

eXpressDSP™

John Schanzenbach

eXpressDSP Platform Manager



What is eXpressDSP?

Code Composer Studio™

Powerful, integrated
development tools

DSP/BIOS II™

Scalable, real-time
software foundation

eXpress (ek-spres') adj. 1. Moving at
high speed. Direct, rapid, usu. non-stop.
v. 2. To communicate ideas through
artistic creativity

DSP Algorithm Standard

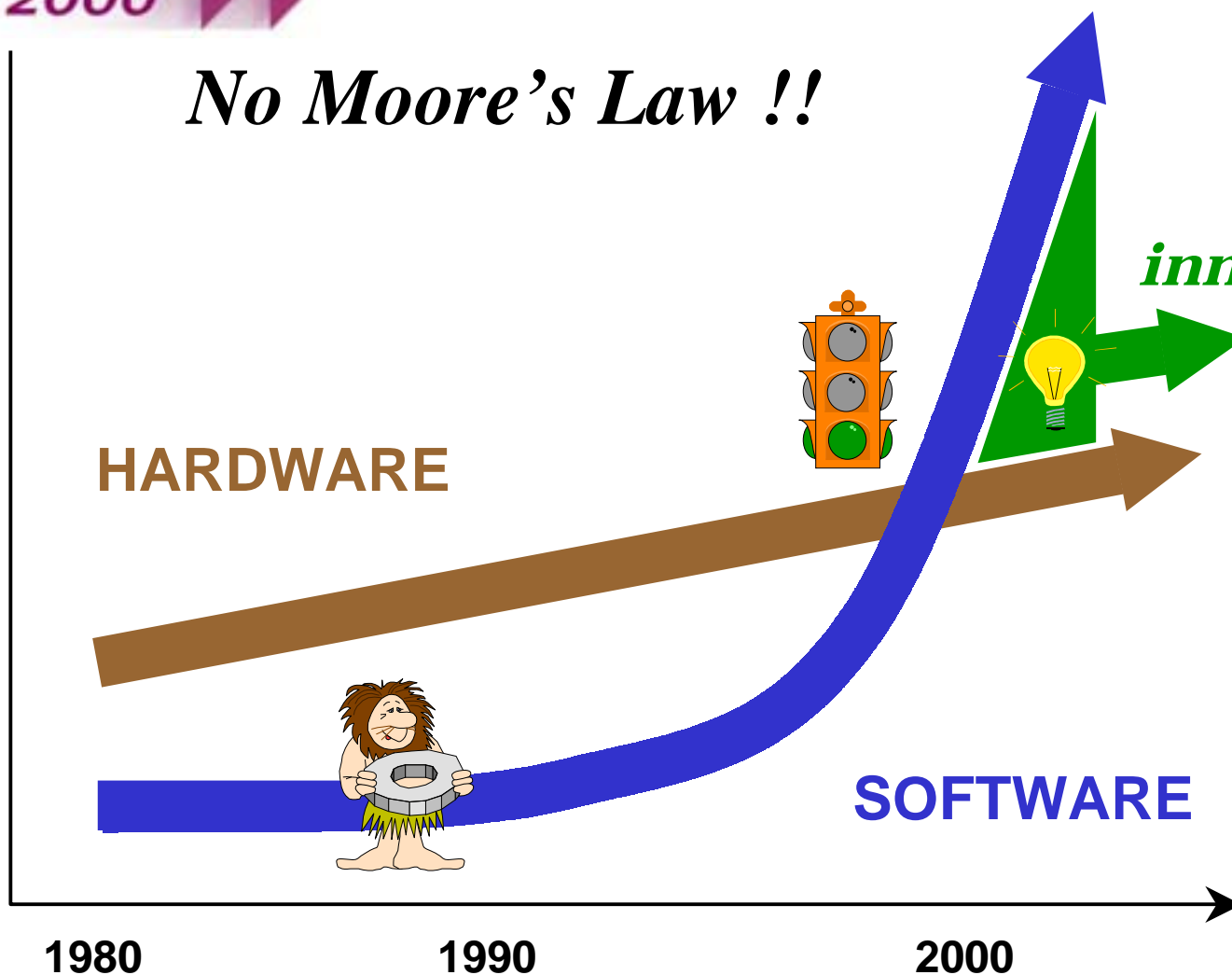
Standards for
application
interoperability

Third-Party Network

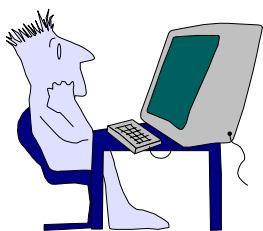
Reusable, modular
software and support

Why eXpressDSP ?

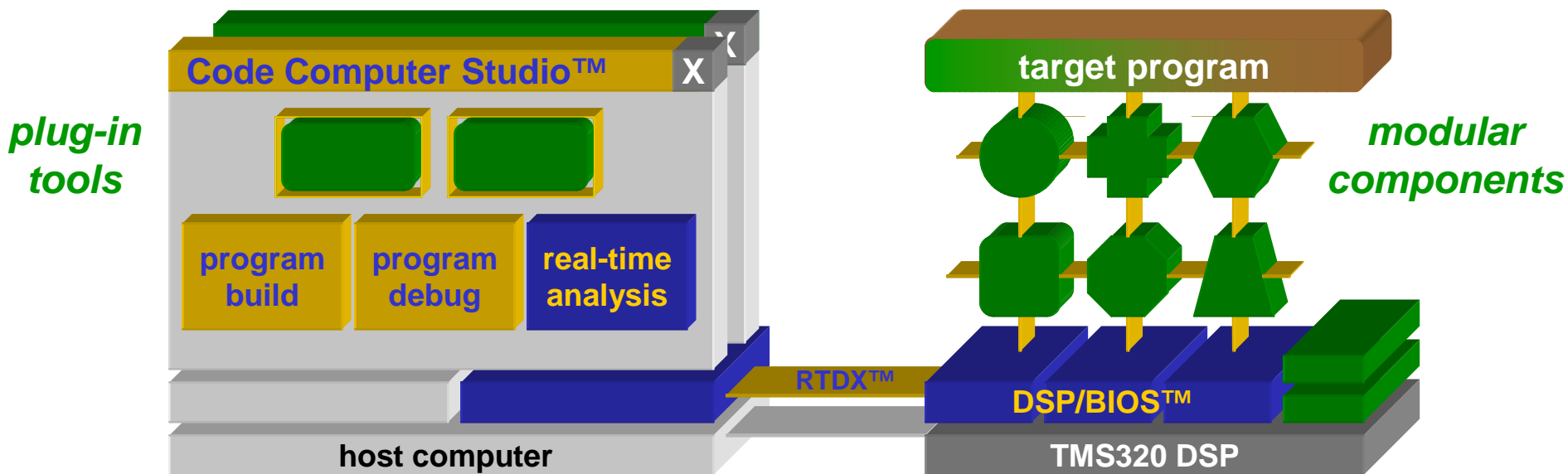
No Moore's Law !!



The Real-Time Software Foundation



- ✓ Integrated program development tools - CCS
- ✓ Scalable, real-time software foundation - DSP/BIOS
- ✓ Standards for application interoperability - XDAIS
- ✓ Third-party & university partners network



Our Vision

DSPS Fest
2000

eXpressDSP,
our *premier open* software
environment,
will drive TI products
to be pervasive in every DSP
application

During 1999

DSPS Fest
2000

Code Composer Studio

Launched CCS 1.0/1.1
FIRST full integration of
acquisition strategy

DSP Algorithm Standard

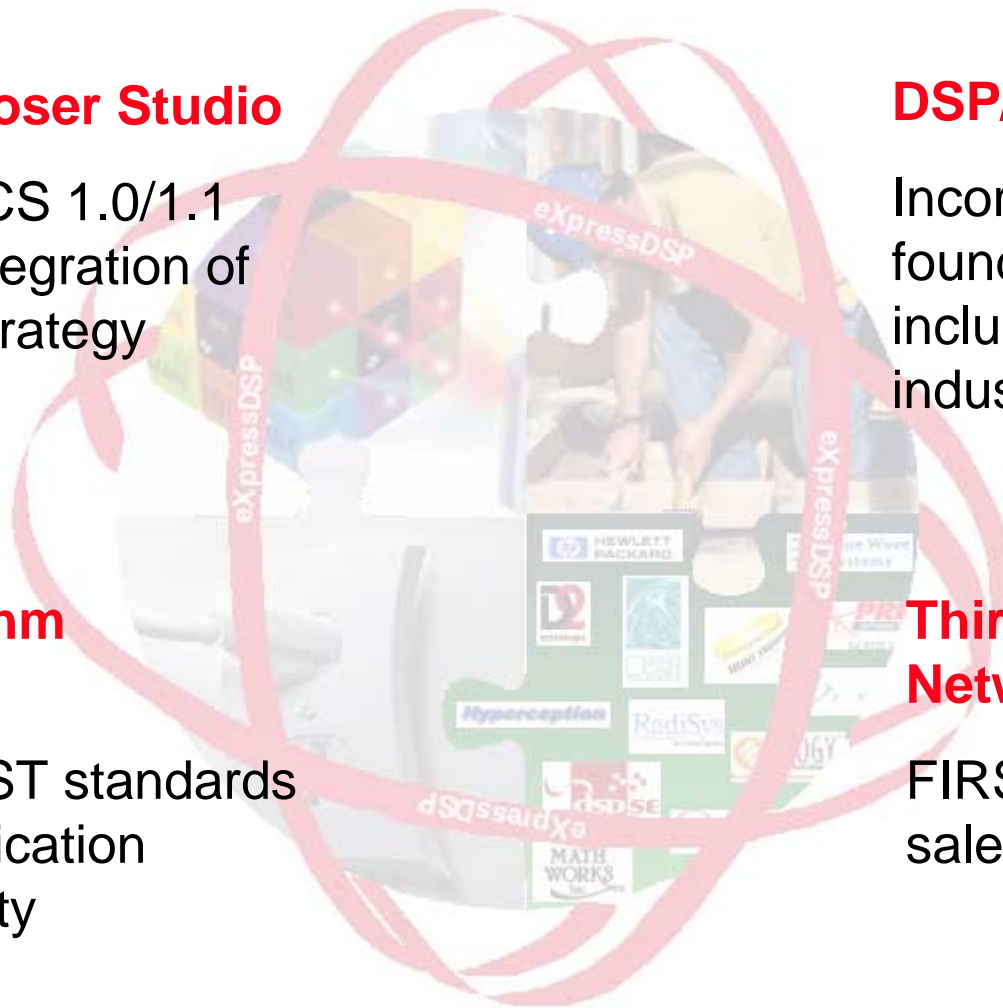
Created FIRST standards
for DSP application
interoperability

DSP/BIOS II

Incorporated as DSP
foundation SW -
included in CCS -
industry FIRST

Third-Party Network

FIRST dedicated
sales/FAE force





2000 Policy Deployment

- ▶▶ Drive eXpressDSP SW adoption
- ▶▶ Create compelling new products and technology that delivers time-to-market advantage to our customers

Accelerating eXpressDSP Adoption

2000 Goals



Code Composer Studio

- ▶ Double 320 developers
- ▶ Launch v1.2
- ▶ Develop v2.0
- ▶ Strategic plug-ins

DSP Algorithm Standard

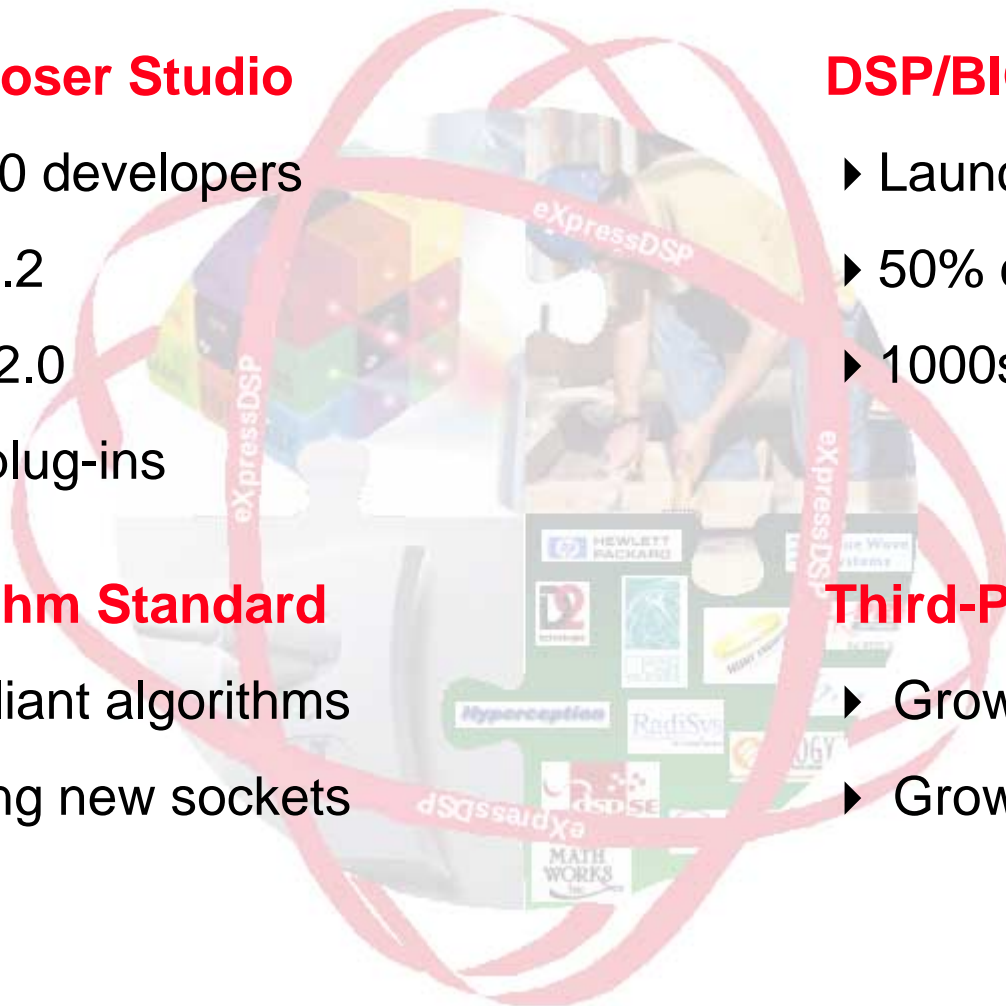
- ▶ 250 compliant algorithms
- ▶ 100 winning new sockets

DSP/BIOS II

- ▶ Launch DSP/BIOS II
- ▶ 50% customer usage
- ▶ 1000s of customers

Third-Party Network

- ▶ Grow SW providers
- ▶ Grow eXpressDSP brand



Industry Leading Real-time Tools

Reduce Cost, Risk and Development Time

Enhancements

In Code Composer Studio 1.2

DSP/BIOS II

Flexibility, scalability and ease of implementation

New Compiler Tools

Visualize and optimize for maximum productivity

New Cores

All customers can start today!

Slash product development time over 50%



Code Composer Studio v1.2

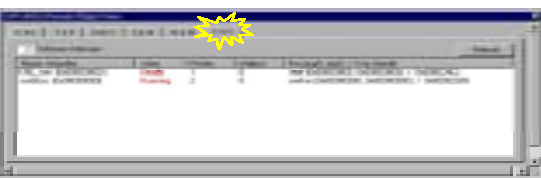
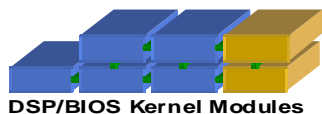
Complete Integrated DSP Kernel

Code Composer Studio™ 1.2

DSP/BIOS II — Managing Time, MIPS and Memory

Scalable, extensible real-time kernel optimized for TMS320™ DSPs

scalable *extensible*



NEW AND ENHANCED SOLUTIONS IN DSP/BIOS II

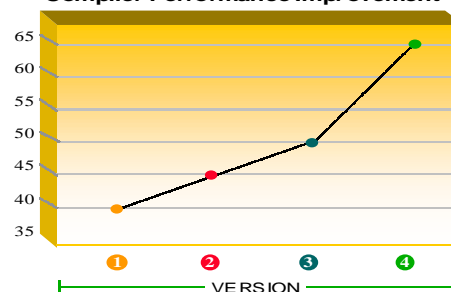
- Increased level of scalability
 - Consumes minimal MIPS and memory
 - Individually selectable modules
- Extensibility with 3rd-party plug-ins such as communication stacks/protocols
- Dynamically reconfigure system priorities
- Visibility of kernel integrated into Code Composer Studio

Industry Leading Compilers

Compile Tools

#1 DSP Compiler Extends Performance Lead

Out-of-the-box Compiler Performance Improvement



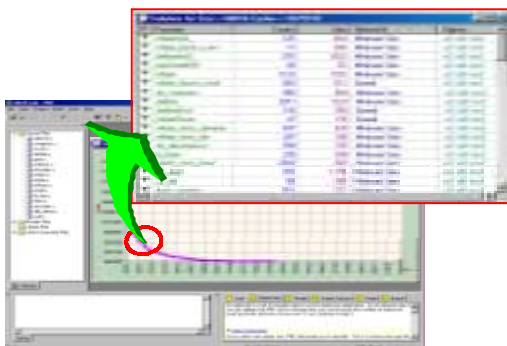
- Achieves 80-90% performance vs. hand coded assembly
- Performance statistics backed up with real code examples downloadable today
- Out-of-the-box C code focus has produced more than 20% performance improvement
- Support for C++

Industry First Profile Based Compiler

Code Composer Studio™ 1.2

New C6000™ Compile Tools

Visualize and optimize code size and performance trade offs



SOLUTIONS FOR THE C6000™ DSP: A Unique Profile-Based Compiler

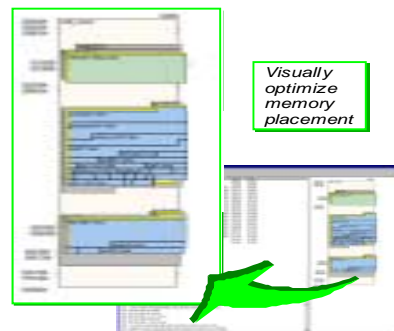
- Build and profile multiple build option sets
- Automatically plot a 2D graph of code size vs. performance
- Graphically select the optimum combination of size and speed for your application
- Click to build desired performance and code size trade-offs in seconds

Industry First Visual Linker

Code Composer Studio™ 1.2

New C5000™ Compile Tools

Visualize and simplify system memory allocation



SOLUTIONS FOR THE C5000™ DSP: The Industry's First Visual Linker

- Drag-and-drop components into multiple memory types and areas
- Obtain immediate visual feedback on memory allocation
- Choose from a library of standard C5000™ device memory maps
- Use "Linker Wizards" to upgrade from existing text to a graphical environment

THE WORLD LEADER IN DSP AND ANALOG

TEXAS INSTRUMENTS

CCS / eXpressDSP WINS!

semiconductor BUSINESS NEWS

“TI offers new kernel, compiler tools to cut DSP development costs, time-to-market”

EETIMES

“Tool sets shorten time from algorithm development to silicon --”



The Center of the Electronics Universe
ChipCenter SM

“New real-time DSP tools from TI increase developer productivity -- enhanced kernel gives DSP system developers greater flexibility, scalability and ease of implementation”



“Blue Wave’s FACT™ resource development kit benefits from Texas Instruments new DSP/BIOS II kernel”

EDN's 1999 Innovation of the Year Award

EDN[®]



The Center of the Electronics Universe
ChipCenter SM

“Texas Instruments leading DSP technologies take home two EDN Innovation of the year awards”

eXpressDSP, an open software-development environment for Texas Instruments DSPs, gives users a real-time make-versus-buy choice for DSP algorithms.

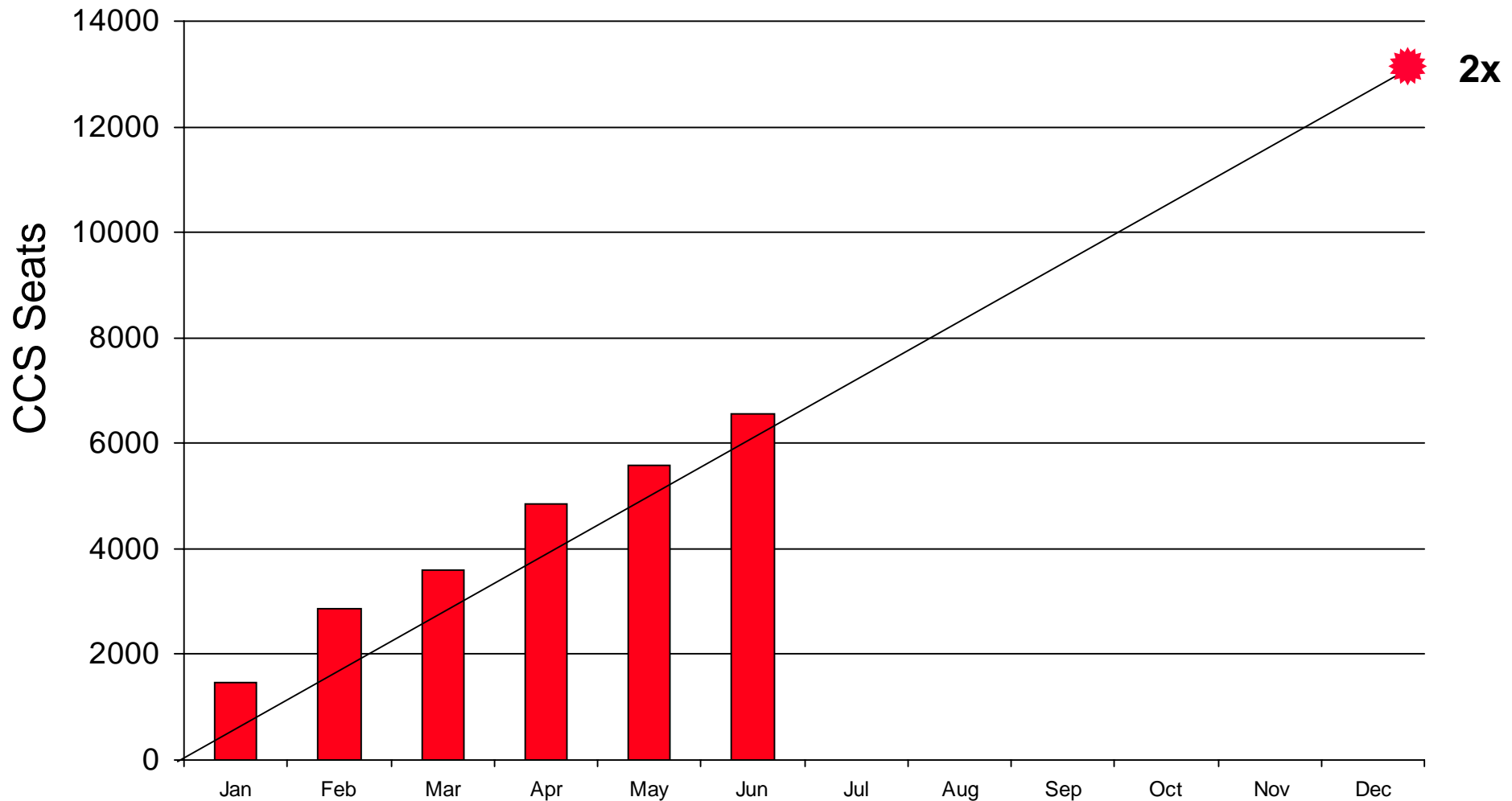
THE WORLD LEADER IN DSP AND ANALOG



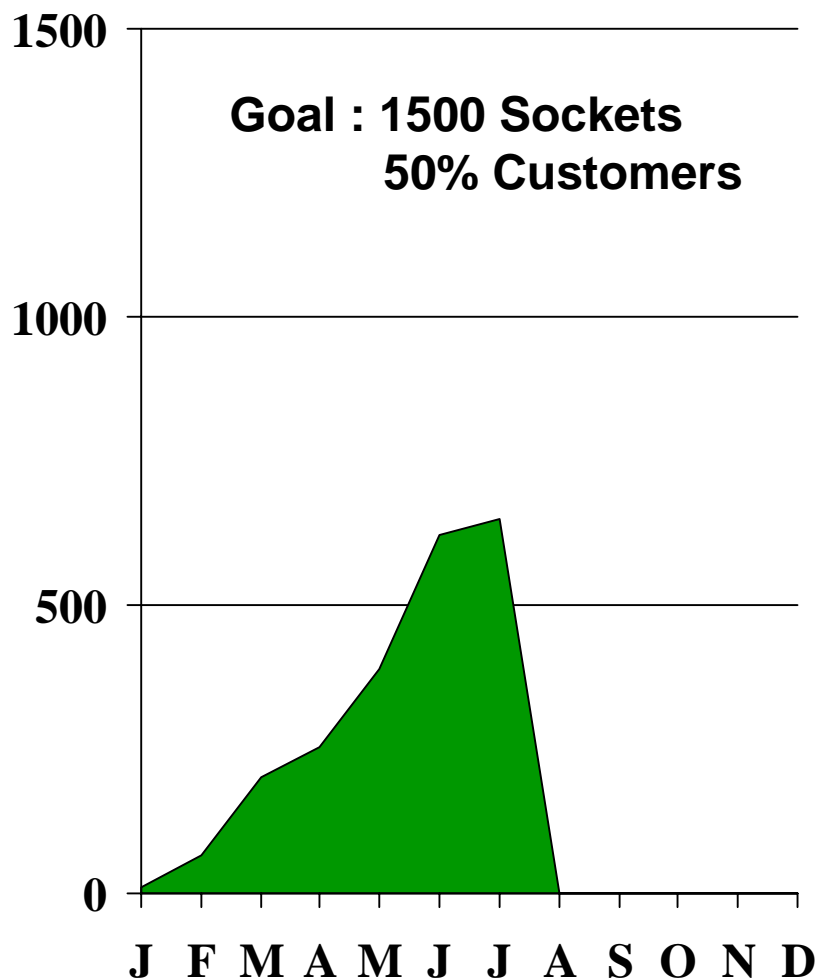
TEXAS INSTRUMENTS



Double the Developers of TMS320



Attaching to 50% of the New Designs



- ▶▶ DSP/BIOS II launched on 4/3
- ▶▶ Boot-camps for TSRs/FAEs completed
- ▶▶ DSP/BIOS featured as FIRST DSP Village discussion group
- ▶▶ Featured in WW seminar series reaching 3000+ customers
- ▶▶ Customer training available - 1 & 3 days classes, web
- ▶▶ Customers are using it TODAY!

DSP Developers Village - opened April 3

- ▶ For DSP developers to find the latest information about TI DSP tools, SW, and 3rd parties
- ▶ Improve quality and efficiency of the TI SW experience
- ▶ Create a community-like experience to address the needs of TI DSP designers
- ▶ Software content merged into Village
- ▶ Currently averaging 40,000 hits/wk

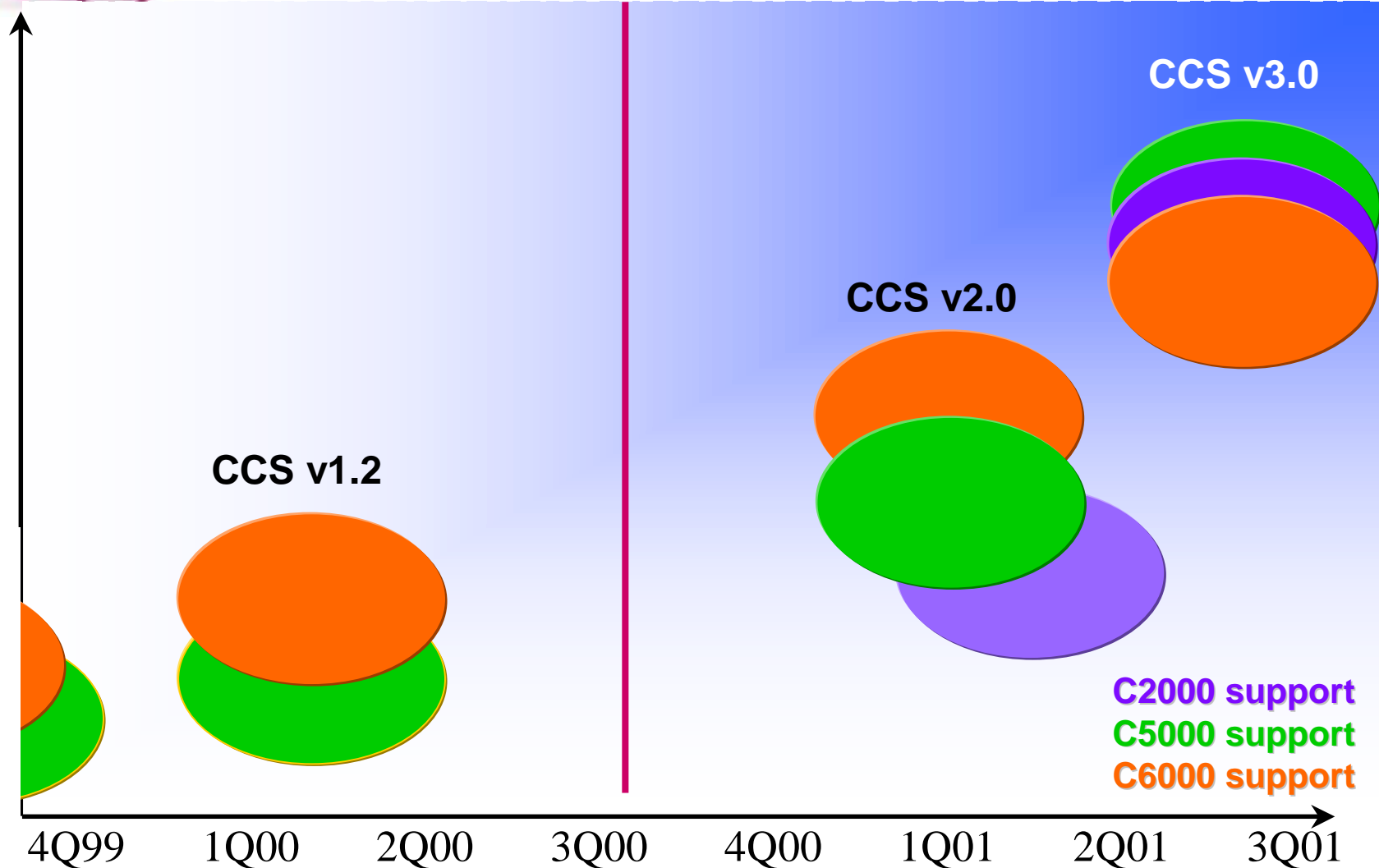
e-Store plan to open June 30, 2000

- ▶ Located "inside" DSPVillage.com
- ▶ TI and 3rd Party DSP product offerings
- ▶ Initially focus on Software solutions
- ▶ First for US, Canada and Europe
- ▶ eXpressDSP compliance requirement

The screenshot shows the DSP Developers' Village website. At the top, the Texas Instruments logo is on the left, and the tagline "THE WORLD LEADER IN DSP AND ANALOG" is on a red background. Below the logo is a search bar with a "GO" button. To the right of the search bar are links for "Advanced Search", "TI Home", "TI Employment", "Tech Support", "Comments", "Site Map", and "TI Global". The main header area has a blue background with the text "DSP Developers' Village" and a graphic of a circuit board. Below this is a blue banner with the text "Where DSP software comes together". The main content area is divided into several sections: "DSP Developer Resources" with links to Discussion Groups, Technical Support, Application Notes, User Manuals, Datasheets, General FAQs, Application Software, Device Drivers, Errata, Application Block Diagrams, Tools Price/Availability, Training, TMS320 DSP Product Catalog, Compatible Analog Products, and Feedback; "eXpressDSP™ Real-Time Software Technology" with a description of the technology; "Purchase Tools" with links to Getting Started, Evaluation Bundles / DSP Starter Kits, Free Evaluation Tools, TMS320 DSP Tools Catalog, Third Party Program, and Third Party Resource Catalog; and "eXpressDSP™ Components" with links to Overview, Code Composer Studio, DSP/BIOS, TMS320 DSP Algorithm Standard, Third Party Products, eXpressDSP demo CD-ROM, New Compliant Products, and New Products in the e-Store. At the bottom, there is a "Featured Documentation" section with links to Application Notes and Benchmarking DSP/BIOS II on the C2000. The Texas Instruments logo and tagline are repeated at the bottom of the page.

What Does the Future Hold?

DSPS Fest
2000



Code Composer Studio

CODE Composer
studio



- ▶ Premier, open, real-time integrated development environment
- ▶ Ease-of-use: dramatic improvements in the things DSP developers do every day
- ▶ Creating compact and high speed code quickly
- ▶ Supporting the entire life cycle of DSP systems development
- ▶ Maturing the requirements gathering process
- ▶ Bringing leadership technology to DSP developers

Code Composer Studio v2.0

▶▶ **Compelling new capabilities**

- ▶ IDE: large project, version control editor enhancements,...
- ▶ WWW based Update Advisor
- ▶ Heterogeneous multiprocessor debug support (RTDX/BIOS)
- ▶ BIOS supported in simulation - RTA
- ▶ CSL integration into Gconf
- ▶ Compiler performance improvements for C55x and C64x
- ▶ Full C++ compile and debug support (C6000 / C5000)

▶▶ **Schedule**

- ▶ Beta Program begins in September
- ▶ Production shipments in 1Q01

▶▶ **Major quality focus**

- ▶ 90+% of known bugs to be fixed
- ▶ Focused 8 week customer beta program - register via DSP Village
- ▶ Utilize new automatic regression test system

▶▶ **O.O.B.E. must be flawless**

- ▶ Improve Install sequence
- ▶ Flow usability improvements
- ▶ Solid project migration
- ▶ 100% customer conversion
- ▶ Host OS Support: Win98, Win2000, WinNT (no Win 95)



Code Composer Studio v3.0

►► **Compelling new capabilities**

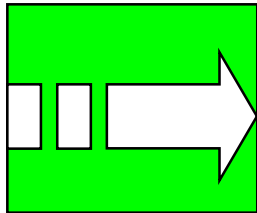
- What are the 3 big capabilities that will make creating high performance/dense DSP systems easier to design?
- Give us your inputs this week

►► **Schedule**

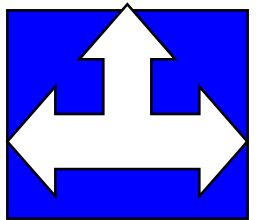
- Requirements closed 4Q00
- Beta Program 2H01
- Production shipments 1H02

Emulation: Real-Time Visibility into Tomorrows Applications

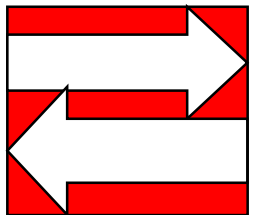
DSPTS Fest
2000



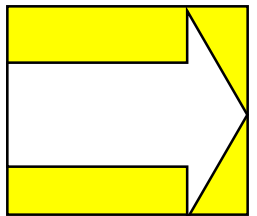
Real-Time
Emulation



Advanced
Event
Triggering



RTDX



Real-Time
Trace

20 MB

XDS5100

XDS560

XDS510

20 KB

- NTSC Raw
- T3/E3
- HDTV MPEG-2
- Videocon Raw

- ADSL
- HDD
- 24 Ch Vocoder
- 20 Ch V.90

- CD Audio
- Low End Videocon
- Audio Telephony

Strengthening the SW Foundation



▶ DSP/BIOS II

- ▶ New target support across ISAs
- ▶ Start early in design with simulation
- ▶ Debug complex multi-processor systems
- ▶ Integration of System Support Libraries (SSL) into common GUI

▶ DSP Algorithm Interoperability Standard

- ▶ New target support across ISAs
- ▶ New XDAIS generation tools
- ▶ New configuration tools

DSPS Fest
2000

eXpressDSP - Supporting all ISAs

C2000™

CCS

1H01

DSP/BIOS

1H01

XDAIS

2H00

3P

NOW

C5000™

NOW

NOW

NOW

NOW

C6000™

NOW

NOW

NOW

NOW



Success is Created with eXpressDSP

- ▶▶ The TMS320 market is accelerating
 - ▶ 10,000s of CCS developers
 - ▶ 1,000s of DSP/BIOS projects
 - ▶ 100s of XDAIS compliant SW
 - ▶ 10s of exciting new plug-ins
- ▶▶ Attend the SW Strategy session
 - ▶ Demo of CCS v2 tonight
- ▶▶ Develop eXpressDSP compliant algorithms and plug-ins
- ▶▶ Participate in our market creation and eStore activities
- ▶▶ Be a driver in the exploding TMS320 DSP market



Steve Blonstein

sblonstein@ti.com

(408) 383-2397



TMS320 DSP Algorithm Standard

▶▶ eXpressDSP compliance program

- ▶ Customers “looking” for additional assurance
- ▶ Significant co-marketing benefits for 3Ps
 - ◆ e-store access, bonus CD-ROMs, shows, web listings
- ▶ Algorithm testing done by TI Santa Barbara
 - ◆ 150 algorithms submitted / 130 passed
- ▶ Plan for independent test house (1H'01)
- ▶ Test pricing
 - ◆ Currently “no charge”
 - ◆ Test fee to apply at independent house
- ▶ Testing level
 - ◆ Currently “link time” only, next rev. will be “run time”.



DSP/BIOS

The real-time software foundation of
eXpressDSP

Elizabeth Keate

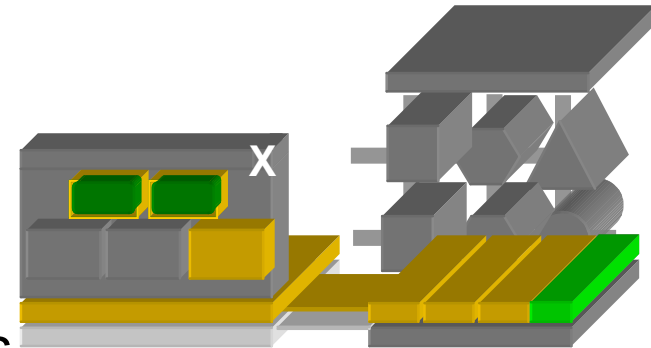
DSP/BIOS Applications Manager



DSP/BIOS II: A Proven Past... A Solid Future

DSPS Fest
2000

- ▶ Built upon established products
- ▶ 100s of OEMs prior to TI acquisition
- ▶ Ramping to 1000s of new OEMs
- ▶ Foundation for interoperable components



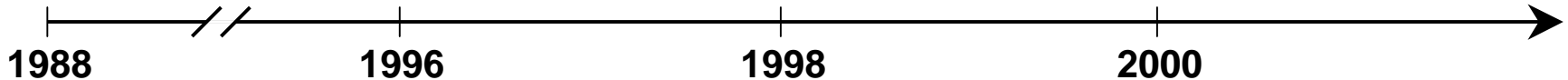
SPOX

SPECTRON
MICROSYSTEMS

DSPBIOS



bundled, royalty-free, pervasive



\$20,000+

Mix-and-Match Modules

▶▶ Real-time capture

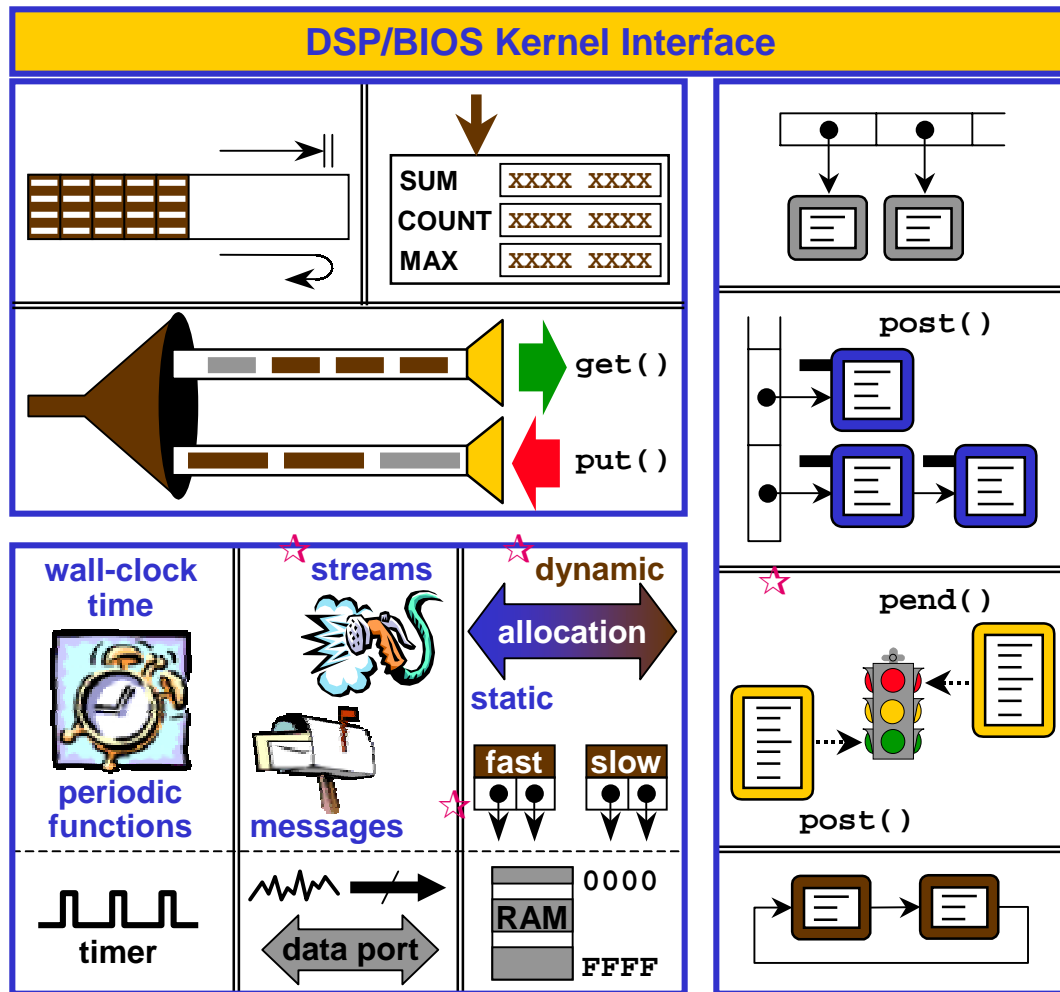
- ▶ Software event logs
- ▶ Statistics accumulators
- ▶ Host cmd/data channels

▶▶ Hardware abstraction

- ▶ Real-time clock services
- ▶ Device-independent I/O
- ▶ Logical memory segments

▶▶ Multiple threads

- ▶ HW + SW interrupts
- ▶ Synchronized tasks
- ▶ Background routines



real-time host link

TARGET TMS320 DSP HARDWARE

☆ = DSP/BIOS II



DSP/BIOS II for CCS 2.0

Debugging and analysis features

- ▶▶ **Simplified DSP application development**
 - ▶ Streamlined configuration
 - ▶ Chip support library (CSL) for configuring all on-chip peripherals registers
 - ▶ CSL fully integrated into DSP/BIOS II
- ▶▶ **Advanced debugging tools**
 - ▶ Kernel view debug
 - ▶ Multi-processor debug support
- ▶▶ **3rd parties create real-time analysis “plug-ins”**
 - ▶ Both Visual Basic and C++ Supported
 - ▶ Host side processing of BIOS instrumentation data



DSP/BIOS II for CCS 2.0

Making it easier to be successful with DSP/BIOS

▶▶ Shorten learning curve

- ▶ Improved online help and documentation
- ▶ New DSP/BIOS II Tutorial
- ▶ On-line training
- ▶ 1 and 3 day classes DSP/BIOS II
- ▶ Product support and DSP/BIOS II users group on www.dspvillage.com
- ▶ Improved product support with product information center and the hotline
- ▶ Application notes and demos available on the www.dspvillage.com

▶▶ Easy product updates

- ▶ Online update advisor to download the latest product updates

EK 8/00

Who is Using DSP/BIOS II?



DSP/BIOS

real-time
scalable
instrumented
kernel

optimized
for TI's DSPs

700 new customers started using DSP/BIOS just this year!

Code Composer Studio

Joseph Facca

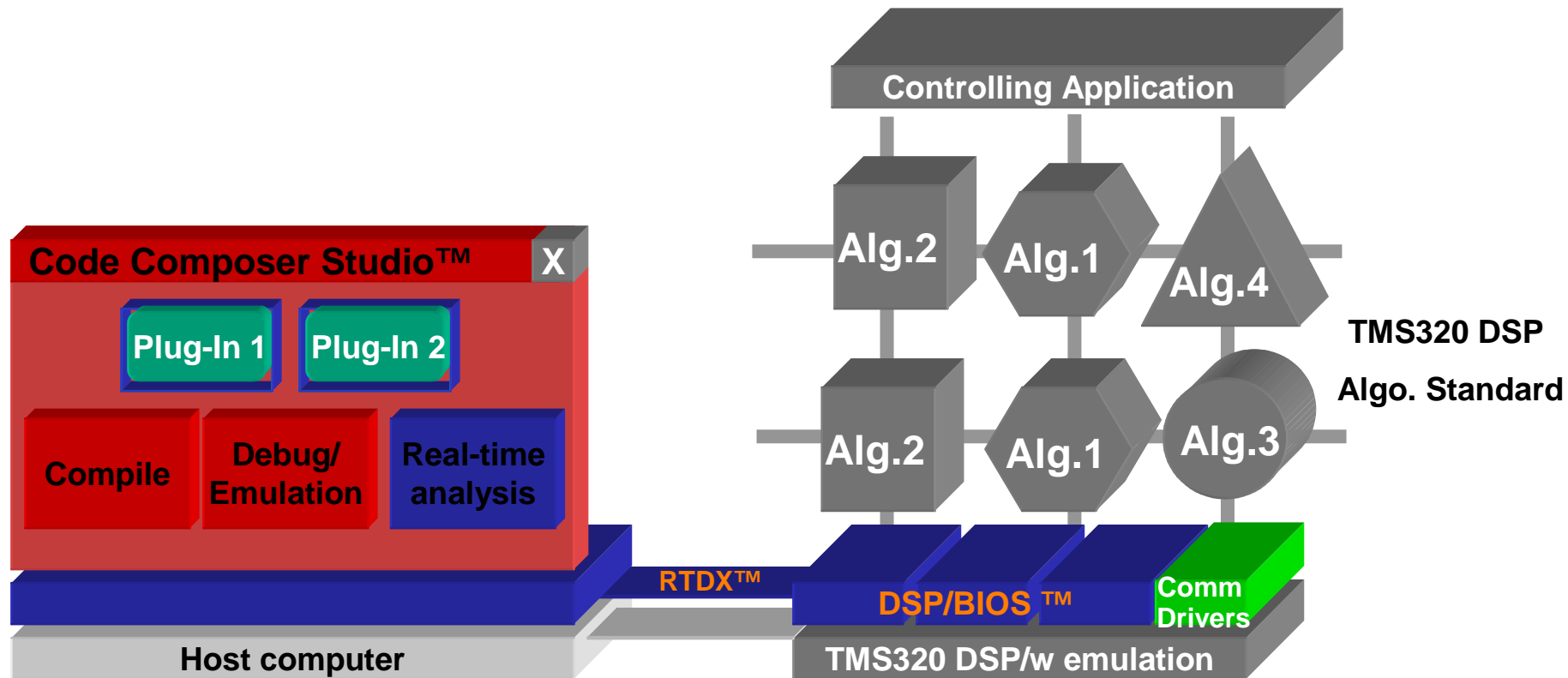
Product Manager, SDS

j-facca@ti.com

(416) 599-6868



Code Composer Studio



Code Composer Studio v2

▶▶ Extending

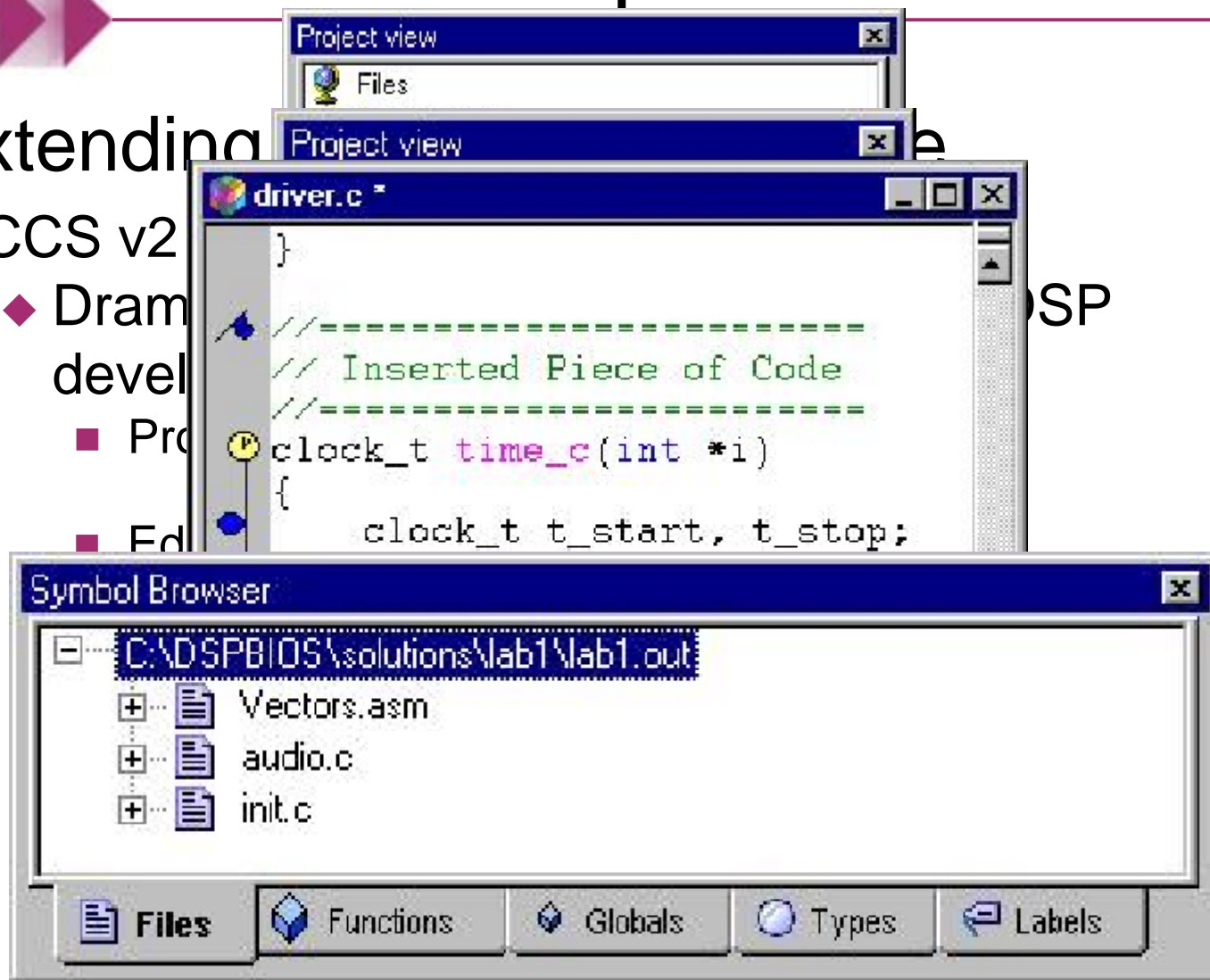
▶ CCS v2

◆ Dram devel

■ Pro

■ Ed

DSP

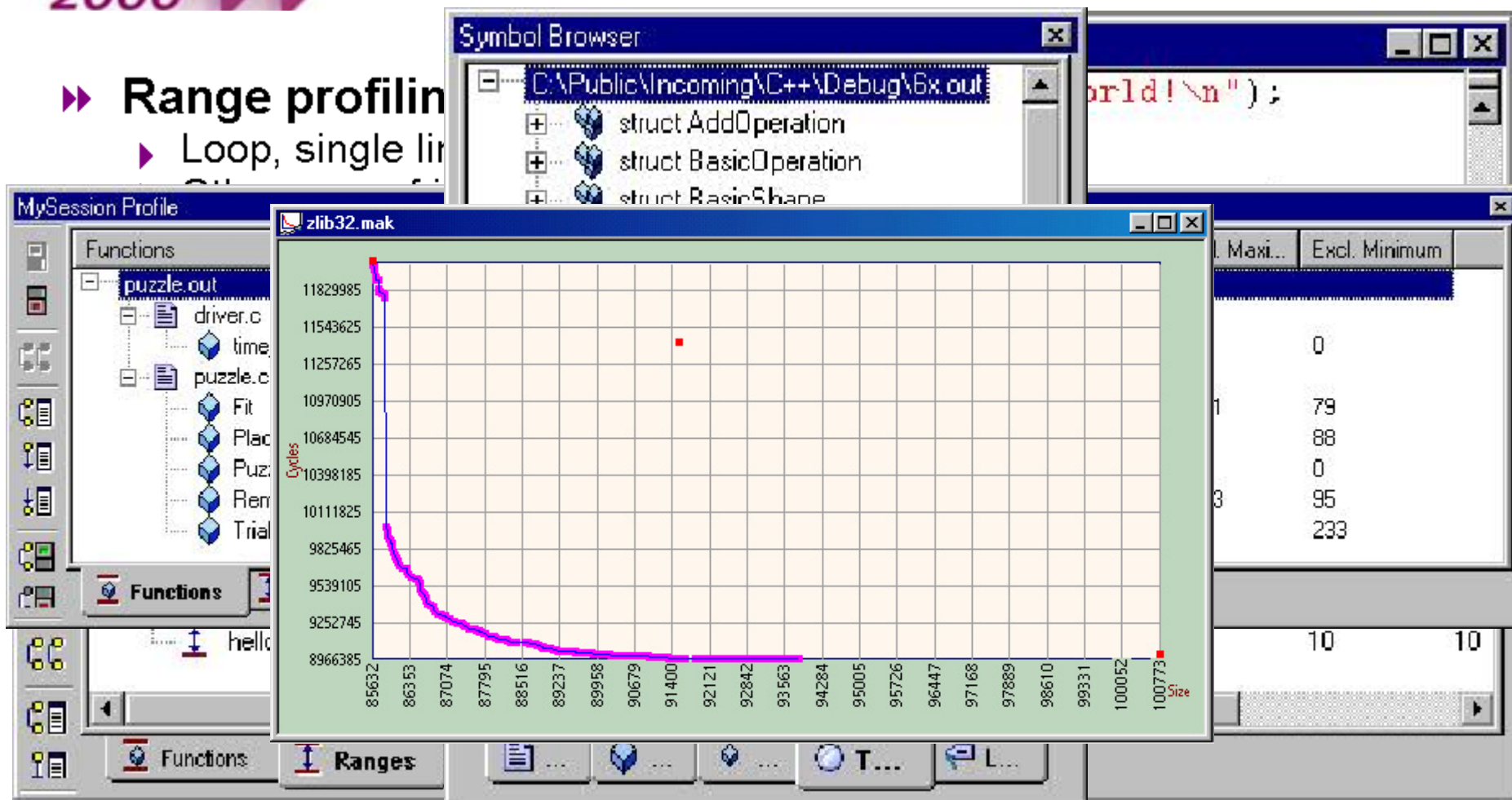


Code Composer Studio v2

DSPS Fest
2000

► Range profiling

- Loop, single line



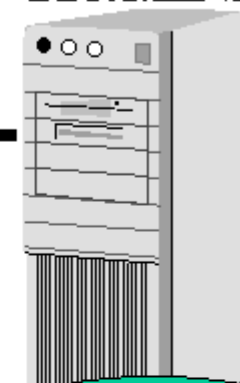
Code Composer Studio v2



Browser



TI&ME Server



Database

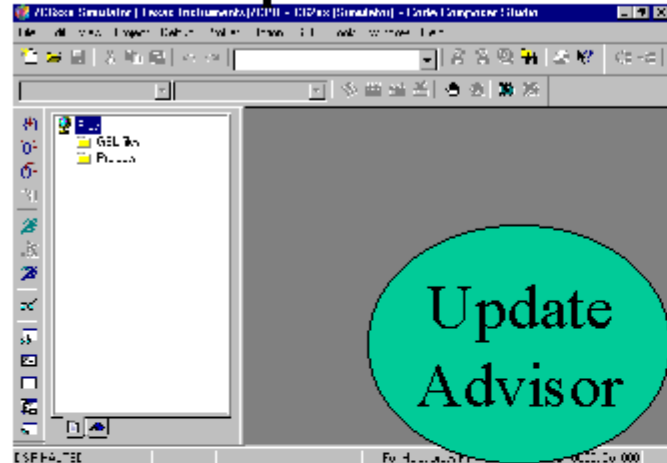
Query

**Update
Advisor**

**System
Info**

**Product
Updates**

Code Composer Studio



Code Composer Studio v2

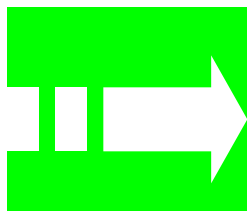
- ▶▶ So when can I get the CCS v2?
 - ▶ Eight week customer beta program starts 4Q00
 - ◆ Features beta update with update advisor
 - ▶ Training programs
 - ◆ 1, 2 and 3 day training classes
 - ◆ Expanded web based training
 - ▶ CCS v2 available for shipment, 1Q01
 - ◆ Available through e-store at dspvillage.ti.com

Code Composer Studio

- ▶▶ What can I do to extend my lead in real time?
 - ▶ Have you upgraded to v1.2
 - ▶ Sign up for v2 beta program at dspvillage.com
 - ▶ Send us your suggestions for CCS v3
 - ◆ Requirements will be completed in 4Q00

Emulation Capabilities

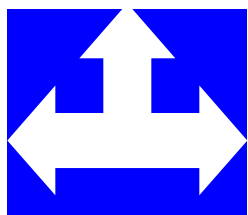
DSPS Fest
2000



Real-Time Emulation

View CPU and memory while application is stopped, but interrupts continue

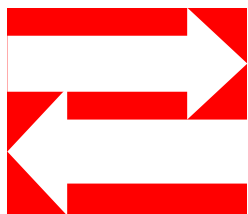
- Basic debug
- Computational problems
- Code design problems



Advanced Event Triggering

Observe events/sequences, measure elapsed time, generate external triggers

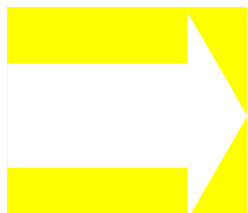
- Benchmarking
- Event/sequence identification
- Ext. trigger generation
- Stop program execution
- Activate Trace and RTDX



RTDX

Exchange commands and data with application while it executes

- Dynamic instrumentation
- Dynamic variable adjustments
- Dynamic data collection



Real-time Trace

Non-intrusively collect program flow and data transactions

- Prog. Flow corruption debug
- Memory corruption
- Benchmarking
- Code Coverage
- Path Coverage
- Program timing problems



XDS560 Capabilities

DSPTS Fest
2000

▶▶ PCI-based Emulation Controller

- ▶ Replaces current XDS510 ISA-bus product with full compatibility

▶▶ Support for Dedicated On-Chip RTDX units

- ▶ 1-2 MB RTDX, 100 times faster than the XDS510 on enabled devices

▶▶ Planned availability in 1Q01

▶▶ Advanced Event Triggering

- ▶ Sequence detection - note a specific sequence of events
- ▶ Extended benchmarking capabilities
- ▶ Program range breakpoints - detect CPU access to a range of addresses

▶▶ Implementation

- ▶ Highly flexible 5-1/2 foot (1.5+ m) host-target cable
- ▶ Based on Test Bus Controller (TBC) device
- ▶ Identical 14-pin JTAG header

Summary



- ▶▶ TI emulation has been very stable for many years
- ▶▶ TI is now making a major investment in new emulation
- ▶▶ Customer applications demand application visibility, which TI is delivering with high-speed RTDX and real-time trace
- ▶▶ TI is delivering aggressive new emulation products in the next three years:
 - ▶ XDS560/Thunderstorm PCI-based emulator with up to 1-2 MB/sec high-speed RTDX available in 1Q 2001
 - ▶ XDS5100 remote emulator with USB and FireWire, real-time program and data trace in 2H 2001
 - ▶ More innovative emulation products are in planning

Profile Based Compiler

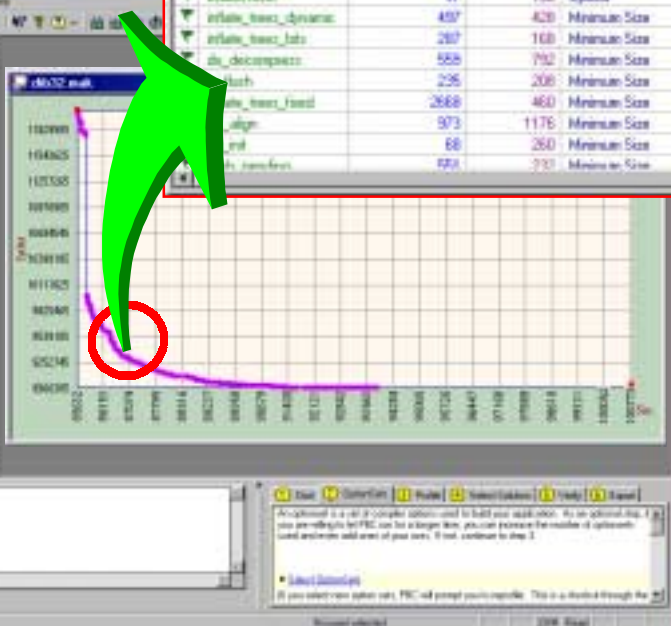
Visualize and optimize code size and performance trade-offs

PROFILE-BASED COMPILER SOLUTIONS

- ▶ Build and profile multiple build option sets
- ▶ Automatically plot a 2D graph of code size vs performance
- ▶ Graphically select the optimum combination of size and speed for your application
- ▶ Click to build desired performance and code size trade-off in seconds

Solution for Size = 80816 Cycles = 3375193

Function	Cycles	Size	OptionSet	Options
erltestv2	125	464	Minimum Size	-c3 -x0 -m3
erltest_block_new	71	260	Minimum Size	-c3 -x0 -m3
erltestv2	276	1032	Minimum Size	-c3 -x0 -m3
putShortM5B	45	52	Minimum Size	-c3 -x0 -m3
erltest	1129	1792	Minimum Size	-c3 -x0 -m3
erltest_block_new	264	312	Speed	-c3 -x0 -m3
de_compress	685	804	Minimum Size	-c3 -x0 -m3
define	2011	1224	Minimum Size	-c3 -x0 -m3
erltestEnd	142	256	Speed	-c3 -x0 -m3
erltestv2	47	136	Speed	-c3 -x0 -m3
erltest_block_dynamic	457	428	Minimum Size	-c3 -x0 -m3
erltest_block_new	267	168	Minimum Size	-c3 -x0 -m3
de_decompress	558	792	Minimum Size	-c3 -x0 -m3
erltest	295	208	Minimum Size	-c3 -x0 -m3
erltest_block_new	2688	460	Minimum Size	-c3 -x0 -m3
erltest	973	1176	Minimum Size	-c3 -x0 -m3
erltest	68	260	Minimum Size	-c3 -x0 -m3
erltest	608	732	Minimum Size	-c3 -x0 -m3



RS 8/00

Visual Linker

**Visualize and simplify system
memory allocation**

CURRENT SITUATION

- ▶▶ Text based memory allocation files are:
 - ▶ Difficult to learn, read and maintain
 - ▶ Cumbersome to manipulate memory optimization
- ▶▶ Setting up memory maps require paging through data books and online help

```

SECTIONS
{
    Boot_Sec:
    {
        isr_v
        *(.tex
        *(.sw
        cinit
        *(.cir
        .+=1;
        .+=1;
        }
        fill
        > I
    .vector
    version
    entry_p
    isr
    .sta
    pag
    ABU_SECT0 :{} > ABU_0 PAGE = 1
    ABU_SECT1 :{} > ABU_1 PAGE = 1
    binsect :{} > BIN_DATA PAGE = 1
    .bss :{} > EXT_DM PAGE = 1
    .data :{} > EXT_DM PAGE = 1
    .system :{} > EXT_DM PAGE = 1
    .ext_data :{} > EXT_DM PAGE = 1
}
    
```

Code Composer Studio Plug-ins

Omar Fattah
Plug-in Strategy Manager



New DSP Starter Kit (DSK) Strategy

Lori Vidra

C5000 Tools Product Manager



Software Beta Programs

David Friedland
SDS Beta Program Manager



Questions?