INtime® RTOS

Scalable real-time OS designed for PC-based embedded solutions

TenAsys INtime® RTOS is a dynamic, deterministic hard real-time operating system for Asymmetric Multi-Processing (AMP) on multi-core x86-compatible processors. Unlike using hypervisors, a Windows device driver, or a monolithic application, INtime RTOS is a full operating system, complete with system services and capabilities that developers expect to see in modern development environments to enable fast and efficient high-performance solutions. Capabilities include dynamic control of processes on multiple nodes (cores) on multiple hosts, and rich inter-process communication (IPC) between all nodes of the system.

Advanced consolidation solutions using Embedded Virtualization

Consolidation of numerous workloads using partitioned multi-core PC hosts, known as "Embedded Virtualization," reduces system costs and complexity by merging different application types onto the same PC.

In a heterogeneous deployment with an SMP OS, INtime RTOS runs in parallel with Windows* (32-bit and 64-bit) to utilize its extensive human machine interfaces (HMI). The system services extend support to multiple hosts, allowing creation of interoperable, distributed, real-time systems with flexible deployment models.

As an AMP architecture, each node (core) runs an independent instance of INtime RTOS, with its explicit hardware partitioned – including a dedicated core, memory, I/O, and interrupts. This approach is optimal for security, reliability, and determinism, when critical response time is important. All INtime RTOS and Windows processes run natively, with support for all current versions of Windows – including Windows 10 (Figure 1).

Current INtime RTOS environments remain backward compatible to applications developed for prior INtime versions, preserving your software investment. Migration libraries are provided for Windows API level real-time extension code.
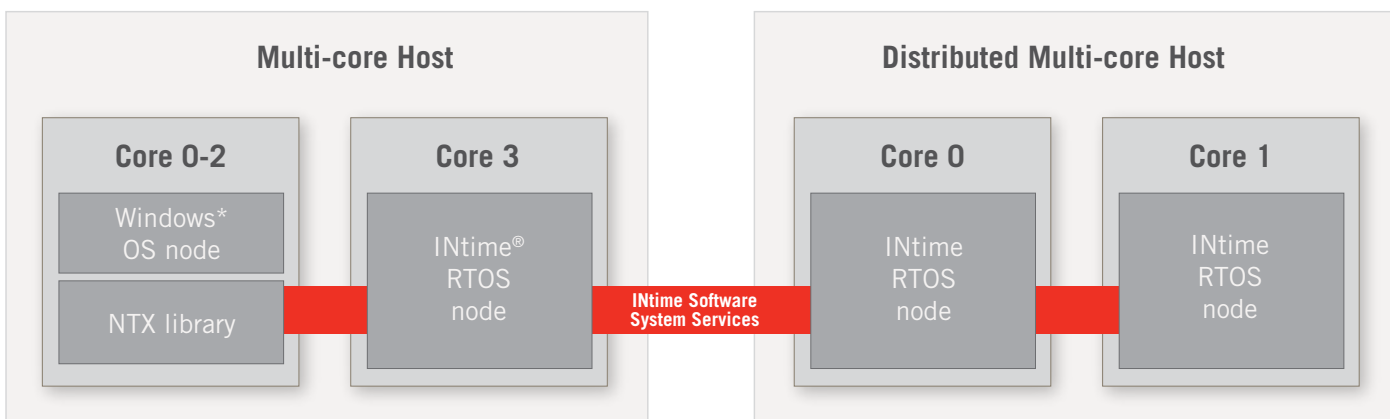

Figure 1. Independent OS instances with distributed system services.

Object-based RTOS with comprehensive kernel services

To accelerate time to market and simplify development, INtime RTOS provides the standard services of general purpose operating systems. These services allow programmers to rely on the OS to manage the many system tasks in their solutions without having to create their own code. INtime RTOS is object based, supporting a familiar programming methodology. The INtime RTOS kernel provides several objects and maintains the data structures that define them and their related system calls. For any created object, the kernel returns a handle for that object, which can be used in any INtime RTOS or Windows process across the distributed system. Each process executes in protected user mode (Ring 3), with up to 4GB of memory, limited only by the host resources.

Features	Benefits
Object management	Creates, deletes, and manipulates object types
Time management	Provides time-of-day, time synchronization, and alarm services
Thread management	Manages scheduling, synchronization, and run-time statistics
Memory management	Manages physical and virtual memory for nodes and processes
Interrupt management	Manages hardware interrupts from I/O devices
Exception handling	Built-in handling of SW exceptions and HW faults for reliable, self-healing solutions
Windows Registry access	Registry for interoperation between Windows and INtime RTOS environments
Connectivity	Standard Ethernet and TCP/IP stacks, including INtime's High Performance Ethernet
IPC Mechanism	GOBSnet, an INtime RTOS comprehensive IPC

Embedded virtualization through explicit hardware partitioning

INtime RTOS is a hard real-time event driven operating system with determinism measured in microseconds.

Deterministic applications require dedicated and isolated resources from the host: cores, memory, and I/O. INtime RTOS was designed for deterministic applications and dedicates resources to each real-time node by explicitly partitioning the host hardware, giving the real-time application the needed resources (Figure 2). INtime RTOS is built for embedded virtualization deployments and it natively supplies a rich set of services and capabilities that developers expect in a mature operating system.

Drivers for low latency are included for:
- Ethernet and INtime's High Performance Ethernet (HPE), a foundation for EtherCAT*, Sercos III*, Profinet*
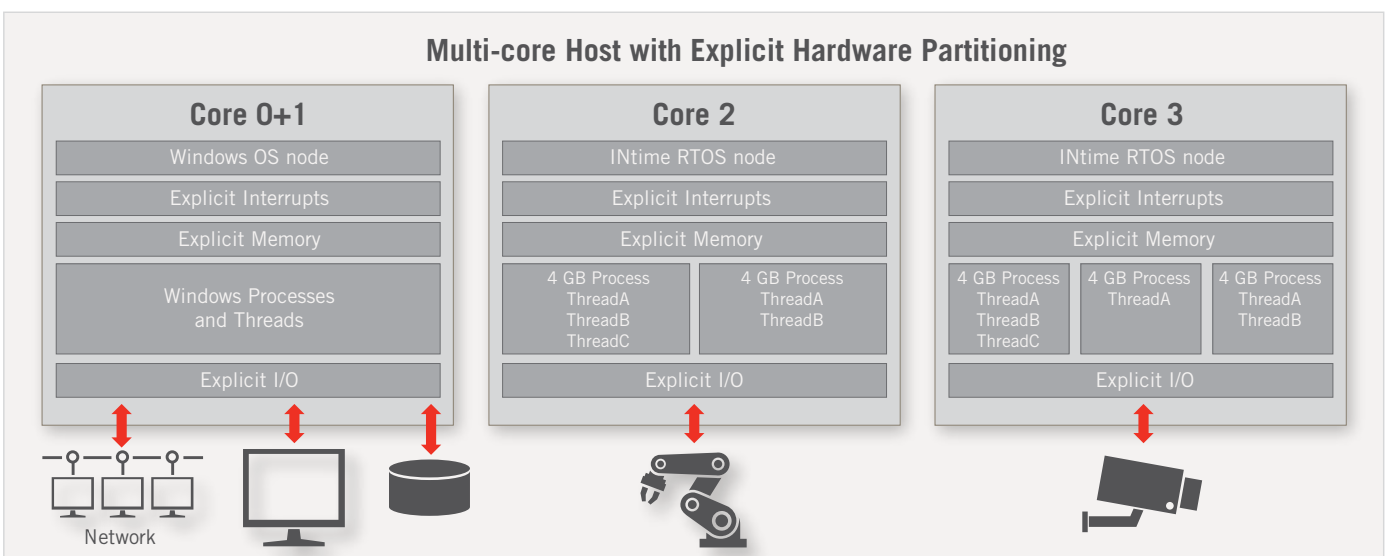- xHCI USB, PCI*/PCIe*, and serial ports

Figure 2. Explicit Hardware Partitioning.

Global Objects (GOBS) enable scalability and flexibility

INtime RTOS provides a deterministic IPC mechanism (GOBSnet) to catalog, search, and use all created objects across the system, enabling scalability for embedded system designs (Figure 3).

Using explicit hardware partitioning and asymmetric multi-processing (AMP or core affinity), INtime RTOS enables scalability of deterministic applications across multiple nodes for performance or combined on fewer nodes for cost savings.

GOBSnet delivers a comprehensive set of efficient communication services across Windows and real-time applications, whether running on the same multi-core host or across distributed hosts. Though isolated from each other, sharing across environments allows Windows services to interact with embedded functions, enabling integration and eliminating the inter-networking complexity and points of failure risks of traditional embedded designs. This provides flexibility to scale with the potentially changing topology of the solution without porting.
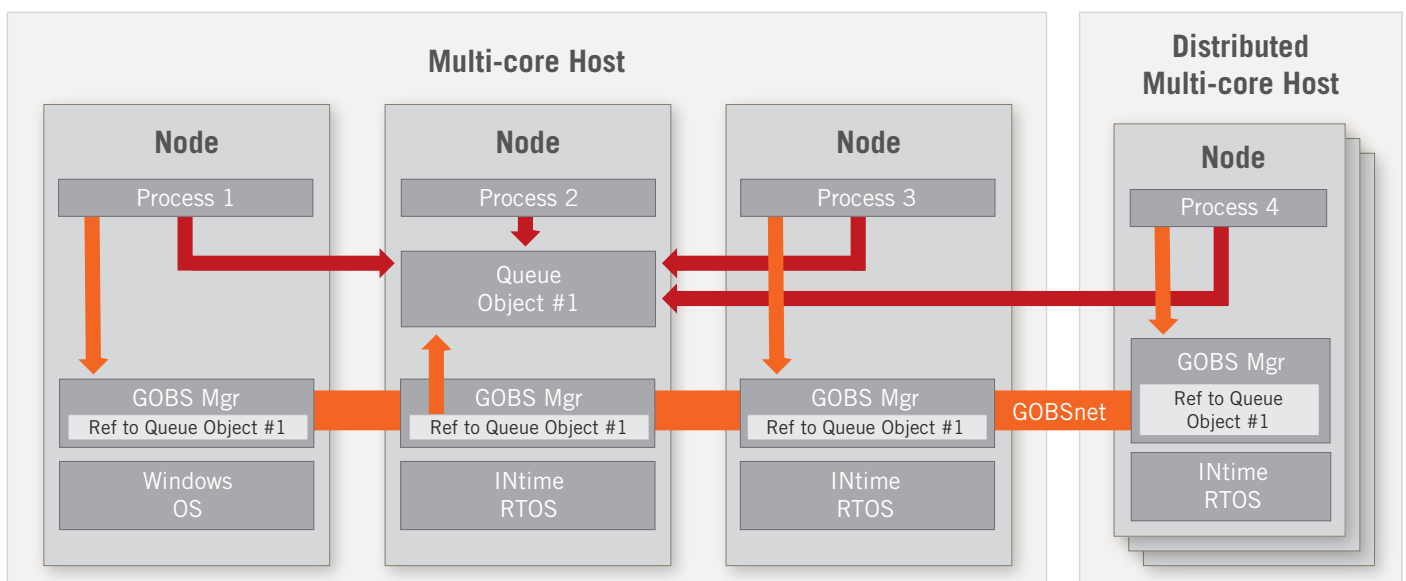

Figure 3. Topology Independent Global Shared Object References for Mailboxes, Semaphores, Queues, and memory regions.

Distributed Systems Manager for reliable distributed solutions

The Distributed Systems Manager (DSM) monitors all nodes and their processes to maintain continuity and availability of the entire embedded system. The DSM tracks the state of the system, monitors the health of its components, and cleans up in the event of component termination or failure.

Each instance of INtime RTOS or Windows is considered a node. Any INtime node can create objects accessible from any other node, whether on a single host or across a system of distributed hosts. An advanced, integrated memory manager maintains memory allocation for each process.

INtime RTOS summary

INtime RTOS enables a modular programming model running user-mode real-time applications instead of kernel mode driver extensions. Support for global objects, multiple IPC mechanisms, full exception and error handling, and a rich set of standard kernel services allows developers to quickly and easily create scalable and reliable embedded applications. TenAsys supports INtime RTOS solution development with a wide range of tools, including INtime Software Development Kit (SDK), which integrates into the familiar Microsoft Visual Studio environment to simplify solution creation.

Choose your deployment model

INtime RTOS offers two different deployment models. INtime for Windows enables a mixed solution of Windows and INtime RTOS nodes on the same host. INtime® Distributed RTOS allows running embedded applications on hosts as standalone systems or part of a distributed system (Figure 4).

Applications developed on INtime RTOS can be deployed – unchanged – across either deployment model or both. Solutions are scalable to reassign and balance applications on available hosts and cores without recompiling.
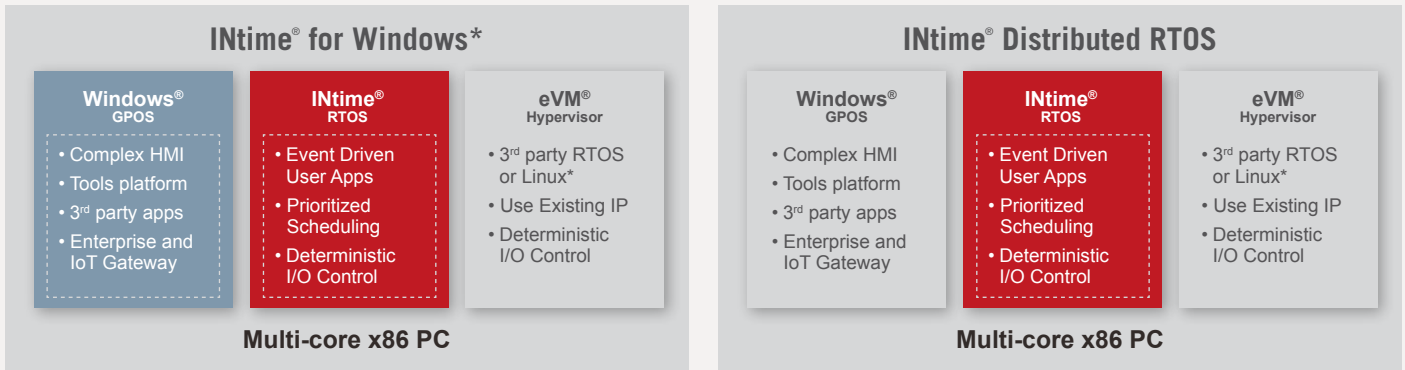

Figure 4. INtime RTOS Deployment models of TenAsys SW Platform.

Features	Benefits
Deterministic, event-driven processing	Reliable foundation for embedded real-time designs
Host-agnostic	Flexibility and compatibility of PC hardware and software to optimize performance and cost: no board support package (BSP) required
Flexible topology	Consolidated or distributed nodes, standalone embedded applications or alongside to Windows
Kernel services in an object-based RTOS	Enables fast development of scalable, reliable solutions using industry programming methodology
GOBSnet: deterministic Inter Process Communication (IPC)	Reliable communications between RTOS and Windows processes across nodes and hosts
Dedicated I/O interface partitioning: HPE, PCI/PCIe, Serial, and xHCI USB	Ensures determinism and eliminates potential failures due to conflicts between RTOS and Windows nodes
Fully featured TCP/IP stack and low-level drivers	Low latency on communication to I/O devices; out-of-the-box driver support for common onboard I/Os
SIMD library support	Use IPP and MKL libraries for optimal MMX, SSE, and AVX services

Reference to related data sheets:

- INtime Software Development Kit
- INtime for Windows
- INtime Distributed RTOS

For more information visit www.tenasys.com or contact one of our world wide offices

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