SQUARED
TECHNOLOGIES INC.

# Powerful Features of Reflective Memory


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SQUARED Reflective **Memory**

# What is REFLECTIVE MEMORY?

**A Reflective Memory network is a special type of shared memory system designed to enable multiple, separate computers to share a common set of data.**

Reflective memory networks place an independent copy of the entire shared memory set in each attached system. Each attached system has dull, unrestricted rights to access and change this set of local data at the full speed of writing to 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. Each subsequent node simultaneously writes this new data to its local copy and sends it on to the next node on the ring. When the message arrives back at the originating node, it is removed from the network and, depending on the specific hardware and number or nodes, every computer on the network has the same data at the same address within a few microseconds.

Local processors can read this data at any time without a network access. In this scheme, each computer always has an up to date copy of the shared memory set. In the four-node example shown, it takes 2.1 µs for all computer to receive the data that was written to Reflective Memory.*

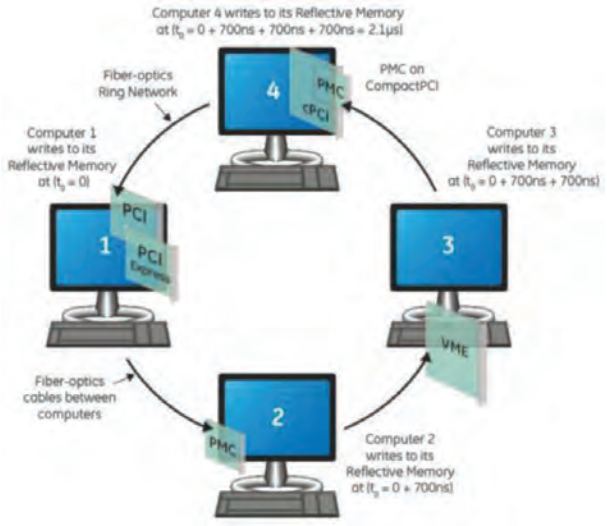



***Figure 1** Reflective Memory provides very low latency between nodes.*

** This latency is calculated assuming no network traffic, short cable lengths and the largest packet size is 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.*

## DETERMINISTIC DATA TRANSFERS

Reflective Memory is a hardware-based network. All data transferred to a node is stored in local memory and automatically sequenced out to all the other nodes' memory. There are no software delays and minimal hardware delays associated in the data transfer. Any latency is imposed at the hardware level and can be predetermined within a very small window of best-to- worst case latency. The determinism of Reflective Memory, the guaranteed time in which communication between two or more nodes is completed, allows system designers to build effective real-time LANs that can guarantee data delivery within a tight window of time. This enables guaranteed scheduling of sequential actions and ensures that data is not lost.

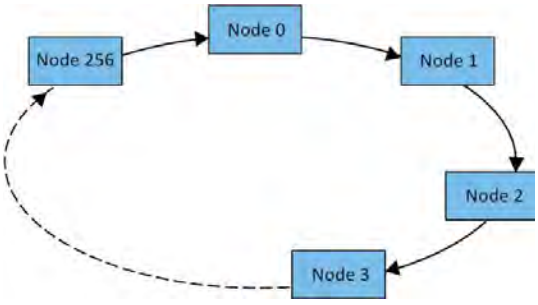



***Figure 2** Reflective Memory Ring Architecture connects up to 256 separate network nodes in real time*

# Powerful FEATURES

## NO DATA COLLISIONS
### RING ARCHITECTURE NETWORK

The J-Squared Reflective Memory product line provides a data-insertion, ring-architecture network operating at rates of 2.12 Gbaud over a fiber optic ring. Because Reflective Memory is not a collision- based bus arbitration system as most Ethernet systems are, it avoids the complexities required for queuing and checking data packets.

The Reflective Memory ring ensures proper connectivity and does not impose additional loading restrictions or termination requirements. Distance between nodes may be up to 10 km. These attributes allow data transfer rates of 170 MB/s for Reflective Memory, compared to about 100 MB/s for Gigabit Ethernet (excluding protocol overheads).

## DATA SYNCHRONIZATION BETWEEN NODES
### THROUGH INTERRUPT CAPABILITY

Reflective Memory allows any network node to interrupt any other node or all nodes. Up to four different interrupts may be assigned and are user-definable per interrupt as to function, priority, and vector. These interrupts may be used for any function, such as mailbox interrupts or data synchronization across the network. When enabled, interrupts typically are used to interrupt one or all the nodes on the network after data has been transferred.

The use of interrupts is not required. Reflective Memory powers up with its interrupts disabled. This allows Reflective Memory to be software transparent and not require driver software to be loaded unless interrupts are needed.

## BUS SUPPORT

The J-Squared 170 MB/s Reflective Memory product line is available for the VMEbus, PMC, CompactPCI, PCI Express and PCI architectures used in most PCs, workstations and systems, and also for VME-based PLC systems.

## DATA TRANSFERS

On the Reflective Memory fiber optic ring network, data to be transferred is placed in packets with other system information and passed from node to node. Each node stores the data received from the previous node then retransmits the data in a packet to the next node in the network. Data insertion by any node may occur at any time.
Packets of data flow around the ring in a stream passing through each node. Within each node, the packets are unpacked, checked for errors, and the data stored in the Reflective Memory. The packets are then reformed and passed to the next node. If data is written to the Reflective Memory by a local CPU or DMA device, then new packets are formed and inserted into the stream of packets flowing through the node.

When a data packet has completed the ring, and returns to the originating node, it is recognized and removed from the network. The result is a highly efficient real-time LAN with minimal hardware delays to complete data transmission to all the computer memories in the network.

# Powerful FEATURES

## SUPERIOR DATA INTEGRITY
### PROVIDED BY ERROR MANAGEMENT TECHNIQUES

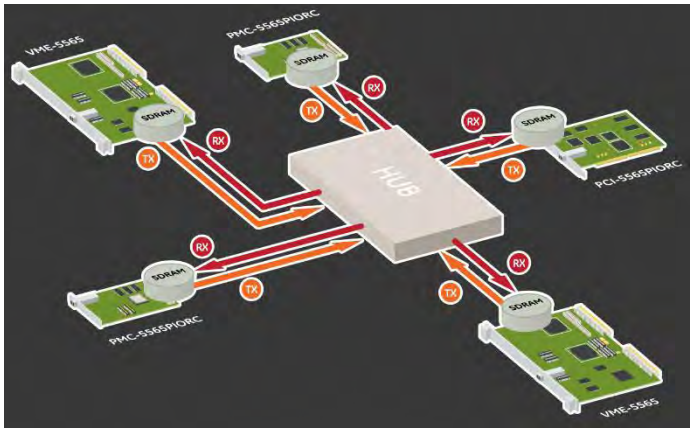
J-Squared Reflective Memory boards have extensive error detection and notification facilities. The error rate of the network is a function of the rate of errors produced in the optical portion of the system. This optical error rate depends on the length and type of fiber optic cable. When a node detects an error, the erroneous transfer is removed from the system and an interrupt is generated, if armed.

For systems where even this minuscule error potential is unacceptable, Reflective Memory can be operated in a redundant transfer mode in which each transfer is transmitted twice. In this mode of operation, the first of the two transfers are used unless an error is detected, in which case the second transfer is used.

If an error is detected in both transfers, the node removes the transfer from the system. The fiber optic Reflective Memory boards also employ a network monitor bit that can be used to verify that the data has properly traversed the ring. This bit can also be monitored to measure network latency (the time for data to be transferred and stored in all computer memories on the network).

## ENHANCED NETWORK RELIABILITY
### WITH AUTOMATIC FIBER OPTIC BYPASS SWITCHES

J-Squared produces a fiber optic hub that enables a Reflective Memory network to continue operating if any node fails. These products automatically bypass a network node if it ceases operating to ensure that a node failure does not crash an entire network. Hubs can be cascaded, permitting a managed hub array with up to 256 nodes. Each port regenerates the serial optical signal, eliminating the problems with insertion losses and cable attenuation. Signal regeneration also reduces jitter.




## OPERATING SYSTEMS

With driver support for various operating systems, J-Squared installation programs allow the user to select from various processor/OS/hardware combinations. Please contact J-Squared Technologies for the latest list of available drivers and operating systems supported.

## SUMMARY

Reflective Memory is an optimal way to share data in time-critical applications ranging from data acquisition and process control to advanced simulation. Reflective Memory networks provide a real-time networking capability that surpasses most communications technologies for low latency and deterministic performance. Reflective Memory networks connect systems with minimal update delays and no access restrictions, to enable multiple, remotely located nodes to share a single data set in real time.

# Comparison

## OFF-THE-SHELF NETWORKING TECHNOLOGIES

| Reflective Memory Network Characteristics | 5565/ 5565RC 5565PIORC | 10/100 Ethernet | Gigabit Ethernet |
|---|---|---|---|
| **Transmission Speed** | 2.1 GBaud/s | 10/100 Mbit/s | 1000 Mbit/s |
| **Data Transfer Speed** | 170 MB/s | 1/10 MB/s | 100 MB/s |
| **Endian Data Conversion** | Yes | No | No |
| **Software Transparent** | Yes | No | No |
| **Media** | Fiber Optic | Coax, UTP | Fiber Optic |
| **Topology** | Ring | Ring, Hub | Ring |
| **Network Data Transmission/ Reception Is Deterministic?** | Yes | No | No |
| **Network Transfer Scheme** | Data Insertion | Carrier Sense Multiple Access/ Collision Detect | Token Passing |
| **Memory Mapped Access to Shared Data?** | Yes | No - Messaging Application Application Must Be Built | No - Messaging Application Must Be Built |
| **Application Must Be Constructed to Share Data?** | No | Yes - Messaging Application | Yes - Messaging Application |
| **Application Must Encode/Decode Messages?** | No | Yes | Yes |
| **Application Must Perform Error Check/Handling Retransmits, etc.?** | No | Yes | Yes |
| **CPU Overhead to Support Shared Data Functionality?** | No | Yes | Yes |
| **CPU Overhead Required at Transmission Hardware Interface?** | No | Yes | Yes |

ESL Technology INC
TESTING YOUR LIMITS

**TEST STANDARDS:**

| | |
|---|---|
| MIL-STD-167 | MIL-STD-461G |
| MIL-STD-810 | 60068-2 |
| MIL-STD-108E | 60529 |
| MIL-E-5400T | 60945 |
| MIL-STD-2164 | 60598-2-3 |
| MIL-S-901D | |

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