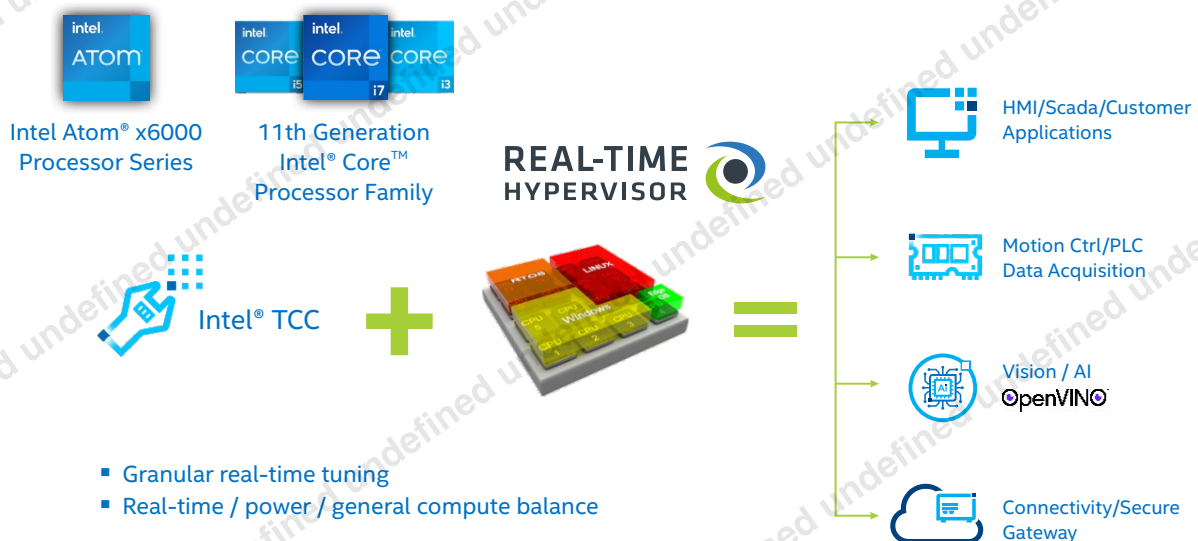intel.

Achieve Near-Zero Virtualization Overhead for Real-Time Workloads Leveraging Enhanced Real-Time Processing with RTS Hypervisor on Latest Intel Processors

Introducing RTS Hypervisor for Real-Time Workload Consolidation with 11th Gen Intel® Core™ and Intel Atom® X6000E Processor Series

The introduction of the Real-Time Systems (RTS) Hypervisor* on the latest Intel platforms facilitates new possibilities for real-time applications, ranging from robotics and smart cars to factory automation and utility load management.

Attaining Virtualized Real-Time Requirements
Enabling workload consolidation of real-time and non real-time workloads

Intel Atom® x6000 Processor Series

11th Generation Intel® Core™ Processor Family

REAL-TIME HYPERVISOR

Intel® TCC

- Granular real-time tuning
- Real-time / power / general compute balance

HMI/Scada/Customer Applications

Motion Ctrl/PLC Data Acquisition

Vision / AI OpenVINO™

Connectivity/Secure Gateway

Attaining virtualized real-time requirements by enabling workload consolidation of real-time and non-real-time workloads.

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The Challenge of Real-Time Workloads

Hard real-time use cases, in which any delay in execution can lead to a catastrophic failure of the entire system, rely on synchronization, timeliness, and a worst-case execution guarantee.

Performance of real-time applications is a result of system-level design and operational behavior. The challenge for real-time system designers is that every platform element must perform its tasks in a reliable and predictable manner, and within a specific time window. Such crucial tasks include both computation and communication. Robotic arms and visual inspection devices, for example, require real-time communication between the control logic, the sensors, and the actuators.

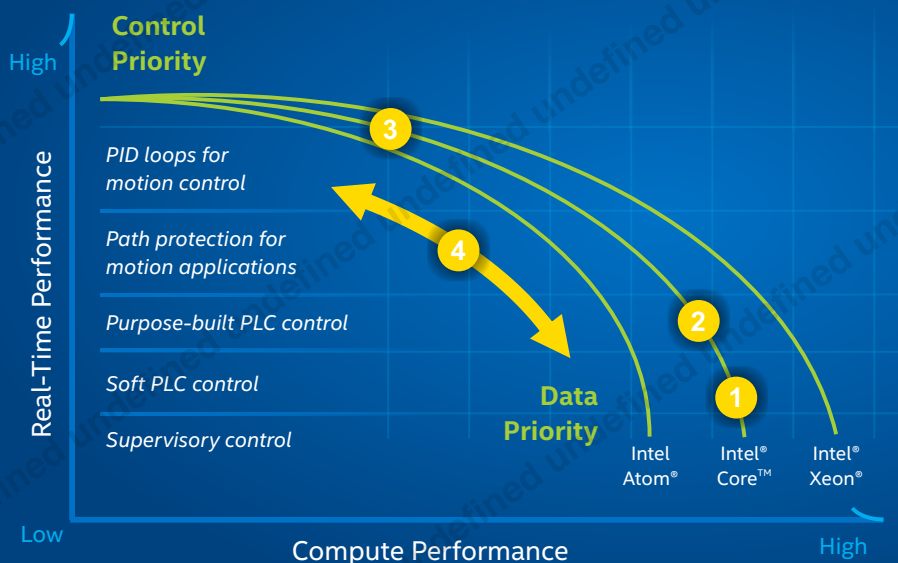Most programmable logic controllers (PLCs) deployed today are single-purpose. They execute a single real-time task, but are unable to perform multiple workloads, such as a combination of real-time and non-real-time jobs. These PLCs do not have sufficient system resources to support multiple workloads, or the ability to handle the cross-workload isolation required to prevent real-time workloads from getting bogged down due to resource competition from less time sensitive tasks.

Workload Consolidation Drives Efficiency

Intel platforms – with their ample computation and communication resources – support workload consolidation. This includes support for parallel execution of multiple workloads, each in its own operating system environment or virtual machine (VM), and managed by a software "hypervisor" layer. The hypervisor facilitates the ability to run different VM instances simultaneously on a single platform. One VM instance might, for example, provide a human machine interface (HMI), while another is dedicated to handling a motion control

Attaining Real-Time Requirements
Without Compromising Other Performance Vectors

Control Priority

High

Real-Time Performance

- PID loops for motion control
- Path protection for motion applications
- Purpose-built PLC control
- Soft PLC control
- Supervisory control

Data Priority

Low

Compute Performance

High

Intel Atom® Intel® Core™ Intel® Xeon®

Fixed Optimization Points

1 No optimizations
  - Recommended industrial SKUs of Intel processors

2 Out-of-box configuration
  - Board support package with real-time optimizations

3 Out-of-box configuration with Intel® TCC optimizations
  - Board support package with real-time optimizations
  - Intel® TCC Mode in BIOS

Flexible Tuning

4 Intel® TCC Tools

Attaining real-time requirements without compromising other performance vectors.

application that requires real-time processing and communication.

Workload consolidation of multiple real-time critical and other workloads on a single platform offers enhanced efficiency than solutions based on single-purpose platforms. Virtualization provides a highly efficient solution for environments that require versatile functionality, such as device control, networking, analytics, safety monitoring, and user interface tasks. Workload consolidation also helps ensure a high degree of coordination, manageability, and orchestration, both within and across devices. This facilitates integration with common information technology (IT) workload management and orchestration systems, enabling the convergence of IT and operational technology (OT).

Developing more robust PLCs, based on general compute platforms that can handle a variety of workloads, requires the ability to account for the worst execution time – whether it is in applications, middleware, operating systems, firmware, or hardware. Interference from other workloads competing for resources needs to be reduced, and the configuration and tuning must be able to balance critical performance vectors for lower latency, lower power, and fast throughput.

The combination of the powerful 11th Gen Intel® Core™ and Intel Atom® X6000E Processor series, with RTS Hypervisor by Real-Time Systems, ensures the real-time execution and isolation of workloads from one another.

Using Intel® Time Coordinated Computing with RTS Hypervisor for Better Real-Time Performance

Intel® Time Coordinated Computing (Intel® TCC) enhances the real-time capabilities of the 11th Gen Intel® Core™ and Intel Atom® X6000E Processor series to support workload consolidation in even the most demanding production environments. The core value proposition of Intel® TCC is minimizing latency and reducing jitter in real-time critical applications at the system level. Applications employing deterministic field buses and networks for real-time critical communication, such as Time Sensitive Networking (TSN), also benefit from Intel® TCC.

Moreover, the RTS Hypervisor offers numerous features for deploying, configuring, executing, and managing multiple workloads. Many of these features are specifically attuned for real-time critical workloads and use Intel® TCC, if available. RTS Hypervisor prioritizes real-time workload access to platform resources, such as CPU cores, cache, memory, and networking. This minimizes disruption from other workloads and helps ensure meeting the real-time requirements. When deploying multiple VMs, the boot sequence can be specified, and, if needed, one VM system can be rebooted independently of the others. To facilitate communication between VMs, RTS Hypervisor implements configurable user-shared memory, an event system, and a TCP/IP-based virtual network.

The 11th Gen Intel® Core™ and Intel Atom® X6000E Processor series include at least four cores. With RTS Hypervisor, these platforms can, for example, run a real-time PLC application on one core and share the other three cores between AI-based analytics, diagnostics, and user interface tasks.

Workload consolidation is further enhanced by integrating Intel® TCC with the RTS Hypervisor. Using Intel® TCC, the RTS Hypervisor facilitates real-time communication across individual virtual machines, reducing the overall system latency and maintaining determinism. At the same time, individual write and read rights for shared memory ensure that user access is limited to authorized OS partitions, increasing platform security and reliability.

The Benefits of Workload Consolidation with Intel® TCC and RTS Hypervisor

Integrating RTS Hypervisor with Intel® TCC reduces the total cost of ownership (TCO), accelerates time to market, facilitates scaling in a production environment, and offers future-proof extensibility.

TCO Savings: Consolidating numerous PLCs and peripherals into a single platform results in physical savings thanks to smaller footprint requirements, a reduction in hardware and cabling costs, and lower maintenance costs. Enabling RTS Hypervisor and Intel® TCC for high performance PLCs also facilitates workload consolidation onto a single machine, eliminating licensing costs across numerous standalone PLC units.

Workload consolidation also enables developers to deploy both deterministic and non-deterministic applications onto a single system, which can streamline operations, improve productivity, and reduce complexity – once again lowering TCO.

Implementing and consolidating PLCs and related applications on Intel platforms facilitates control and maintenance using standard IT workload management and orchestration solutions – with potentially huge efficiency gains and cost savings.

Acceleration of Time to Market: RTS Hypervisor with Intel® TCC support facilitates deployment of the 11th Gen Intel® Core™ and Intel Atom® X6000E Processor series for real-time applications. It simplifies upgrading from one generation to the next by reducing development and deployment costs, preserving investments in real-time applications, accelerating implementation, shortening testing and validation cycles, and reducing risks.

Because different workloads are no longer tied to specific customized hardware – thanks to software-defined virtualized environments –updates and upgrades become easier to design, validate, and deploy high performance hardware, such as 11th Gen Intel® Core™ and Intel Atom®X6000E Processors.

Future-proof Extensibility: Intel® TCC enables new approaches to software optimization, with performance and workload scalability from the Intel Atom® X6000E series up to the 11th Gen Intel® Core™ processors – and in future generations of Intel® TCC-enabled processors.

Conclusion

RTS Hypervisor with Intel® TCC support on the 11th Gen Intel® Core™ and Intel Atom® X6000E Processor series enables new opportunities for implementing, consolidating, deploying, and managing even the most demanding and versatile real-time critical applications. This is accomplished without adding any latency, and by reducing jitter. The result is real-time processing that optimizes workload consolidation, reduces costs, and offers future-proofing for upgrades and enhancements.

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