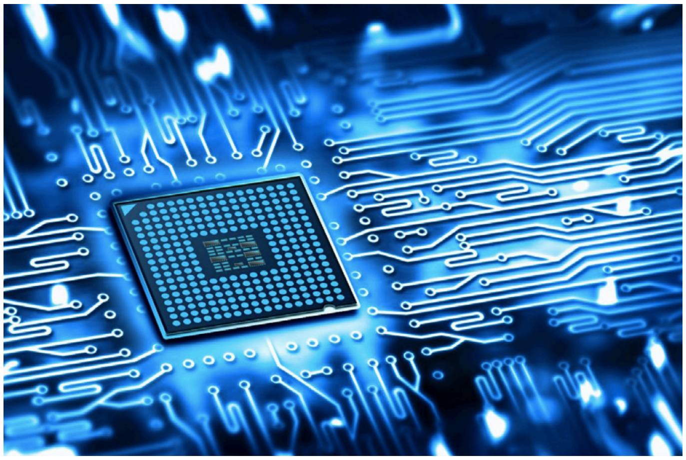
WHITE PAPER

Developing Critical Applications for Multicore Environments: The SCADE Advantage

Bringing together a broad range of components and functionality, electronics systems for automobiles, aircraft and other critical applications has always been a complex design challenge for engineers. Now the addition of multicore processors is making the development of embedded software for these systems even more challenging. Software developers must learn to exploit these multicore platforms with languages and libraries generally not designed for multiprocessor environments. In response, Ansys SCADE — the industry-leading solution for designing embedded software — now delivers powerful capabilities that allow the flawless, reliable automation of design tasks for even the most complex multicore and many-core environments.



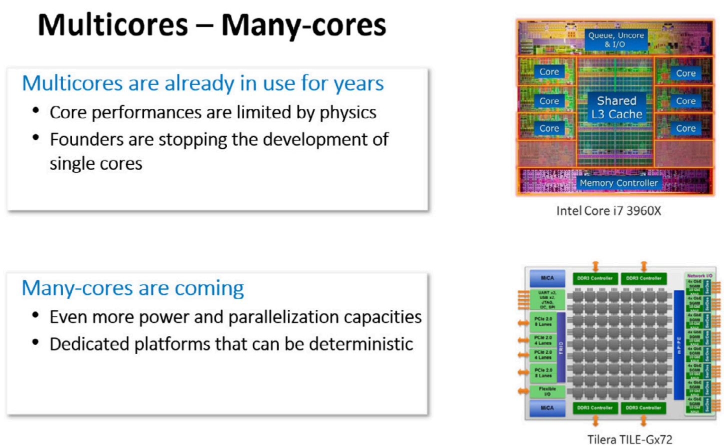
Electronics systems are becoming larger and more complex than ever, delivering new smart functionality and incorporating a greater number of components. At the same time, consumers and product designers alike are calling for smaller technology footprints. The solution? Multicore environments that feature clusters of microprocessors — capable of delivering high levels of power and performance by distributing tasks across the entire processing array, instead of relying on a single-core processor. While multicore environments deliver a range of benefits, they present a significant challenge to the engineers who design embedded software for automotive, aerospace and other mission-critical applications. Not only do these engineers need to ensure that embedded software enables the entire electronics architecture to perform reliably, and that all components will work together flawlessly — but now they must account for the way essential tasks are distributed across multiple cores, how they communicate and how they are synchronized. Fortunately, Ansys SCADE, an industry-leading, model-based development environment for critical embedded software, features innovative capabilities that automate and accelerate design for even the most complex multicore environments.

/ The Multicore Revolution

Incorporating mission-critical components like braking systems or autonomous driving, luxury features like infotainment systems and advanced digital technologies like radar, the modern passenger car is an electrical engineering marvel. Similarly, aircraft, rail vehicles and medical devices have also become incredibly complex — delivering ever-higher levels of functionality via an increasingly complex electronics architecture. At the same time, there are extremely stringent functional safety requirements across the entire automotive and industrial application fields.

As if these challenges weren't daunting enough, today there is a new consideration. In response to market demand for greater and greater power in a smaller and smaller footprint, component designers are incorporating new multicore processors. Single-core processors, the standard for years, are gradually being phased out.

Because they are highly parallel in nature, multicore processors not only facilitate greater speed and power, but they also allow for clean separation of functionalities. This separation can be important in defining different safety or cyber-security protocols for various processing activities and sets of data.



By replacing a single core with a number of microprocessors, product developers have introduced a true innovation — but also have made the job of systems designers even more complex. Now these systems designers need to understand and verify exactly how different software tasks will be distributed across multiple cores and how they will interact in a deterministic fashion, while still honoring the tight deadlines and budgetary pressures that are a given in today's business landscape.

/ A Complicated — and Risky — Design Challenge

Designing systems architectures that incorporate multicore processors is difficult for a number of practical reasons. Numerical problems must be distributed across the processors in a way that makes the most sense, taking into consideration that these tasks will be executed simultaneously and some will take longer than others. Shared memory must be minimized to reduce bottlenecks and dependencies. Communication and synchronization among multiple cores must be managed carefully to reduce interference and ensure deterministic execution and defined Worst Cases Execution Time (WCET).

The use of traditional, manual processes and consumer-grade software tools like Excel™ is simply insufficient to manage this level of complexity. Lacking a graphic view of task distribution across multiple cores, along with automated workflows to manage task scheduling and allocation, engineers are forced to assign functionality across multiple cores in large "chunks" of work — which may or may not lead to an optimal result when the electronics system is deployed in the field. This is a risky approach which compromises safety, adds time and costs, and fails to leverage the full performance benefits enabled by multicore processors.

/ Leveraging the Power of SCADE

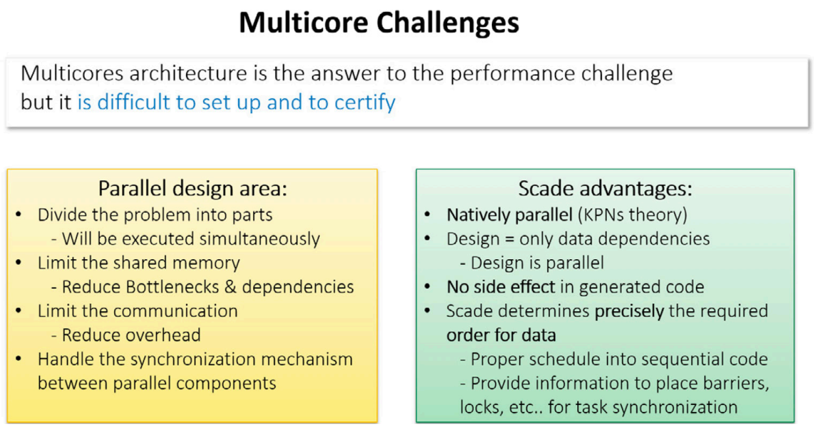
For years, software developers have relied on SCADE solutions from Ansys to ensure the reliability of their control software under real-world conditions. By replacing manual coding processes with SCADE, software engineers have been able to cut significant time and costs from the design cycle — while still ensuring the safety and integrity of their systems designs. It's been demonstrated that, by leveraging SCADE for embedded software design, engineering teams can save 40% of their overall development costs.

/ The Benefits of a Specialized Solution

Why is SCADE so ideally suited to the job of multicore design? One of the main reasons is that the SCADE language is natively parallel. In fact, its underlying foundation, the Kahn Process Networks (KPN) theory, was created for parallel solution design. As the language is naturally concurrent, any operations without data dependencies can be executed in parallel. This means that a user can generate code for multicore targets from any SCADE model. The model is completely independent from the target.

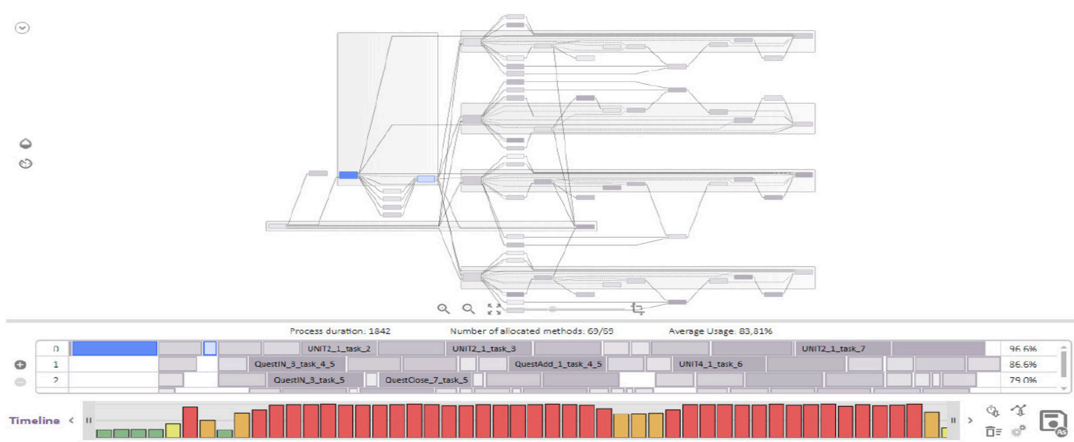
With SCADE, there are no surprises or unwanted consequences as software code is generated by a certified code generator, unlike the bulk distribution of tasks associated with manual methods. SCADE optimizes the synchronization and sequencing of tasks to produce the right deterministic outcome; the behavior of the generated code is the same as for the sequential and multicore versions. SCADE has the high degree of reliability needed to meet the most stringent safety standards for the global automotive and aerospace industries, as well as other mission-critical applications.

In addition, the SCADE environment provides users with a means to perform retargeting — thanks to a dedicated multicore code integration toolbox — without changing the overall functionality description. The code that is generated can easily be integrated into very different contexts such as the number of cores (from two to several hundred), the nature of the communications (by shared memory or by message passing), or the real-time operating system used (or its absence).



This is an important consideration because there are times when, based on the final multicore target or specific constraints, designers may want to change the partitioning and scheduling, while keeping the same input model. SCADE solutions bring a new level of flexibility to this common challenge.

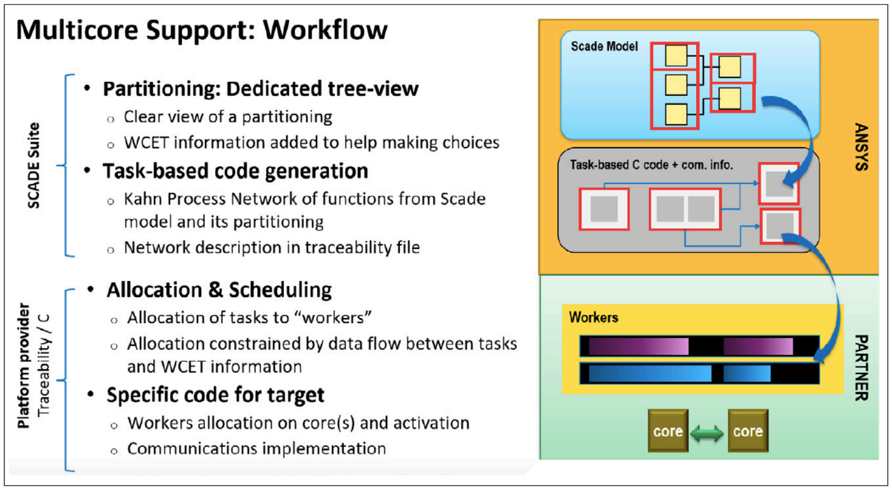
SCADE also facilitates verification of the final software design, so engineers can have a high degree of confidence that electronics systems will operate as planned. Whether running on a single core or distributed across multiple cores, key properties of the sequential code are kept in the multicore generated code: execution determinism, static memory model, and consistent behavior between the model, the sequential code and the distributed code. In addition, SCADE's automatically generated software can be certified to meet relevant industry standards for safety and reliability — eliminating manual labor and its associated costs.



/ Capitalizing on the Multicore Opportunity

While the growing use of multicore processors is delivering new levels of power and performance for electronics systems, it is also making the job of systems design even more challenging. Systems designers must now account for every component and subsystem in the larger electronics package, as well as the multiple processing cores underlying many of these components.

The good news is that SCADE solutions from Ansys can simplify and streamline the design of even the most complex multicore embedded software. By capitalizing on the powerful functionality and automation of SCADE, engineering teams can create a competitive advantage as they speed their designs to market — while also reducing the cost of development. Most important, they can be confident that their systems will perform reliably and safely in automotive, aerospace and other mission-critical applications.



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