WE INNOVATE. WE DELIVER.
YOU SUCCEED.

Reflective Memory

Great technology from a true innovator.

At Abaco, we deliver the most innovative technologies to help our customers succeed in solving their toughest problems.

Abaco is a leader in reflective memory technology, and we offer an extensive selection of proven hardware and supporting software. You can turn to us with confidence, knowing we have over two decades of experience developing reflective memory solutions. If one of our standard products is not precisely what your application requires, we are also able to create variations to meet your needs.

Our products are designed to fit into your existing hardware environment, and can be installed in a variety of computer backplanes and buses, including VME, PMC, PCI, and PCI Express® form factors. We support a variety of operating systems in Microsoft® Windows®, Linux® and VxWorks®. You also have the choice of multi-mode for short fiber runs and single-mode for spanning long distances

between nodes for the fiber optic cable interconnect. As the technology has advanced, we have provided you with software tools that make it easy to migrate from older node cards to newer, fuller-featured, higher-performance cards.

Reflective memory is only one of a broad range of innovative technology solutions created by Abaco to solve the challenges of deploying high performance computing into demanding environments. That range includes rugged single board computers based on industry standard hardware and software technologies to complete through advanced graphics, digital signal processing and sensor processing solutions to mission ready systems that minimize risk, cost and time-to-deployment – and much more.

Rocket Engine Testing

A rocket engine test stand uses hundreds of transducers to measure various parameters. Operators need a lag-free connection to the testing, but for safety reasons, the instrumentation/viewing center may be located 3,000 meters away. With Reflective Memory, a single link can send data to the main computer in the control room, eliminating hundreds of discrete wires spanning the 3,000 meters. Operators can observe and react to changes as they occur, with minimal delays imposed by the connection, minimize risks to personnel and equipment with no degradation of test performance.

Real-time local area networks.

Reflective memory networks are real-time local area networks in which each computer always has a local, up-to-date copy of the network's shared memory set.

Reflective memory networks are designed to provide the highly deterministic, tightly timed performance necessary for a variety of distributed simulation and industrial control applications. They have benefited from advances in general-purpose data networks, but they remain an entirely independent technology, driven by different requirements and catering to applications where determinism, implementation simplicity, and a lack of software overhead are key factors. Reflective memory is also able to integrate diverse hardware platforms running different operating systems into a single, shared memory network.

Distributed processing systems can provide "supercomputer" power at a reasonable cost, but their response time is often limited by latency in the network that connects the individual microprocessor units. The only way to improve distributed system response time is to provide a better connection between the microprocessors.

That's where reflective memory comes in. Using reflective memory systems, designers are able to eliminate most communication latency and realize drastic improvements in resource utilization over traditional LAN technologies. The benefit of a low-software, high-speed, hardware-driven network like reflective memory is extremely low data latency, both overall and between individual network nodes. This low-latency performance is of paramount importance when building real-time systems such as simulators.

Flight Simulation

An interactive combat flight simulator highlights the importance of low-latency performance. Separate computing system are responsible for generating a display, managing individual participants' inputs, generating terrain, managing weapons systems, or a variety of other functions, and multiple participants perform dynamic movements at extremely high speeds. It is imperative that the system is fast enough to present a lifelike simulation of reality. By minimizing latency, Reflective Memory ensures that the simulation can withstand the sensory scrutiny of the participants.

Determinism, simplicity and sheer performance.

Reflective memory offers unique benefits to the network designer, and therefore has become a de facto standard in demanding applications.

Unlike global shared memory systems, in which individual systems vie to access a single, centralized data set, reflective memory networks place an independent copy of the entire shared memory set in each attached system. Each attached system has full, unrestricted rights to access and change this set of local data at the full speed of the local memory.

Each reflective memory board (node) has its own local memory, an embedded interface, and arbitration logic that allows both the host computer and the reflective memory network to access this local memory. When data is written to the local copy of reflective memory, high speed logic simultaneously sends it to the next node on the ring network. Local processors can read this data at any time without a network access. In this scheme, each computer always has an up-to-date local copy of the shared memory set.

The reflective memory boards may be physically installed or connected to a variety of computer backplanes, including VME, and PCI/PCI-X/PCI Express, as well as CompactPCI® or any standardized or proprietary system capable of hosting a PMC site. This allows most popular workstations and single board computers to be connected via reflective memory regardless of their interoperability.

When a designer chooses to use the Reflective Memory architecture, the decision is usually based upon several of the following characteristics:

Performance
> High-speed, low latency data delivery
> Deterministic data transfers for demanding real-time communications

Simplicity
> Easy to implement and transparent to use
> Operating system and processor independent
> It is just memory – Read it and Write it
• Each networked node has its own local copy of the data
• Write operations are first performed in local RAM, then automatically broadcast to all other nodes on the network
• Read operations access the local copy of the data, which always mirrors other local copies on the network

Flexibility
> Drastically reduced software development time and cost (time-to-market)
> Connections to dissimilar computers and bus structures including standard and custom platforms.
> Easy-to-use software, low overhead
> Small to large separation distance between network nodes
> Data can be shared regardless of processor type or operating system

Aluminum Rolling Mill
On a 3,500 ft/min rolling mill, a standard PLC Control loop had a response time that allowed 2 to 3 feet of aluminum to pass through before actuators could respond. These actuators were applying and releasing pressure on the aluminum to vary the thickness. Using Reflective Memory, the response time was reduced to 4 inches, resulting in tremendous waste reduction and quality improvement in the final product.

Where interaction in real time is a primary concern.

Reflective Memory introduces almost no network latency, so it is well suited to applications such as simulation, process automation and test and measurement.

Reflective memory LANs or real time networks are usually constructed because the designer has needs or problems that are solved by one or more of the following reflective memory board characteristics:

> Deterministic data transfers
> High-speed performance
> Ease of use
> Operating system- and processor independence
> Economics and available time to build systems

Reflective memory may be used in any application that uses Ethernet, Fibre Channel, or other network technologies to connect computers or PLCs together, but it is not ideal for all applications.
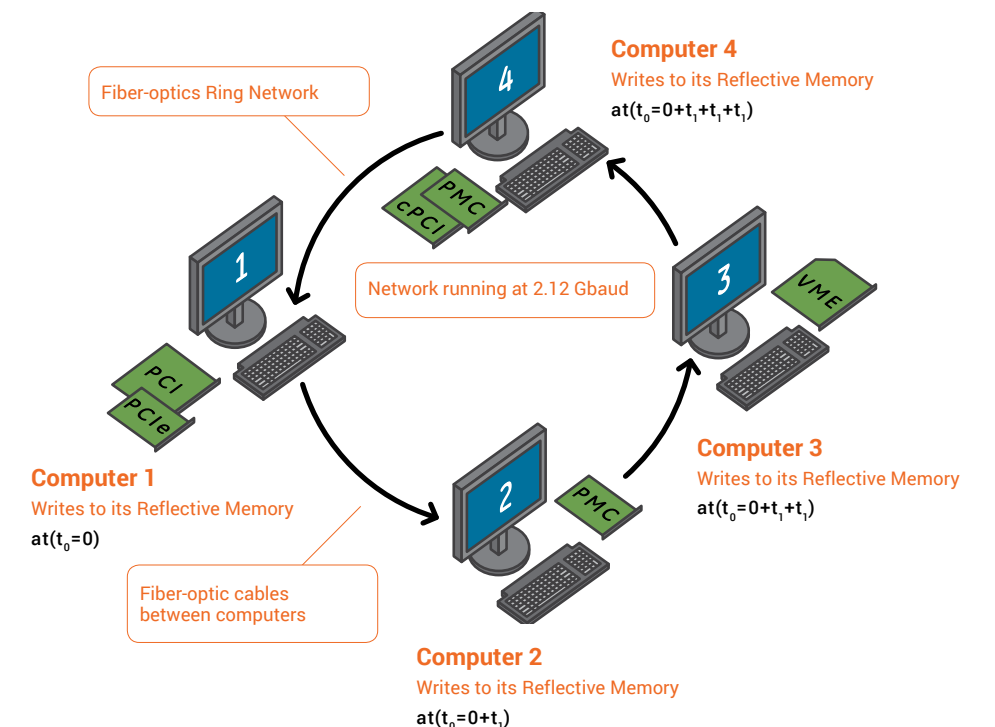
In systems where determinism, low latency, and high-speed communication are necessary, reflective memory boards, while typically more expensive than lower performance hardware, provide a huge return in performance with the added benefit of ease of use.

Using a reflective memory network requires only a few simple steps:

1. Plug reflective memory into any available backplane slot or bus via VME, PCI, PCIe, PMC, or connect it to any single board computer or carrier (VME, CompactPCI, etc.) with a PMC site, and connect cabling.
2. Install the driver.
3. Write to memory (reflective memory's global memory appears to the computer as standard RAM).
4. Read memory (from reflective memory boards on the network).

Extremely Low Latency
Data written to the local copy of Reflective Memory is simultaneously sent to the next node on the ring network, until each computer has an up-to-date local copy of the shared memory set. In the four-node example shown here, it takes 2.1 µs for all computers to receive the data. This latency is calculated assuming no network traffic, short cable lengths and the largest packet size possible. Cable length and network traffic can cause the latency to increase, but as long as the bandwidth of the network is not exceeded, the latency should not increase significantly.

Fiber-optics Ring Network

Network running at 2.12 Gbaud

Computer 4
Writes to its Reflective Memory
at $(t_0 = 0 + t_1 + t_1 + t_1)$

Computer 3
Writes to its Reflective Memory
at $(t_0 = 0 + t_1 + t_1)$

Computer 2
Writes to its Reflective Memory
at $(t_0 = 0 + t_1)$

Computer 1
Writes to its Reflective Memory
at $(t_0 = 0)$

Fiber-optic cables between computers

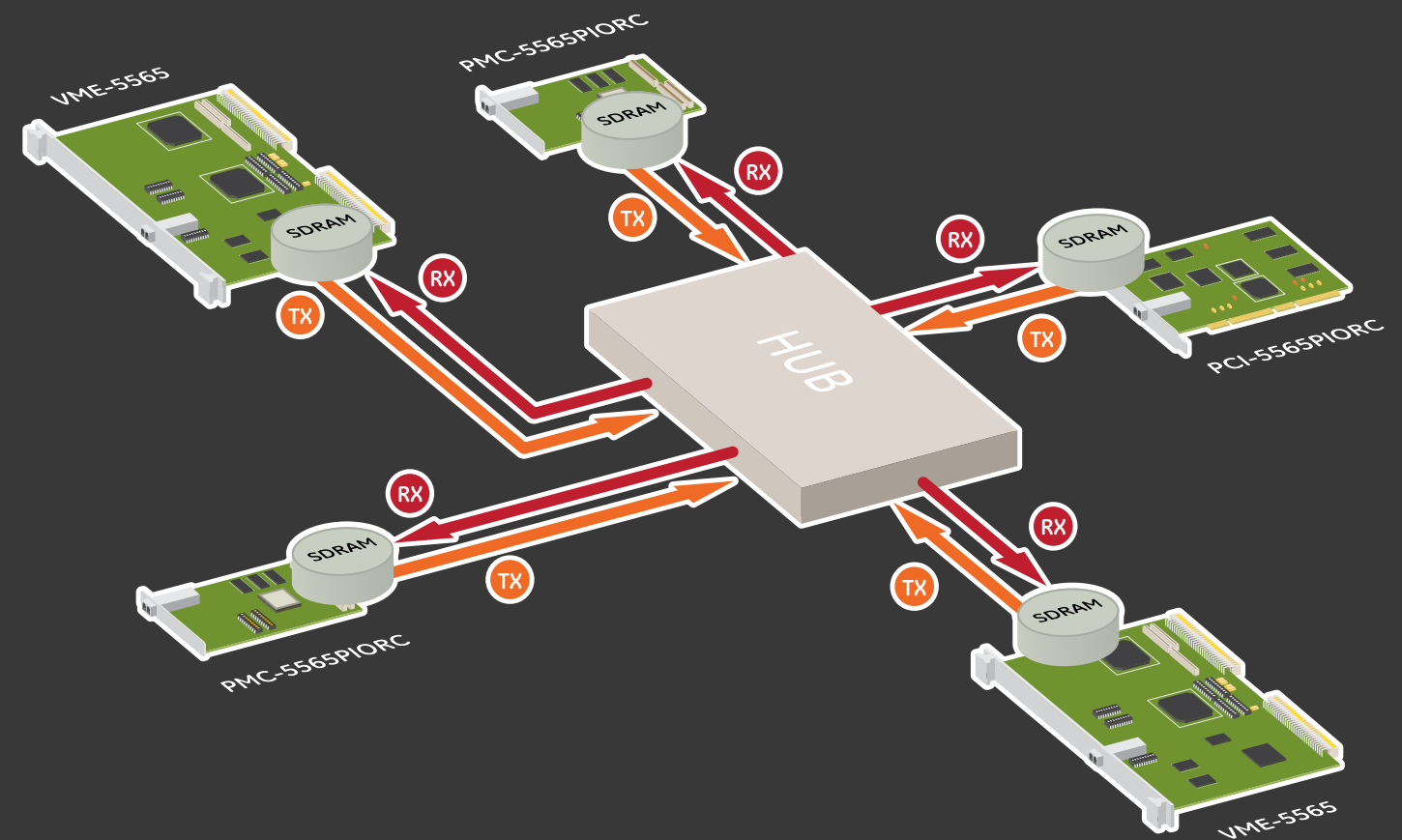# Choose the network topology that matches your needs.

Ring Topology

Choose the network topology that matches your needs. The reflective memory ring architecture is capable of data transfer rates of 170 MB/s over fiber-optic media. It is not a collision-based bus arbitration system as most Ethernet systems are, so it avoids the complexities of queuing and checking data packets. This topology also ensures proper connectivity and does not impose additional loading restrictions or termination requirements. Distances between nodes may be up to 10 km.
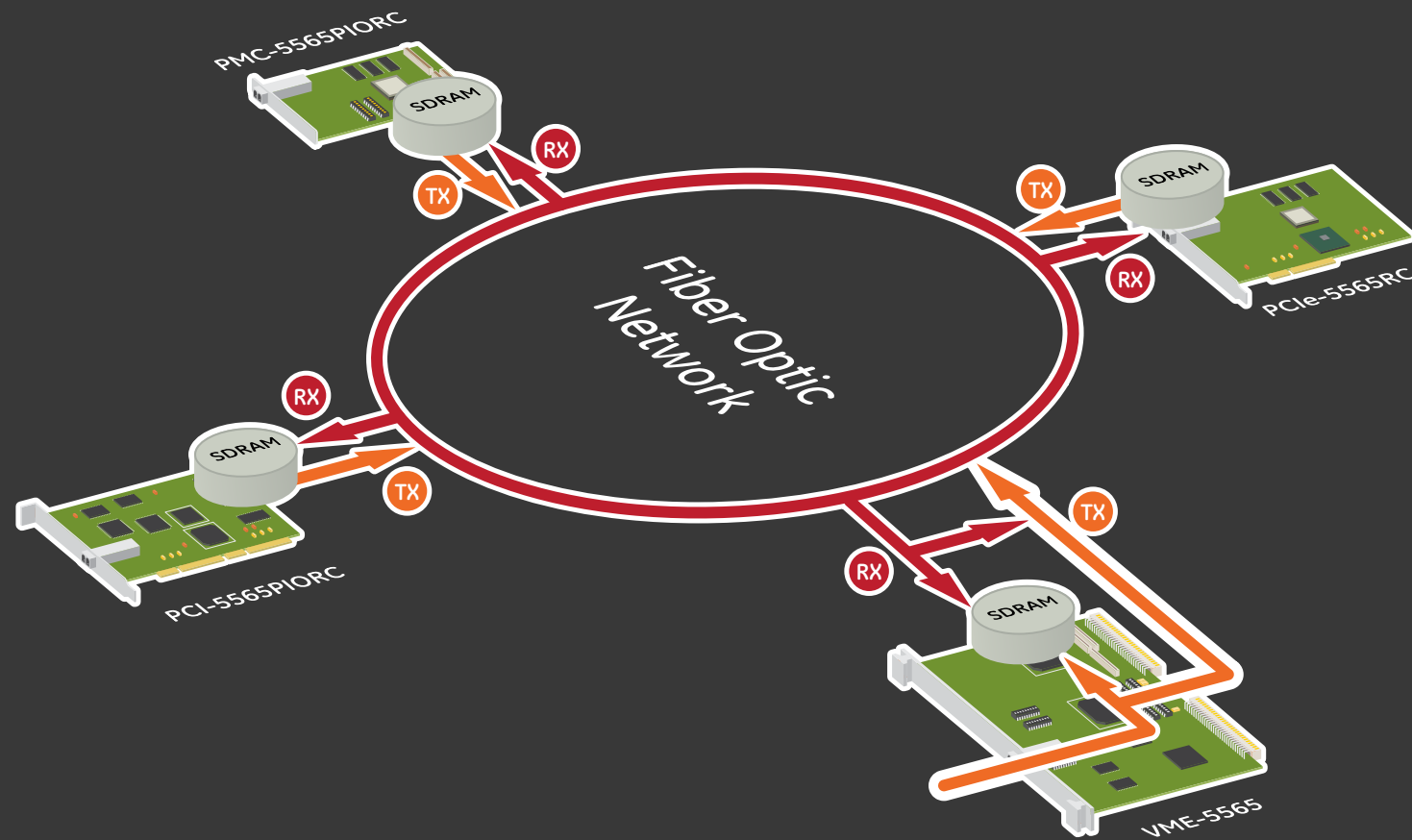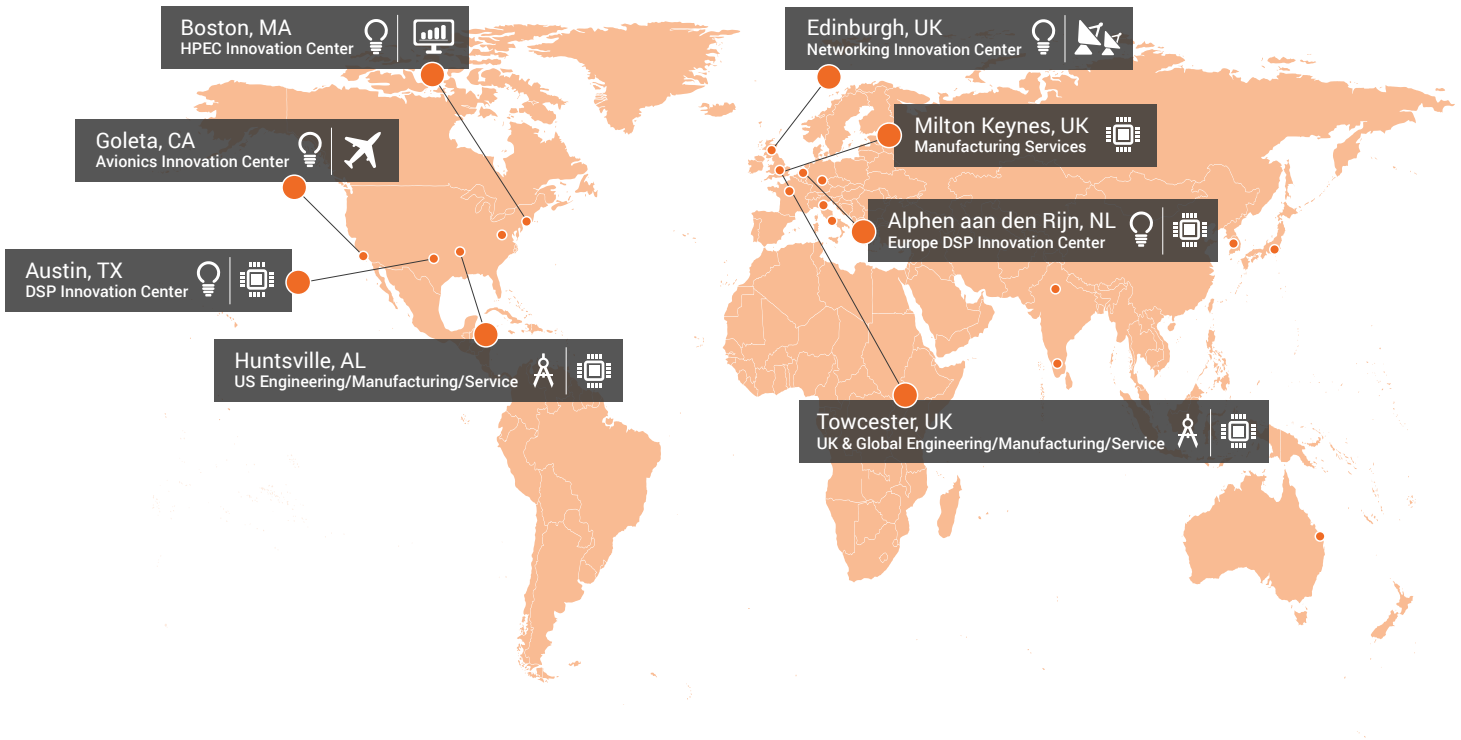
Star Topology

With a fiber-optic hub, the reflective memory network will continue to operate even if a node has been turned off. The hub automatically bypasses any network node which ceases operation to ensure data continues to the next node in the network, thus maintaining the integrity of the ring. Hubs can be cascaded, permitting a managed hub array with up to 256 nodes. Each port regenerates the serial optical signal, eliminating problems with insertion losses and cable attenuation. Signal regeneration also reduces jitter.

Global coverage

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DSP Innovation Center

Huntsville, AL
US Engineering/Manufacturing/Service

Edinburgh, UK
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Manufacturing Services

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