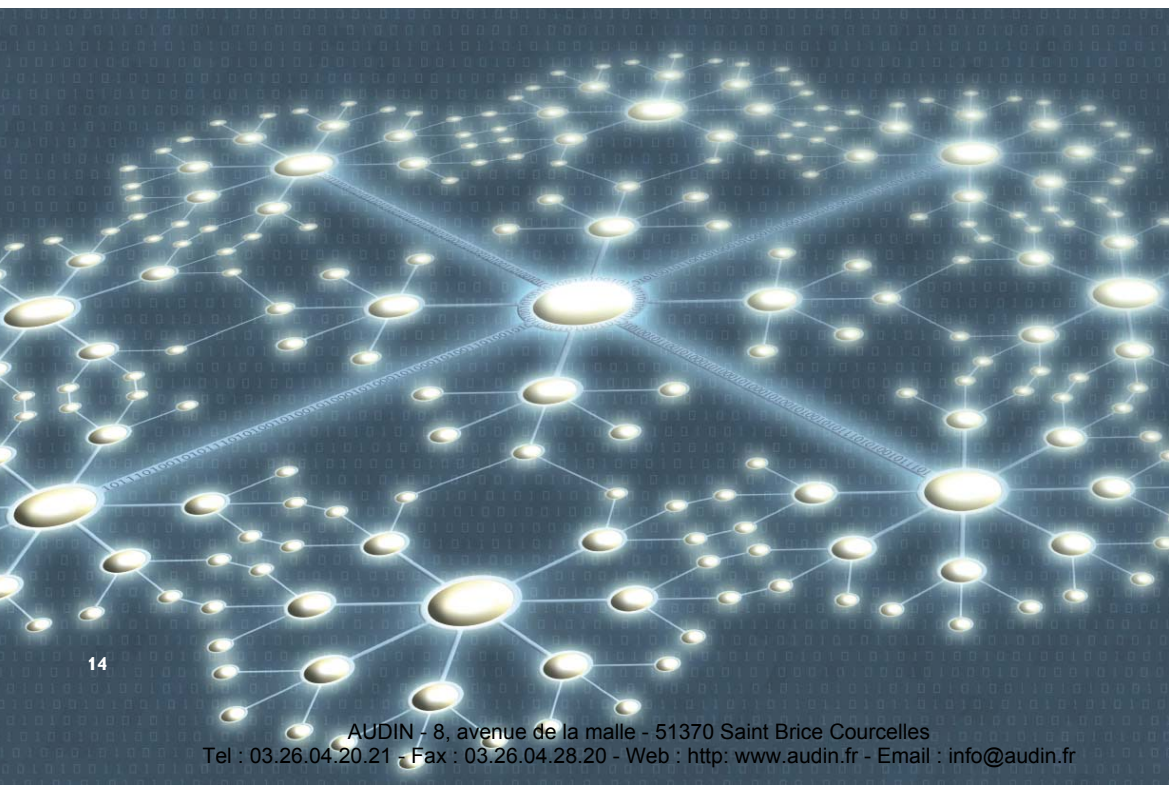
FRNT and Redundancy (Fast Recovery of Network Topology)

Our unique FRNT technology is the fastest network recovery protocol on the market. FRNT is able to reconfigure a redundant ring network consisting of up to 200 switches within 20 ms of the initial failure, regardless of network load. FRNT is a protocol supported by other Westermo switches like the Lynx, Wolverine and Viper series meaning that different types of Westermo switch can be configured in the ring.

To provide compatibility with industry standard redundancy protocols the RedFox also supports STP and RSTP.



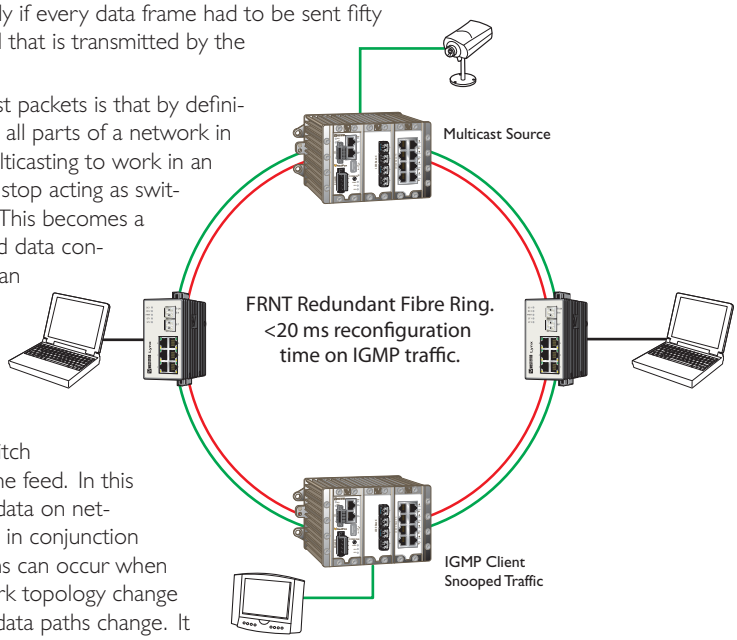


IGMP
(Internet Group Management Protocol)

Multicast data packets are the perfect way to transmit data to multiple 'consumers' on a network. If for instance fifty users wish to view a video feed it would congest a network completely if every data frame had to be sent fifty times. A single multicast packet is all that is transmitted by the data 'producer'.

The problem however with multicast packets is that by definition they must be made available to all parts of a network in case they are required. To allow multicasting to work in an Ethernet network, switches have to stop acting as switches and pass the data to all ports. This becomes a huge problem if there are low speed data connections in your network as these can become flooded with potentially unwanted traffic.

IGMP Snooping is a method that actually "snoops" or inspects IGMP traffic. The protocol will only enable multicast streams to switch ports that have requested to 'join' the feed. In this way switches can control multicast data on networks. When using IGMP Snooping in conjunction with redundancy protocols problems can occur when a network reconfigures. The network topology change by definition means that the IGMP data paths change. It is for this reason that Westermo have closely integrated our IGMP solution with FRNT to ensure that these delays do not occur.



VLAN
(Virtual LAN)

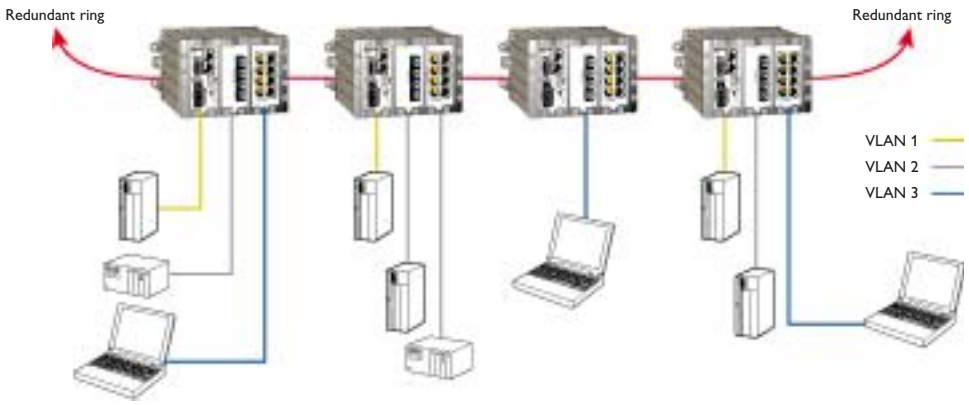
RedFox features comprehensive VLAN support. This technique allows a large physical switched network to be divided into smaller more manageable logical networks or VLANs.

This has a number of benefits including increased security, increased network bandwidth and improved manageability.

RedFox allows VLANs to be allocated to particular switch ports meaning that access to certain network services can be restricted. This can be beneficial for security purposes but also it allows certain high bandwidth protocols to be isolated from the rest of the network.

By subdividing the physical network into VLANs broadcast traffic can be controlled within separate networks thus preventing broadcast storms affecting the whole network.

As VLANs can be centrally configured it is possible for a network manager to reconfigure a badly performing network centrally rather than having to physically plug and unplug cables out in the field.



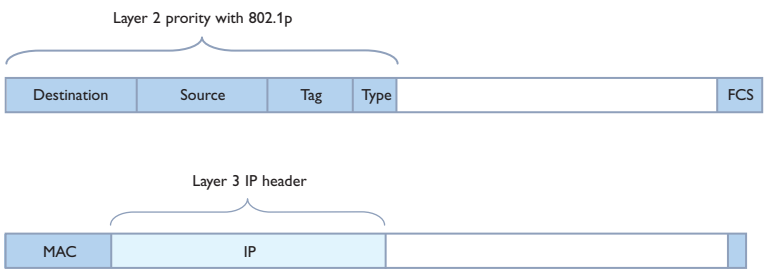
Real-Time Ethernet

Ethernet through its design is not deterministic, i.e. you cannot guarantee the transfer time of a data packet from one occasion to another. A switched network is subject to delays, which can vary from 10 µs to several ms due to the load, speed of the drop link, packet size, switch architecture and the number of switches between the server and client.

This previously made it impossible to use Ethernet for real time applications, such as motion control or highly complex industrial processes. These applications are now within the scope of RedFox.

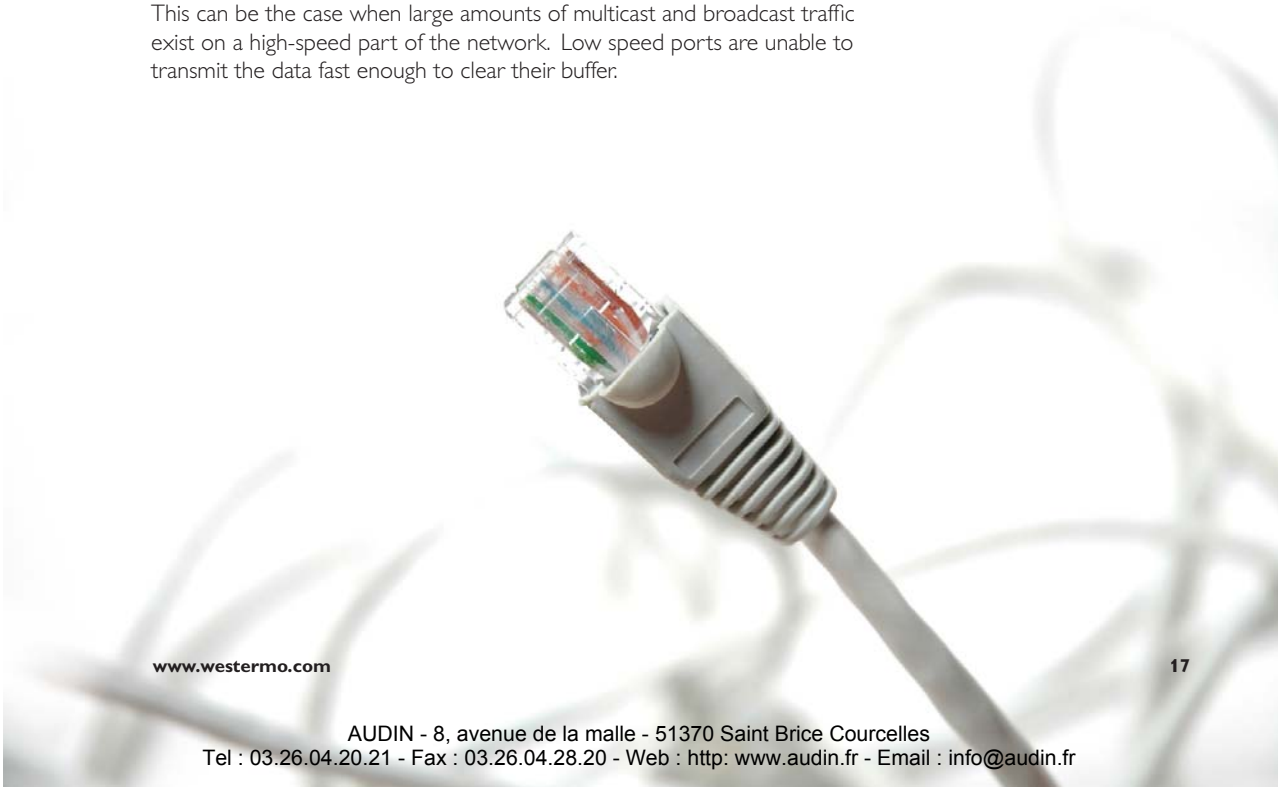
Prioritisation (QoS, Quality of Service)

RedFox contains four priority queues per port, where the queue handling is based on strict priority scheduling in order to offer maximum determinism for real time critical and latency sensitive data. This means that high priority data always has preference over low priority data. Priority is accomplished through layer 2 tagging based on IEEE802.1p and/or layer 3 based on IP ToS.



Head of Line blocking prevention

Head of line blocking prevention ensures that the switch does not become congested due to bottlenecks on a port caused by a highly loaded network. This can be the case when large amounts of multicast and broadcast traffic exist on a high-speed part of the network. Low speed ports are unable to transmit the data fast enough to clear their buffer.

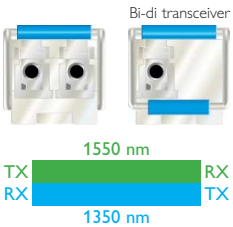


Transceivers

Westermo offer a wide selection of Small Form Pluggable (SFP) transceivers for use with RedFox. The table below shows the standard selection of these transceivers offering transmission ranges from 2 km to 80 km over fibre. The CX module allows SFP ports to be used for copper connection.

LC-Connector
Duplex connector used for single- or multimode cables.

SFP Transceiver
The SFP-transceiver (Small Form-Factor Pluggable), provides huge flexibility in port configuration.
The LC connector is the preferred fibre termination.



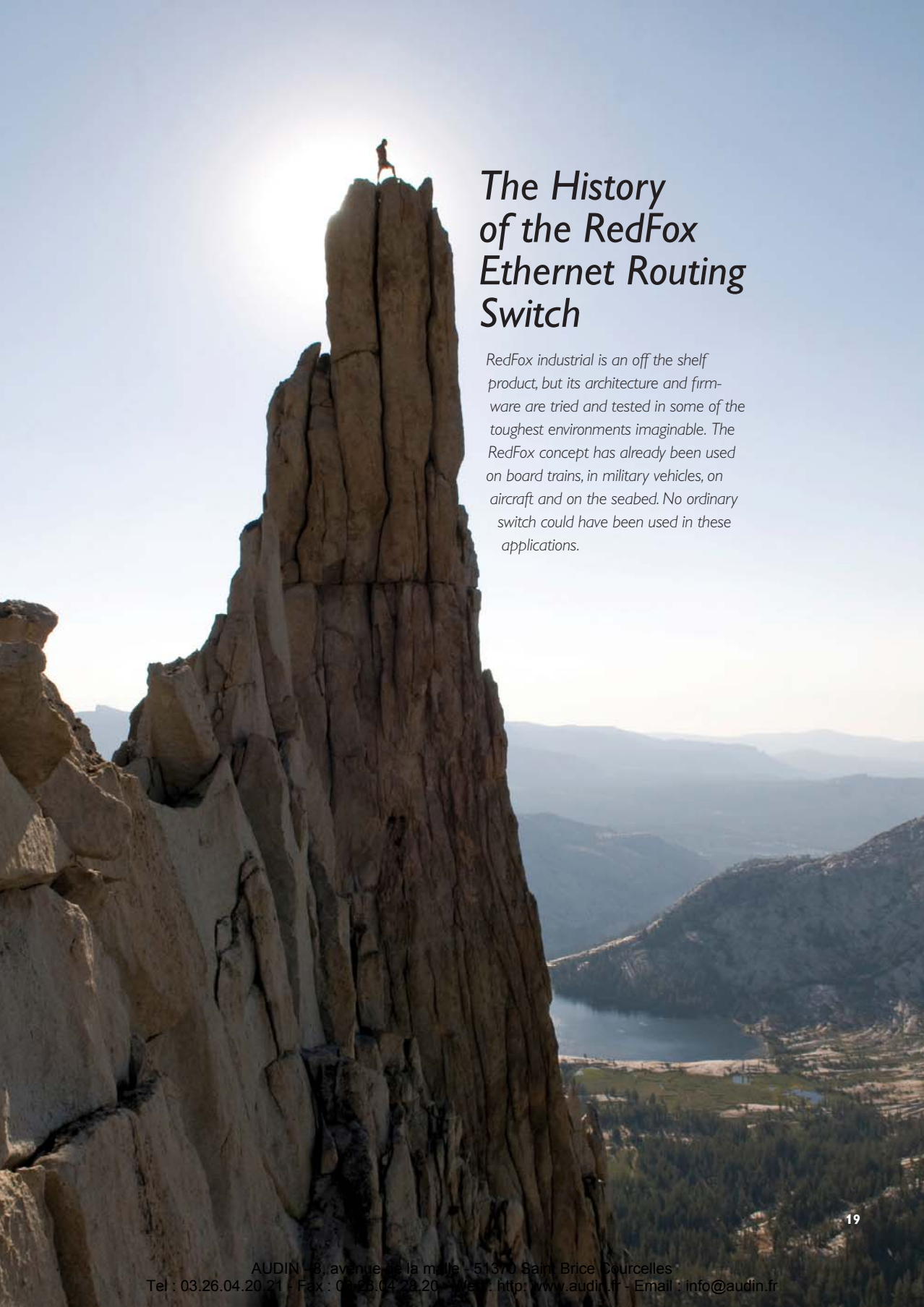
Bi-directional transceivers allow full duplex communication over a single fibre by using different light wavelengths.

CX-Transceiver
The transceiver used as an SFP-transceiver (Small Form-Factor Pluggable), which offers a flexible configuration.

FX100 Mbit (Fibre)	Bi-di LC2	Bi-di LC20	SM-LC80	SM-LC40	SM-LC20	MM-LC2
Connector	LC	LC	LC	LC	LC	LC
Distance km*	2	20	80	40	20	2
Fibre type µm	Multimode 62.5/125 and 50/125	Singlemode 9/125	Singlemode 9/125	Singlemode 9/125	Singlemode 9/125	Multimode 62.5/125 and 50/125
Wavelength nm	Connector 1		1550	1310	1310	1310
	Tx 1310 Rx 1550					
	Connector 2					
	Tx 1550 Rx 1310					
Transceiver type	LC Small Form Factor Pluggable (SFP)					
Laser class	Class 1, IEC 825-1 Accessible Emission Limit (AEL)					

Gbit	Bi-di LC10	Bi-di LC20	SM-LC80	SM-LC50	SM-LC10	MM-LC2	CX
Connector	LC	LC	LC	LC	LC	LC	RJ-45
Distance km*	10	20	80	50	10	2	100 m
Fibre type µm	Single-mode 9/125	Single-mode 9/125	Single-mode 9/125	Single-mode 9/125	Single-mode 9/125	Multi-mode 62.5/125 and 50/125	–
Wavelength nm	Connector 1		1550	1550	1310	1310	–
	Tx 1310 Rx 1550						
	Connector 2						
	Tx 1550 Rx 1310						
Transceiver type	LC Small Form Factor Pluggable (SFP)						
Laser class	Class 1, IEC 825-1 Accessible Emission Limit (AEL)						–

* Other distances are also available, please contact Westermo.



The History of the RedFox Ethernet Routing Switch

RedFox industrial is an off the shelf product, but its architecture and firmware are tried and tested in some of the toughest environments imaginable. The RedFox concept has already been used on board trains, in military vehicles, on aircraft and on the seabed. No ordinary switch could have been used in these applications.

The Ethernet Train

Regional trains in Germany and the Netherlands are currently being delivered by Bombardier with an on board Ethernet network. This is the world's first example of Ethernet being used for train control data management. Train control has traditionally been via a TCN (Train Control Network) however using Ethernet for this network will reduce cost and increase functionality. For this innovation, Bombardier has chosen Westermo's RedFox railway switches. 400 units have been supplied for the first projects.

Up to now, Ethernet has been used on board trains only for CCTV (Close Circuit Television), passenger information systems and entertainment. Traditionally different train subsystems used dedicated networks. For train operation, a railway-specific network called TCN was used. Bombardier Transportation has developed a new system where Ethernet now manages all of the train's on board equipment. In the first projects, the old and new networks – Ethernet rings and TCN – will coexist, but Ethernet will fully replace the TCN in two or three years. The Bombardier Transportation system will be the first to integrate all the intelligent devices onboard into one Ethernet network.
The first train projects without any TCN – relying solely on Ethernet networks – are already in the design phase.

For the regional trains already operational in Germany and the Netherlands, the Ethernet network is able to determine the composition of a train e.g. what kind of coaches constitute the train, in which order they are coupled together, and in what direction they run (to be able to open the correct set of doors, etc) while the TCN is still used for some local subsystems.

"We have a project where the TCN will be kept only for localised subsystems whereas train-wide communication will be carried out on the ETB (Ethernet Backbone). This is the next step on the way to a totally Ethernet train. The network will ultimately carry all the data needed for train operation, surveillance and passenger information. All systems except signalling and Internet access will be managed through this Ethernet network." Says Klas Englund, TCMS Product Manager at Bombardier Transportation Sweden.

There are between 2 and 4 switches in each carriage and up to 8 carriages making up a complete train. To this point over 400 switches have been delivered. The advantage of using Ethernet switches is that there is no limit to how many can be cascaded down the length of the train ensuring that no consideration ever needs to be made to the length of the network.

Reduced costs and greater flexibility were the two main reasons to use Ethernet networks on board trains. Hardened Ethernet solutions already existed offering the high

bandwidth required for audio and video services at a reasonable cost whereas a new rail-specific network would have been expensive.

"There were many candidates for cooperation on this product that will probably become the new train standard. The main reasons for selecting Westermo were, firstly, that they had an interesting and promising concept with their RedFox product line which could serve as a platform for implementation of our add-on functionality. Together we saw the possibility for adaptation to our needs and the integration of own software functions into the products. Westermo also demonstrated an open mind about the way to cooperate, and a strong involvement in customisation for rail needs." Adds Mr Englund.

A new front panel was developed by Westermo with M12 connectors. Adjustments have also been made to meet the railway specific standards regarding EMC (Electromagnetic Compatibility) EN50155 and other environmental requirements. On Bombardier's side, engineers have developed a custom application that has been integrated into the switches.

"In the future Westermo products will be on all types of rail vehicles from trams to locomotives," concluded Mr Englund.

High Altitude Airliner Testing

Modern airliners have to undergo rigorous testing prior to delivery and use by the airlines to transport passengers.

Test data must be collected and stored on thousands of hours of test flights in order to verify that the aircraft is safe to use. The Boeing Corporation selected Ethernet as the high speed network to allow all this data to be collected during its development of the 787 Dreamliner.

To be used in this application RedFox had to be tested to RTCA DO-160E – "Environmental Conditions and Test Procedures for Airborne Equipment" and D6-16050-5 Rev B – "Electromagnetic Interference Control Requirements for composite Airplanes". These tests meant that the switch had to operate up to altitudes of 16000 m and meet comprehensive vibration specifications.

Ocean Floor Monitoring

When Cameron Subsea required an Ethernet switch that could be built into its subsea control modules the RedFox was the best solution.

The modules were there to control and monitor seabed pumps used for extracting oil and gas at depths of up to 3000 m. The biggest area of concern for a switch in this environment was vibration and RedFox had already been proven to meet the highest specifications.

Another advantage that RedFox offered was that it could be configured with fibre ports allowing communications over 80 km and also support redundant protocols. Both points critical with the remoteness of the installations.

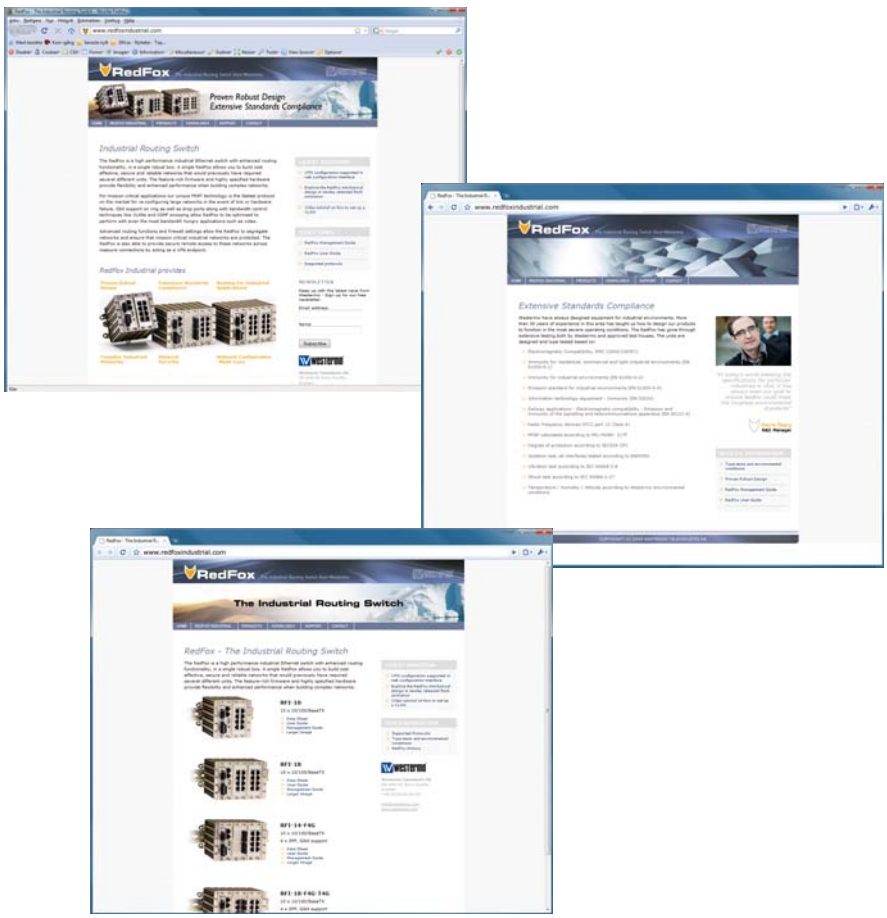
www.redfoxindustrial.com

Please visit the RedFox Industrial website. This is where you can find more useful information on the Industrial Routing Switch. Available for download are data sheets, user guide, management guide, IP configuration software, brochure, illustrations and high resolution photographs.

You will also find comprehensible video tutorials on how to set up a VLAN, redundant rings and more. Animations explaining complex network features such as multicasting, IGMP snooping and FRNT redundant protocol with the worlds fastest reconfiguration time.

This is where you will find all the latest updates, news and information about enhanced functionality and features.

Be the first to know what is going on in the world of industrial routing, visit us and don't forget to sign up for the Westermo newsletter!



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