Datasheet

SGI® IRIX®: Leader in Demonstrated Real-Time Capability

While the marketplace is full of system vendors that are telling the world about their plans to develop real-time capabilities, SGI has produced systems capable of hard real time for more than 10 years. This technology, SGI® REACT™ software, combined with our industry-leading third-generation SGI® NUMA system architecture in the recently released SGI® Origin® 3000 series and SGI® Onyx® 3000 series computer systems, makes SGI the clear choice for this critical technology capability.

Real-Time Requirement

Real-time systems can complete computational operations within stringent time constraints while obtaining accurate results. There are two distinctions to make in real-time processing: hard real time (HRT) and soft real time (SRT). In HRT processing, the computation is successful only when the correct result is delivered within the required time constraint. In SRT, the computation is successful when correct results are delivered within a response distribution that falls within an acceptable threshold. HRT systems provide capabilities within the base operating system that guarantee latencies and determinism. HRT is much more challenging to achieve than SRT and guarantees the user that the system will always meet real-time performance requirements. SGI provides a rich feature set of HRT capabilities within its IRIX 6.5 operating system.

Real Time at SGI

Real-time systems are critical in applications that require determinism and guaranteed latency. Mission-critical system applications include advanced simulators, radar, and telemetry data acquisition/processing, target acquisition and guidance systems, dynamic command-and-control systems, and imagery and video-processing systems, to name just a few. SGI provides real-time computing solutions for a wide range of successful user applications. Some of these applications are:

- Map-in-the-loop simulators: closed-loop simulators with frame rates up to 200 Hz. These include visual training simulators, engineering simulators, and power plant simulators. They usually require high floating-point performance and may require a large I/O subsystem.
- Hardware-in-the-loop simulators: closed-loop simulators with frame rates often exceeding 1,000 Hz. These usually require high-speed and low-level I/O processing.
- Telemetry, radar, and data acquisition: open-loop systems for acquiring, processing, and storing (or retransmitting) data in real time. These require a guaranteed data rate among VME, network, and disk.
- Command, Control, Communication, Computers, and Intelligence (C4I): These systems combine data acquisition, decision support, and control. Often, these systems include displays that must be updated as new data is received. Combined with telemetry processing, these C4I systems serve as the backbone for modern ground processing stations.
- Video applications: systems that handle live video, either in compressed or uncompressed form. These include virtual sets, which texture map video onto computer-generated surfaces in real time; broadcast studio solutions, which supply uncompressed digital or analog video directly to other studio equipment; and video-on-demand (VOD) solutions, which supply compressed video over a network. While all require a guaranteed frame rate, VOD also requires deterministic data transfer from disk over a network with hundreds of simultaneous data streams.

SGI IRIX and REACT—The SGI Real-Time Advantage

IRIX 6.5 is a hard-real-time operating system, since it is capable of supporting applications that can be guaranteed a deterministic response to external events. IRIX 6.5 offers two models to achieve real-time determinism:

- Kernal preemption: This model achieves determinism by executing critical processes at high priorities and relying upon preemption, including preemption of kernal processes and interrupts, to ensure that the highest priority runnable process is always executing. The user is granted full control of application and interrupt priorities—including the capability of scheduling higher process priorities than the operating system.

- Processor isolation: In this model, determinism is achieved by restricting or fully removing operating scheduling effects on a CPU or group of CPUs. Interrupt response time can be decreased by isolating real-time processes and interrupts to certain CPUs of a multiprocessor system.

REACT is the name of the set of real-time features that come standard with every IRIX operating system. REACT is not an optional product but an integral part of IRIX.

SGI IRIX with REACT—Standard UNIX® with Deterministic Performance

REACT provides deterministic system behavior by allowing you to:

- Restrict UNIX system overhead
- Direct interrupts to processors
- Assign real-time process priorities
- Experience guaranteed latency and throughput
- Allocate processors
- Lock memory
- Control process scheduling

With the standard POSIX® 1003.1b and POSIX 1003.1c features, IRIX offers high performance and portability:

- Clocks and timers (hardware-assisted)
- Interprocess communication:
  - Semaphores
  - Real-time signals
  - Shared-memory objects
  - Message queues
- Real-time disk I/O:
  - Asynchronous
  - Synchronous
- Memory-mapped files
- Process memory locking
- P threads
- Execution scheduling:
  - FIFO
  - Round-robin

Advanced hardware support boosts performance and simplifies integration:

- Memory-mapped I/O allows VME or PCI bus access without system calls
- DMA engine speeds data transfer to/from slave-only VME devices
- External interrupt input synchronizes user process execution with external events

REACT/pro™

REACT/pro, an optional product for IRIX, is a set of tools designed primarily for hard-real-time applications (available for multiprocessor systems only). The tools include the following:

- Frame scheduler (FRS)
- User-level interrupts (ULIs)
- User-mapped serial ports

These tools are designed to speed the development of real-time applications while at the same time maximize performance and determinism.

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