

# TI-Nspire family of graphing calculators + Mentor's Nucleus OS = a win for both students and teachers!

*Making mathematics and physics popular subjects in classrooms across the United States is a real challenge today. Finding new and innovative methods to engage students and keep students learning is fundamental to successful classroom learning. Indeed, there is good news for teacher and student alike with the collaboration between the Education Technology Division of Texas Instruments and Mentor Graphics.*

Since its inception in 1941, Texas Instruments (TI) of Dallas, Texas, has been recognized as a technology innovator and leader in areas such as consumer electronics, computers, defense electronics, and software.

Today, TI focuses primarily in the semiconductor sector, which includes DSPs and other application-specific products. Another area of concentration outside of semis is Educational Technology, where the main focus is providing students and educators with the latest technology to make classroom learning a more rewarding experience.

TI's Educational Technology group continues to break new ground in both education circles and in the products they offer. The group provides a wide range of advanced tools to connect the classroom experience with meaningful, real-world applications. For the past 15 years, TI has worked closely

with educators and administrators to develop student-focused curricular and supplemental classroom materials.

## The challenge at hand

TI is known for many new products and technologies. In this particular situation, the Educational Technology group was tasked with creating a next generation graphing calculator that would enable secondary through collegiate mathematics students to learn visual representations of problem solving, which in turn, would allow them a deeper understanding of mathematical concepts. This would be no ordinary graphing calculator. It would require an advanced gray scale LCD, 32-bit CPU, SDRAM, NOR Flash, NAND Flash, USB, and secure 802.11 – all on an extendable operating system that could handle a variety of additional demands such as support for



*The TI-Nspire handheld is quite possibly the most inspired learning technology device ever imagined.*

peripherals, including temperature and motion data collection sensors.

As a result of these challenges, the new TI-Nspire™ family of graphing calculators was born. The idea behind TI-Nspire is to bring together representations of graphing, interactive geometry, and mathematical spreadsheets onto a single LCD screen. Therefore, graphs, geometric sketches, spreadsheets of problem-based data, mathematical figures and symbols, along with text conveniently organized and linked would serve as the core functionalities.

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## TI turns to Mentor

Because TI graphing calculators have a long, useful life it was important to align with a company that would be in business for the foreseeable future. Further, as new models of the graphing calculator roll-out, it's critical that the software already developed by TI, be rapidly re-used, to reduce development time and costs. Mentor Graphics represents the ideal company in this regard. As one of the lead systems engineers on the TI-Nspire project said, "we were looking for a software platform with a high longevity, which is mission critical for us in order to meet our long-term objectives and maximizing ROI."

TI decided to work with Mentor Graphics because of Mentor's track record in developing and supporting its own connectivity middleware solutions for interfaces such as USB, TCP/IP, and secure 802.11. The TI-Nspire team knew that future products will likely require additional connectivity middleware and working with Mentor Graphics, a company that develops, supports, and offers a wide portfolio of middleware products, would allow TI to cut down on development time and costs over the years. "As we commit to an OS vendor, the last thing we need is to have our key

software components become obsolete because that vendor is no longer around a few years from now," said one of the technical leads on the project.

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*“Research shows that graphing calculators and wireless collaborative technologies lead to higher student interest, engagement, and achievement in mathematics”*

— UNIVERSITY OF HAWAII,  
CURRICULUM RESEARCH & DEVELOPMENT GROUP

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In order for TI-Nspire to be successful and launch on time, it was essential for the developers to insource trusted middleware solutions from Mentor Graphics so that TI could add value where it was most needed – in this case, developing the key operating characteristics of the TI-Nspire graphing calculator.

### **Nucleus OS – the foundation of TI-Nspire**

The TI Educational Technology group selected Mentor's Nucleus<sup>®</sup> OS as their primary operating system for a number of reasons. TI liked the fact that the Nucleus OS is a proven and stable operating system. Nucleus OS also offers scalable features, a small memory footprint, and middleware for major features.

From a pure business perspective, it didn't hurt that Nucleus OS offers royalty-free source code.

Nucleus OS provided the TI-Nspire team with quick up-time, which allowed the developers to be productive right out of the box. To understand the merits of the Nucleus OS, a closer look at these stated reasons is required:

- **Proven and stable OS**

Nucleus OS is currently deployed in millions of devices worldwide. A stable kernel means a reliable OS with minimal risks.

- **Scalable features**

The scalable and modular aspects of Nucleus OS mean it's highly configurable. TI developers used a lightweight kernel for peripherals, and the complete OS for the handheld platform. Design teams use only the components they need, negating overhead.

- **Small memory footprint**

A small footprint reduces the amount of memory required. This not only enables reduced power consumption, but also enhances product margins by lowering bill-of-material costs.

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### • **Middleware solutions**

As the device evolves, it's critical that new feature-set requirements be met with minimal OS development effort. TI can insource trusted middleware, developed and supported by Mentor Graphics, to respond to changing market dynamics.

### • **Royalty-free license**

There are no surprises or hidden costs down the road with Nucleus OS. Licensing issues are all but eliminated.

The bottom line, TI selected Nucleus OS and Nucleus USB stack to help get the TI-Nspire product to completion. TI also knew that Mentor has been in the business for nearly 25 years, supplying strategic software technology to the world's leading electronics firms. TI looked at Mentor as an experienced, trusted, and low-risk design-team collaborator who would be around for the many years to come. Finally, the TI-Nspire team liked the fact that Nucleus OS was easy to port and that developers did not have to re-learn Nucleus with each new application.

### **EDGE Developer Suite plays an early role**

The TI-Nspire team used an iterative approach when developing the TI-Nspire product which means continuous development cycles, integrations, and testing. This allowed for all third-party components to be included at the system level

early in the design and development phases. This type of approach eliminates major surprises later in the final stages. During the initial development phase, the TI-Nspire team used SimTest, a software prototyping environment available as part of Mentor's EDGE™ Developer Suite, to demonstrate proof-of-concept within the embedded application when the actual device hardware was not yet available.

### **The value of a successful working relationship**

In the past, the TI Educational Technology group used its own proprietary OS and drivers. This was the first time the team had licensed most of the foundation

from an outside source. The team placed a lot of confidence in what the Mentor products could deliver. Also, this was the first time the group was working on a new ASIC design, so they were trying out certain new features of the hardware. The team was quite pleased with the results.

Further, it's always a bit of a challenge getting a stable kernel for a handheld device. But this time Nucleus OS proved to be very stable kernel. The real challenge was integrating Nucleus networking with the Nucleus USB stack.



*TI-Nspire graphing calculators in the classroom environment.*

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## Solid support: onsite and online

Along with reaping the advantages from Mentor's proven embedded solutions, the TI-Nspire team was equally impressed with Mentor support, both onsite and online.

The team tapped into SupportNet, Mentor's award-winning Internet support network that allows customers access to a vast database of customer case studies and problem solving. The SupportNet service proved invaluable, "most of the assistance we needed we received within 24

*"Nucleus OS and USB drivers provided a very strong foundation for us."*

— TECHNICAL LEAD, TI

hours," said one of TI-Nspire technical leads.

In addition to Internet support, Mentor was also active onsite during the integration process, solving many of the unexpected challenges that

appeared. Mentor support also provided documentation and demo applications when needed.

## Looking toward the future

The TI-Nspire product launch was successful because the team was able to go to market on time with the intended feature set.

Look for new versions and updates to the TI-Nspire family of graphing calculators in the coming months and years ahead!



*The TI-Nspire family of graphing calculators from Texas Instruments.*

## Visit [www.mentor.com/embedded](http://www.mentor.com/embedded) for additional product information.

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02/07 MGC

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