WHITE PAPER

Network Engineering for mission critical applications

abaco SYSTEMS

Abaco Systems and networking: what can we do for you?

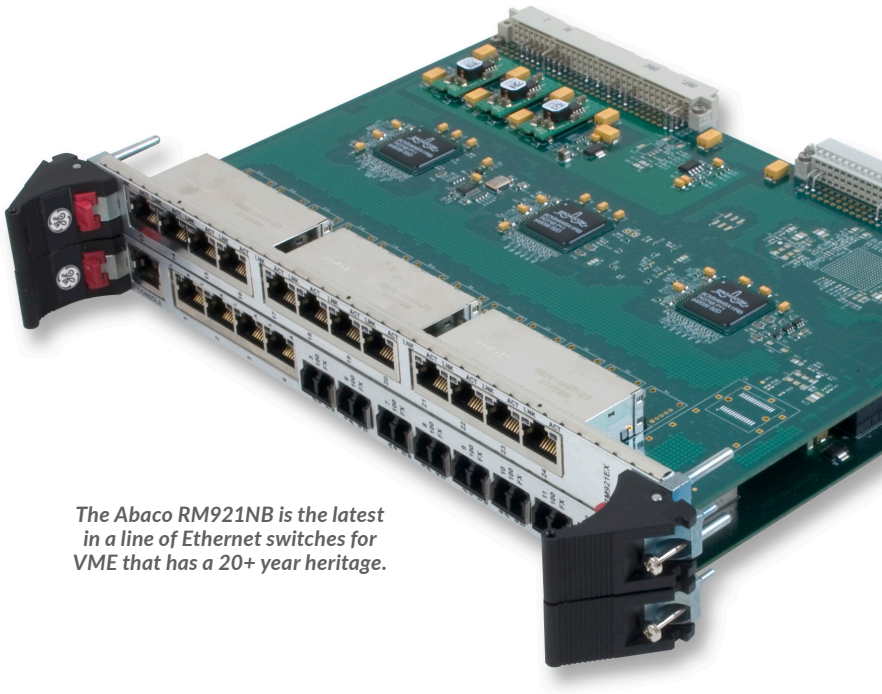
Introduction

With the introduction of VME Ethernet switches to the embedded computing market over 20 years ago, Abaco Systems has an extensive pedigree in developing and deploying networking products and in helping our customers solve the toughest networking problems. Even today, our RM921N VME Ethernet switch (introduced in 2007) is one of our biggest selling products.

Today, Abaco switches can be found in an enormous diversity of applications and environments, from the International Space Station to oil rig pipework on the ocean bed, and from aircraft and armored vehicles to ships and railroad locomotives.

At Abaco, it's not just about the hardware, or even our market-leading switch management software, OpenWare. Rather, it's about the extensive expertise and experience that lie behind them, exemplified by our Networking Center of Excellence, that our customers have come to rely on.

This paper describes Abaco's approach to solving networking problems, and some of those customer challenges to which we have risen.



The Abaco RM921NB is the latest in a line of Ethernet switches for VME that has a 20+ year heritage.

What rank are you?

Many years ago, one of our customers, working on a solution for Navy ships, needed a simple change to the user setup. The Navy had three types of user which related to specific rank or role:

- A super-user, who can change anything
- An admin, who can change most of the common settings
- A status-only user, who can see what's happening (status, statistics, etc.) but can't change anything

We implemented the requested feature for this customer, and it is now the normal way all our military users control the switch configurations.

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Product philosophy

Abaco's product offering has long been characterized by extensive flexibility with support for, as an example, both copper and fiber. Performance has also been fundamental to Abaco's design approach. Our first switches supported 10Mbps Ethernet; 100Mbps quickly followed, with Gigabit (1000Mbps) and 10 Gigabit in quick succession.

Our next generation switch supports 40Gigabit speeds - 4,000x the throughput of our first switch. Such is the power of the processing technology being deployed today, and given the growing network-centricity of defense and industrial organizations alike, it's easy to see how, even in a short period, that may not be enough.

At Abaco, our networking product design is exclusively driven by our customers – made easier by our close working relationships with them.

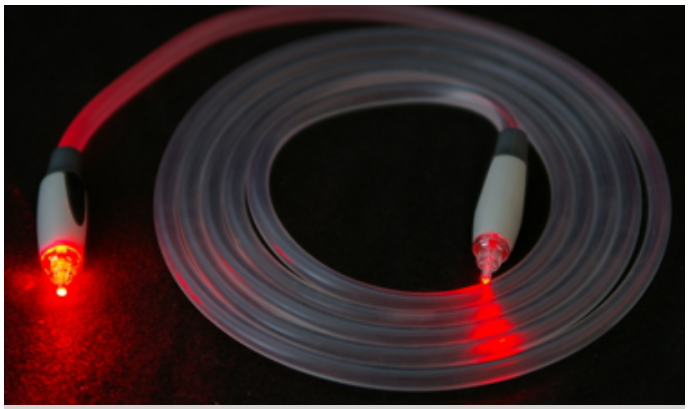
That approach has seen us:

- picking the right switch fabric silicon
- combining it with the most suitable management processor
- adding appropriate low-level physical devices
- packaging it for the right range of shock and vibration
- making the product small enough to fit in vehicles
- building in appropriate thermal solutions

Our advanced hardware provides the ideal platform for our in-house developed OpenWare switch management software. Initially created over 15 years ago, it is perhaps the most vital asset in our networking portfolio and provides Abaco customers with significant competitive advantage.

The OpenWare advantage

- Because it's developed and controlled in-house, we have full control over the quality
- We develop the protocol expertise ourselves, and thus have experts who can talk to customer engineers on all protocol and networking issues
- We are free to use switch fabrics from any manufacturer to suit customer needs for new features
- We can modify the protocol features to meet particular customer requirements



It's all in the detail

Some of the customer-driven enhancements on which we've worked were focused on the communications mechanisms themselves – such as reporting of the optical power budget used on fiber cables, and the adjustment of the inter-frame gap (IFG) in low-level Ethernet.

Other customers have concerns about physical damage to their network, and how to cope with particular types of damage. In one enhancement - used in a ground combat vehicle – Abaco enabled the customer to allow for a single failure in a particular set of fiber cables to trigger special handling of the network.

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OpenWare

The majority of Abaco's switches are now "managed", meaning that they combine a switch fabric (which makes the fast but simple decisions about where to send a packet) and a general purpose processor (which sets up and controls the fabric, and handles the more complex decisions about new routes and so on).

The OpenWare software manages the switch fabric. It is complex, comprising many hundreds of thousands of lines of code, and extremely sophisticated, powerful and flexible.

The role of OpenWare is to:

- initialize the fabric
- control the tables in the fabric
- handle packets that the fabric doesn't understand
- send and receive packets for hundreds of different protocols
- interact with the user via console or web
- record statistics, errors and other reporting information

OpenWare makes use of a combination of in-house code, fabric-supplier code and open source code. This means, for example, that SNMP protocol support is based on the very popular netSNMP open source package. OpenWare is based on the GNU/Linux operating system, meaning that we – and our customers - can rely on industry-wide efforts to keep up to date with operating system security, for example.

For our customers, it is truly a best of both worlds solution – leveraging open standards and open source for maximum flexibility, maximum interoperability and maximum supportability on the one hand, and Abaco's IP which guarantees that the software remains under our control. Because OpenWare was developed in-house, it is uniquely customizable to meet specific customer needs. Like our switch hardware, it is truly commercial off-the-shelf (COTS) – but for many organizations, a COTS product does not always meet the specific requirements of the application. A COTS solution will get them most of the way there – but Abaco's ability to modify its functionality is what can make it the ideal solution.

And, when it comes to solving tough networking problems, that's the Abaco difference - as the case studies illustrate.

Seeing through the FOG

A telecom customer came to us with a request for a special failover mechanism. The customer had a network in which there were redundant links to support failover if one link went down - but uncontrolled use of redundant links causes a nasty network condition called a "broadcast storm". The standard way of controlling this would be by using the Rapid Spanning Tree Protocol (RSTP). However, the customer didn't have full control over the network, so couldn't use RSTP.

We worked with their engineers and came up with what we call FOG "FailOver Groups". FOG gave the customer the ability to control the forwarding of traffic out of the appropriate connection into neighboring networks, even when things went wrong. FOG is now a standard offering on our OpenWare switches, and has been adopted by other users. Indeed, we have performed more customization to the feature based on the FOG idea for a military application for another customer.

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Telesender

For one of our customers running OpenWare in the International Space Station, we were required to provide a very efficient, low-throughput way of sending remote telematics data (about data traffic and errors) from the switch over very low-speed links to the ground station.

We quickly developed an example of a simple way to do this, received agreement from the customer on the implementation - and it is still in continuous use.

DHCP with bells on

DHCP (Dynamic Host Configuration Protocol) is a very common way for devices to get information from a central point in the network about who they are (IP address) and what they should run (remote boot).

The DHCP protocol has an option to pass information to the DHCP server about what port the device is connected to. Our customer wanted the switch itself to not just add that port information to the packet, but to act on it itself.

A relatively simple change was made to OpenWare, and we now support “port-aware DHCP server”. This allows a different address to be automatically issued, depending on the port to which an SBC is plugged in – which is very useful if, for example, a vehicle is wired up with different processor units in specific sites.

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Massive multicast

A customer working with UAVs had the need for a multicast table which was bigger than usual. They required operation using L2 multicast addresses, which creates a very large range. After a series of engineer-to-engineer conversations with the customer, Abaco developed a different option for OpenWare, and the whole address space was opened up to them. By operating with the L2 multicast address range, they have 32x the number of addresses available.

Security – unique solutions

Maximizing security is a key concern for many of your customers, and Abaco provides a number of standard solutions to allay those concerns. However: some organizations with whom we work have unique security requirements – and we have the expertise to develop customer-specific solutions for our switches. Examples include:

- The ability to network boot the switch, accessing its configuration information from a centralized secure server. (Abaco also made the necessary hardware modification to remove the NAND flash)
- NAND overwrite feature, allowing the customer to specify both the pattern and the frequency with which it would be written over the non-volatile storage device – reminiscent of the old techniques for "scratching" a disk
- Password protection at bootloader level
- A new "learning mode" for MAC-level security

Get on the train

A rail customer had a requirement to connect up switches using VDSL technology. This allowed them to connect between railcars over only two, very noisy, wires. While Abaco was able to develop a modified hardware and software solution that solved their problem, a significant problem became apparent: how to perform initial lab testing without a train coupled through this very poor cable?

The answer: a very long, normal cable could be used – resulting in huge drums of hundreds of feet of cable in the Abaco Networking Center of Excellence laboratory.This provided us with a 'real world' testing environment, closely reflecting the adverse conditions under which it would be installed and allowing us to prove the effectiveness of the VDSL technology.

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