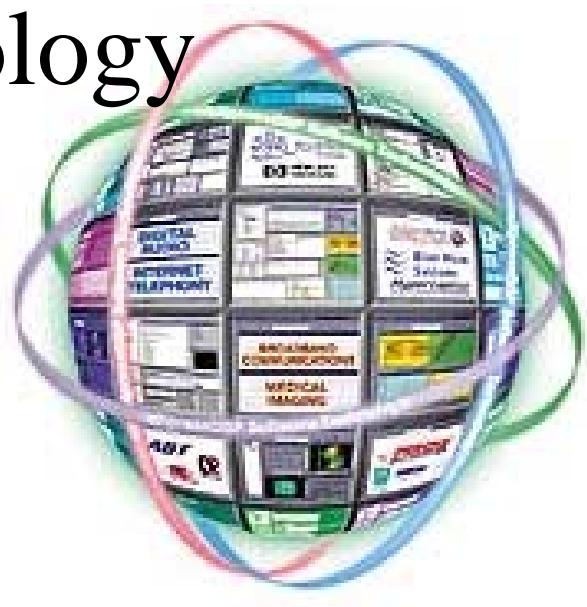


eXpressDSP™ Real-time Software Technology

John Schanzenbach
eXpressDSP Platform Manager



What is eXpressDSP?

Code Composer Studio™

Powerful, integrated development tools

DSP/BIOS II™

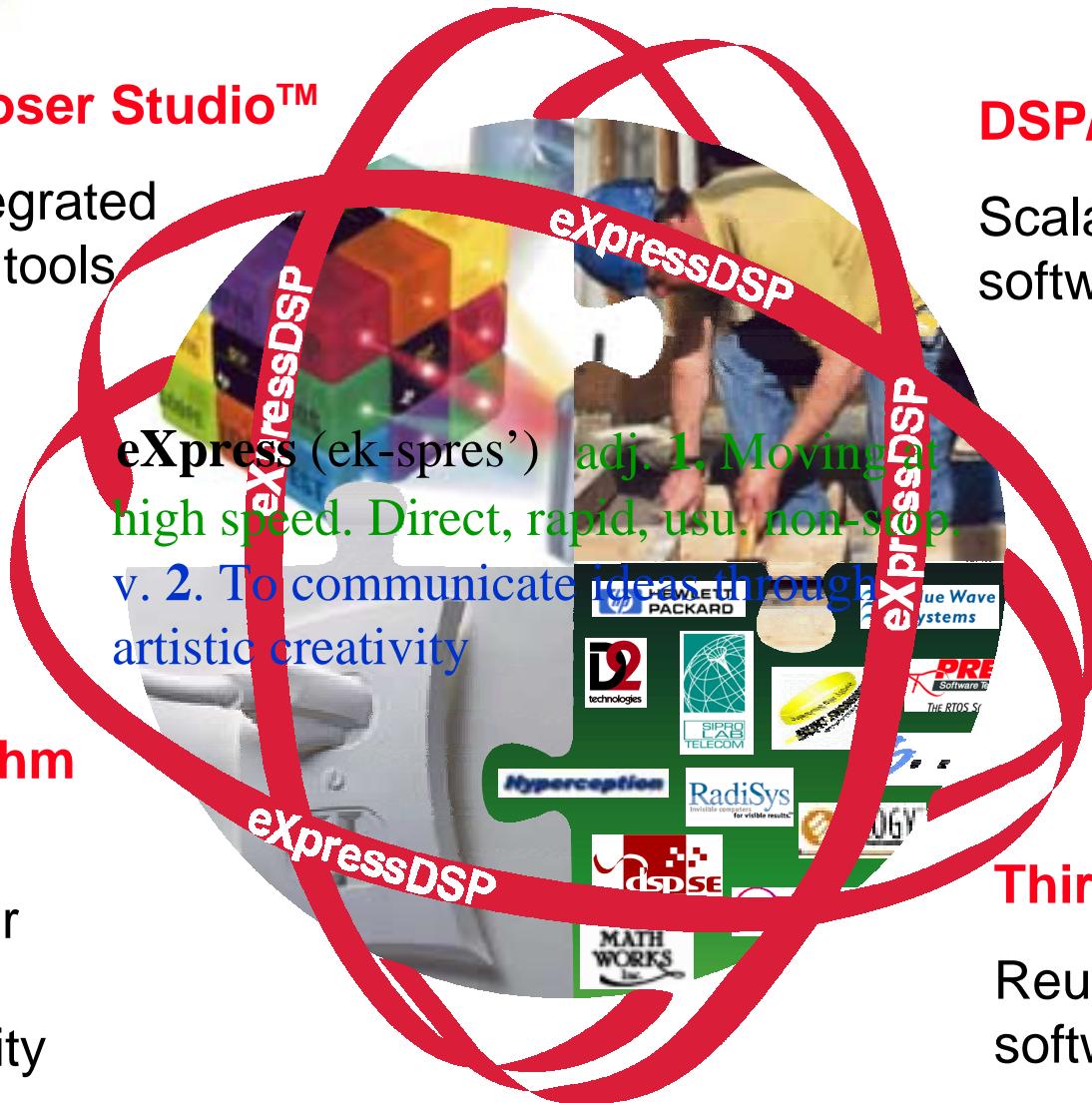
Scalable, real-time software foundation

DSP Algorithm Standard

Standards for application interoperability

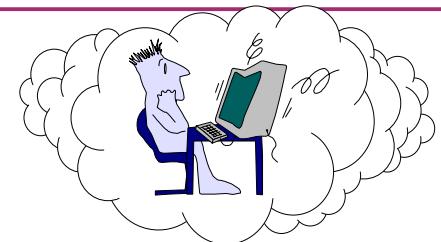
Third-Party Network

Reusable, modular software and support

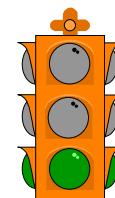


Why eXpressDSP ?

No Moore's Law !!



HARDWARE



innovation

SOFTWARE



1980

1990

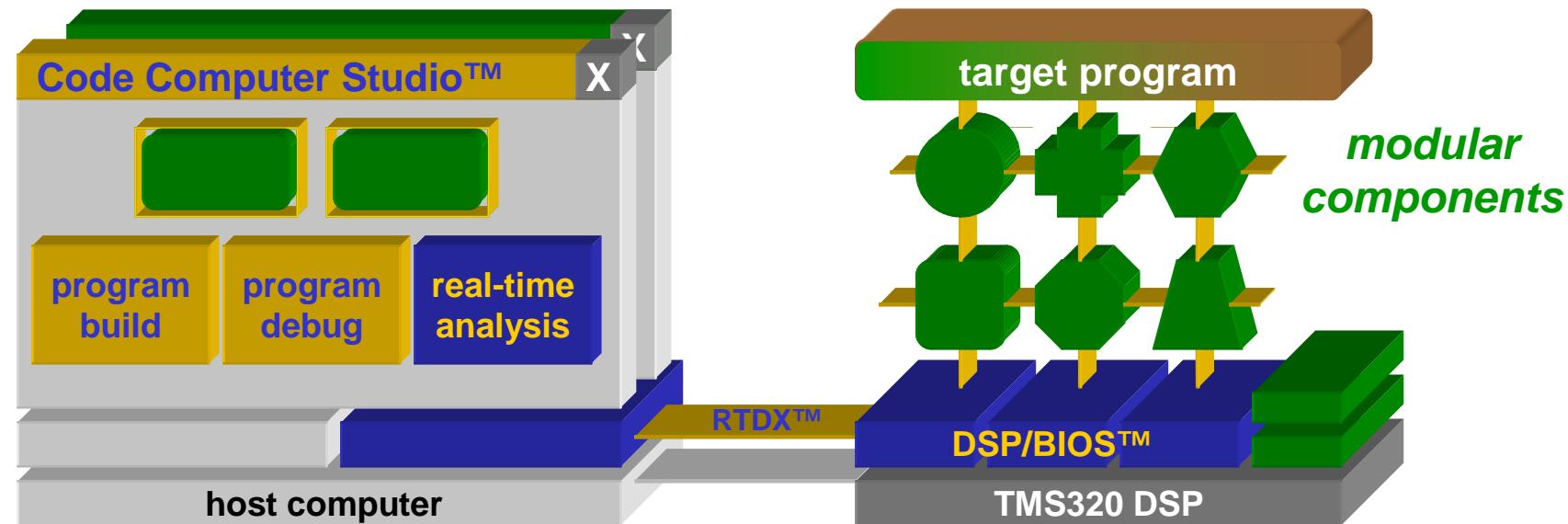
2000



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

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

During 1999

DSP Fest
2000

Code Composer Studio

Launched CCS 1.0/1.1
FIRST full integration of
acquisition strategy

DSP Algorithm Standard

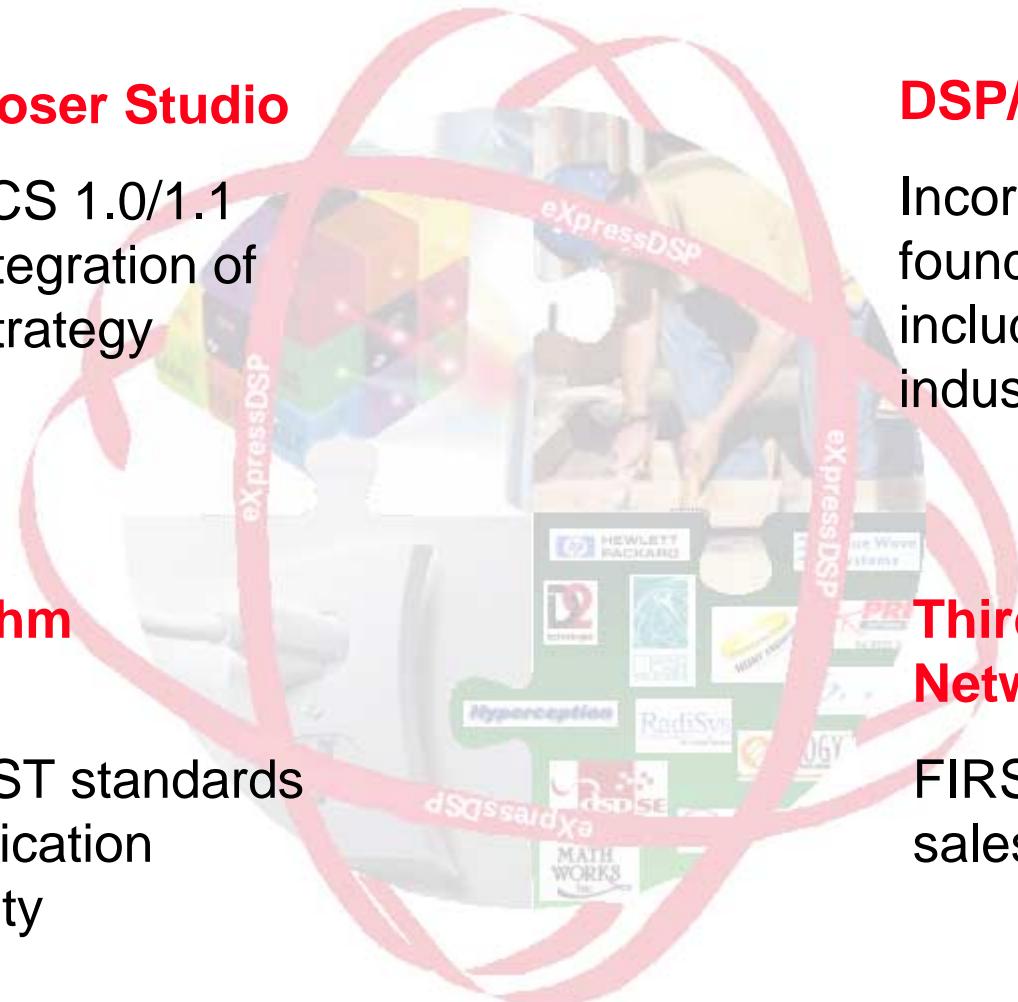
Created FIRST standards
for DSP application
interoperability

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

DSPS Fest
2000

Code Composer Studio

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

DSP/BIOS II

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

DSP Algorithm Standard

- ▶ 250 compliant algorithms
- ▶ 100 winning new sockets

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%



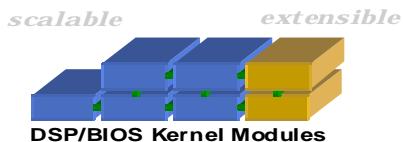
Code Composer Studio v1.2

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



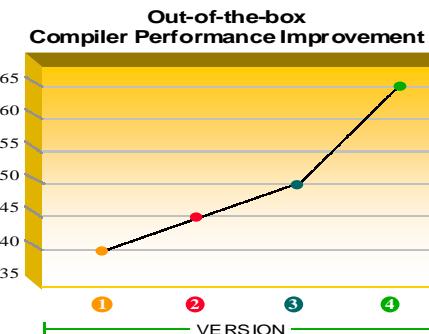
NEW AND ENHANCED SOLUTIONS IN DSP/BIOS II

- 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



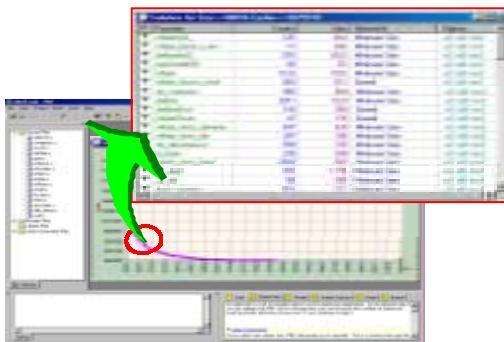
- Achieves 80-90% performance vs. hand coded assembly
- Performance statistics backed up with real code examples downloadable today
- Out-of-the-box C code focus has produced more than 20% performance improvement
- Support for C++

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

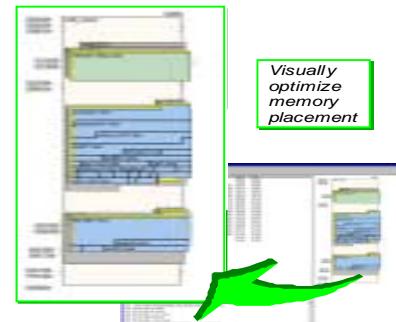
- Build and profile multiple build option sets
- Automatically plot a 2D graph of code size vs performance
- Graphically select the optimum combination of size and speed for your application
- Click to build desired performance and code size trade-offs in seconds

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

CCS / eXpressDSP WINS!

semiconductor **BUSINESS NEWS**

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



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

EETIMES

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



The Center of the Electronics Universe
ChipCenterSM

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

EDN's 1999 Innovation of the Year Award

EDN[®]



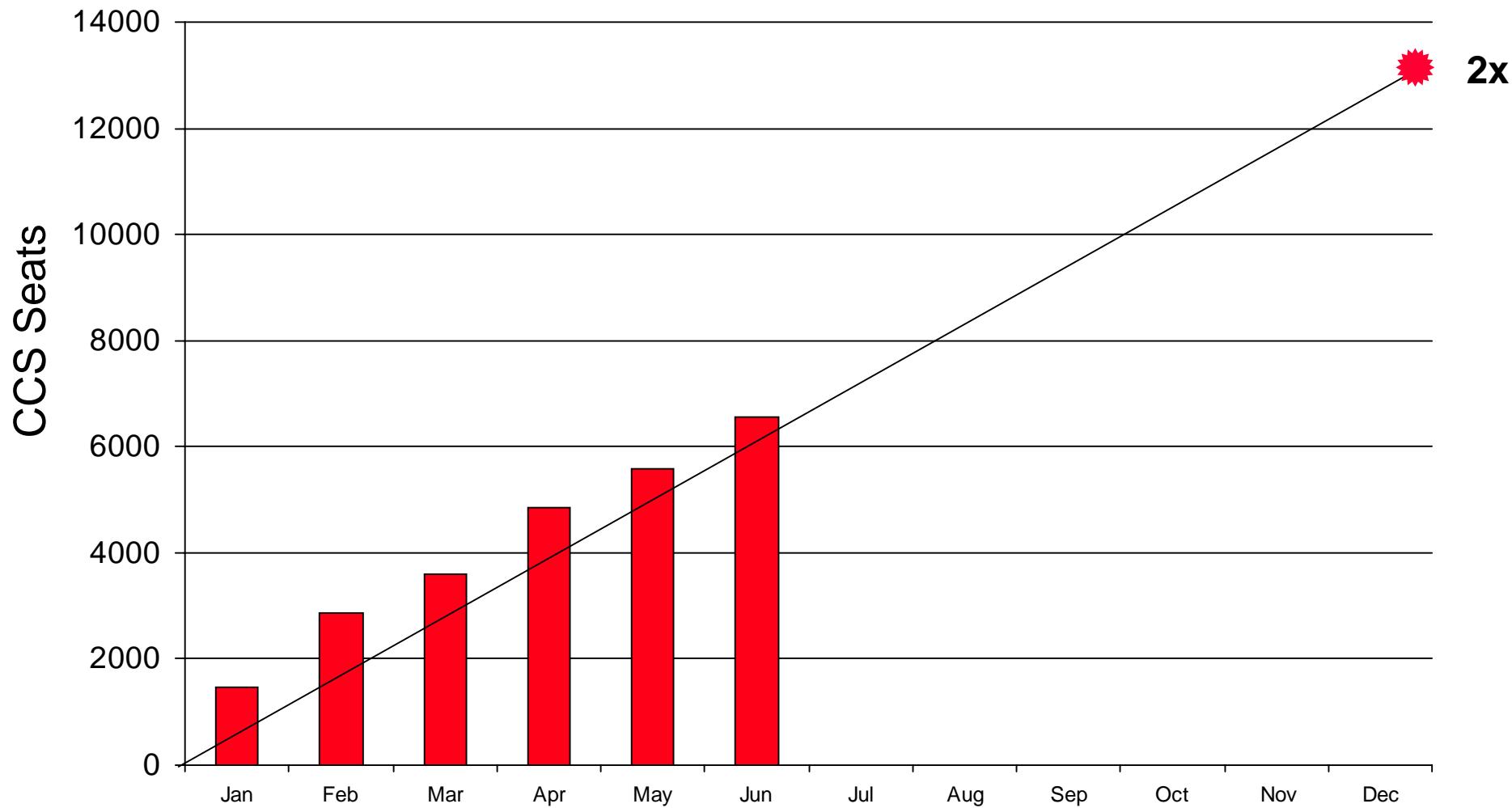
eXpressDSP, an open software-development environment for Texas Instruments DSPs, gives users a real-time make-versus-buy choice for DSP algorithms.



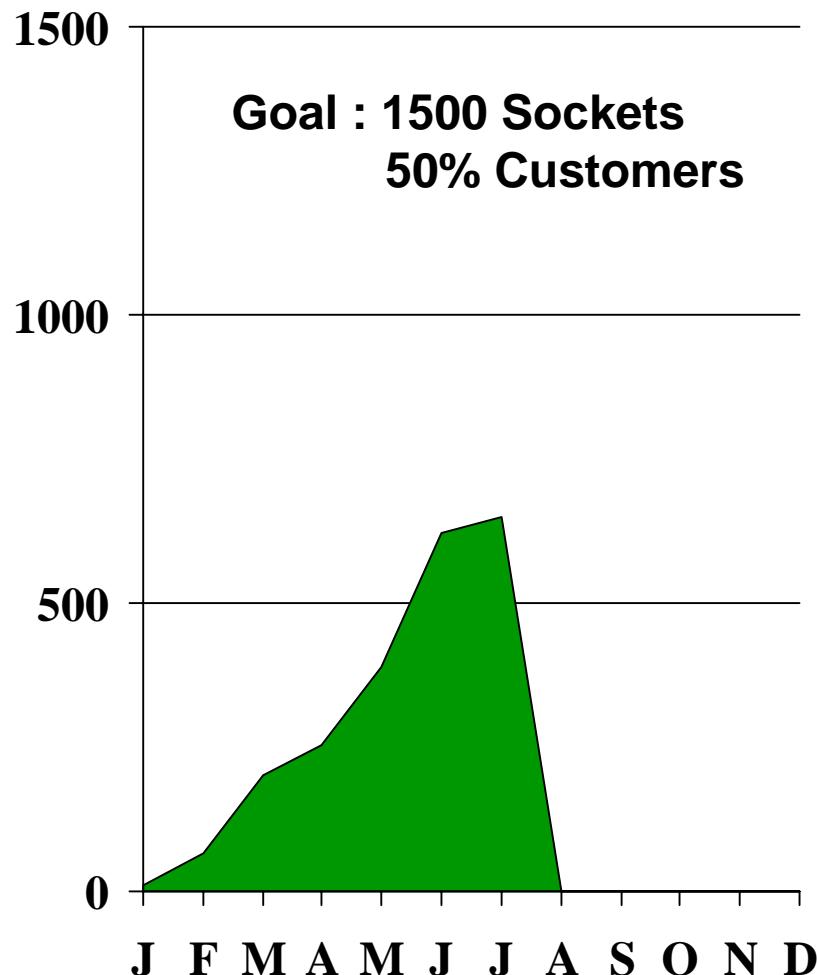
The Center of the Electronics Universe
ChipCenterSM

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

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

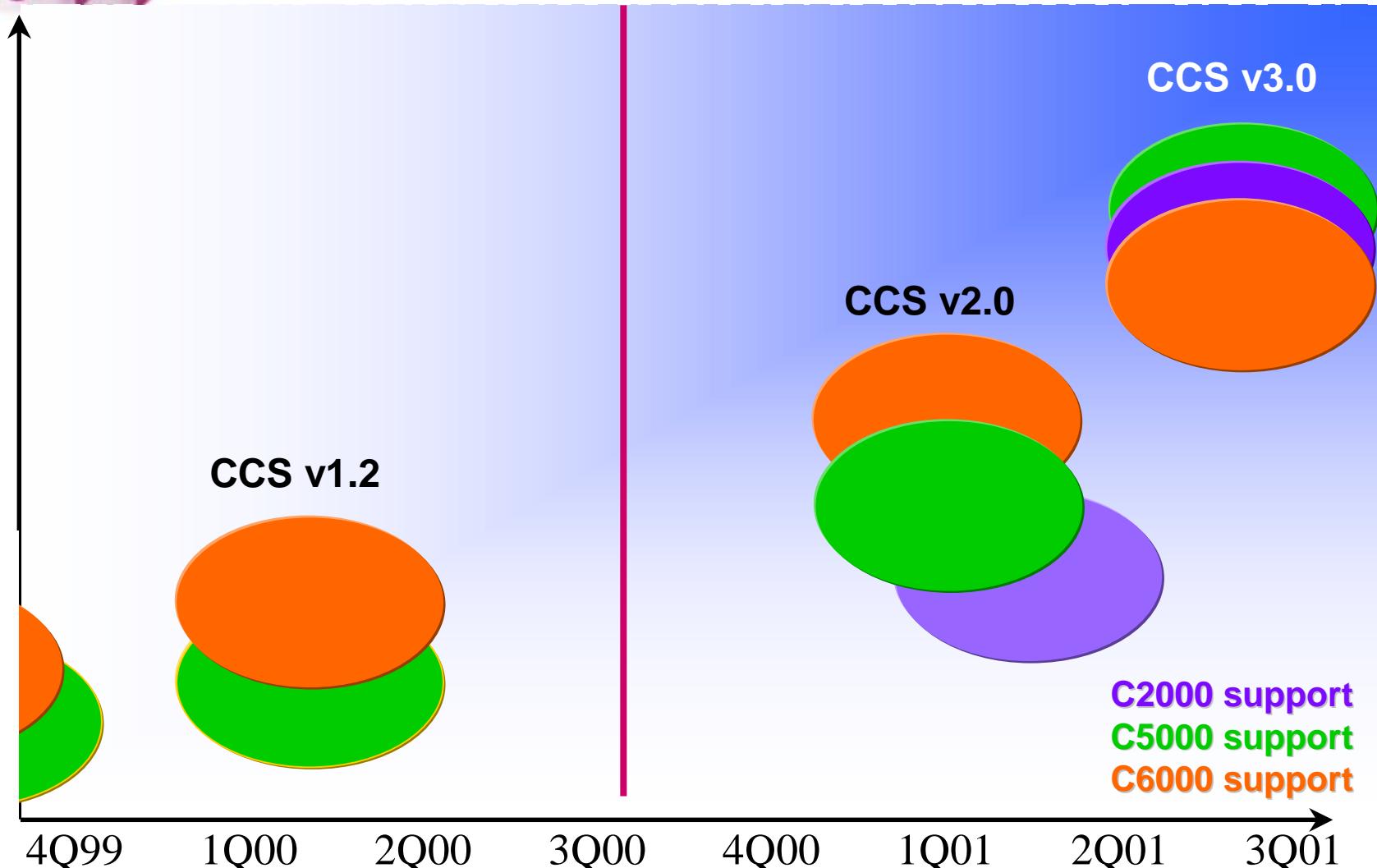
e-Store plan to open June 30, 2000

- ▶ 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 homepage of the Texas Instruments DSP Developers' Village. The top navigation bar includes links for Advanced Search, TI Home, TI HOME, TI Employment, Tech Support, Comments, Site Map, and TI Global. The main content area features a banner for 'eXpressDSP™ Real-Time Software Technology' and a sidebar for 'Purchase Tools' and 'eXpressDSP™ Components'. The central column contains links to various developer resources like Discussion Groups, Technical Support, Application Notes, and Device Drivers. The bottom of the page features a 'Featured Documentation' section and a 'TI Home' link.

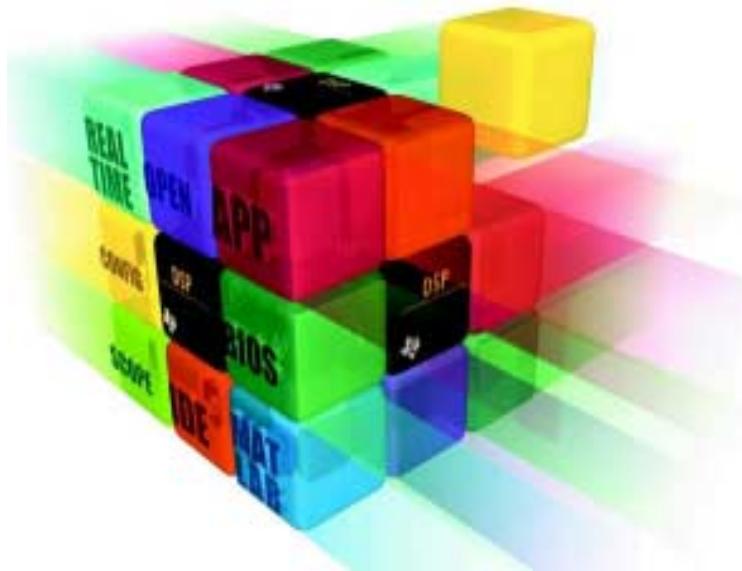
What Does the Future Hold?

DSP 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

DSPS Fest
2000



► 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)

► 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)

► Schedule

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

► Compelling new capabilities

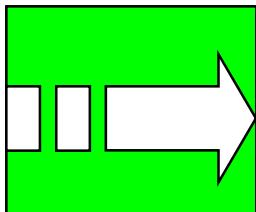
- ▶ What are the 3 big capabilities that will make creating high performance/dense DSP systems easier to design?
- ▶ Give us your inputs this week

► Schedule

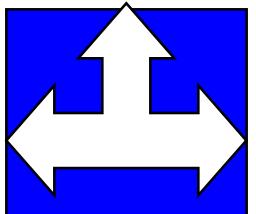
- ▶ Requirements closed 4Q00
- ▶ Beta Program 2H01
- ▶ Production shipments 1H02

Emulation: Real-Time Visibility into Tomorrows Applications

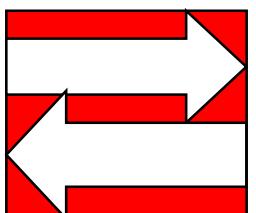
DSPS Fest
2000



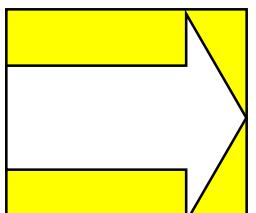
Real-Time
Emulation



Advanced
Event
Triggering



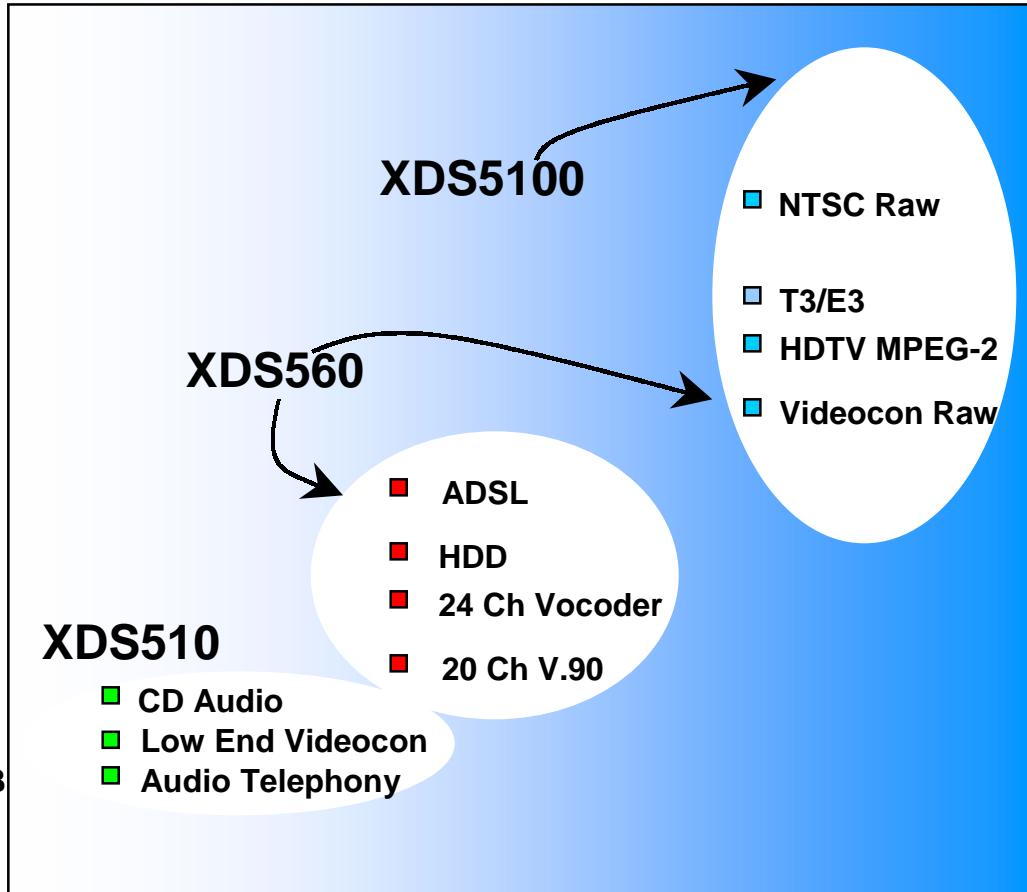
RTDX



Real-Time
Trace

20 MB

20 KB



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

eXpressDSP - Supporting all ISAs

DSPS Fest
2000

	C2000™	C5000™	C6000™
CCS	1H01	NOW	NOW
DSP/BIOS	1H01	NOW	NOW
XDAIS	2H00	NOW	NOW
3P	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



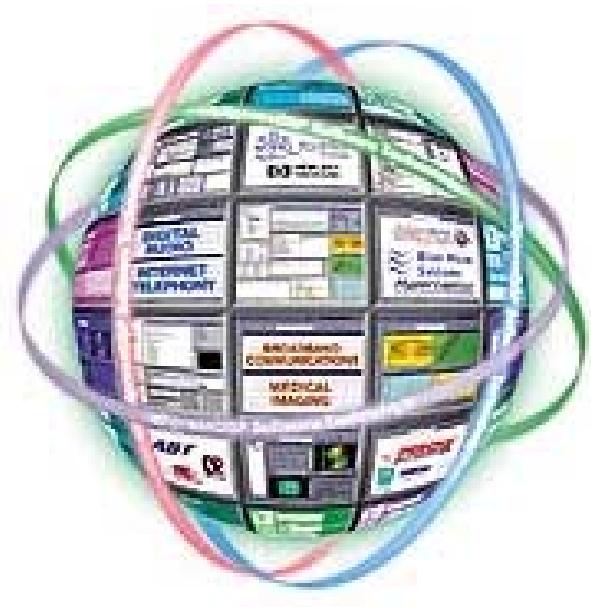
TMS320 DSP Algorithm Standard

Steve Blonstein

Technical Director, SDS

sblonstein@ti.com

(408) 383-2397



► 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

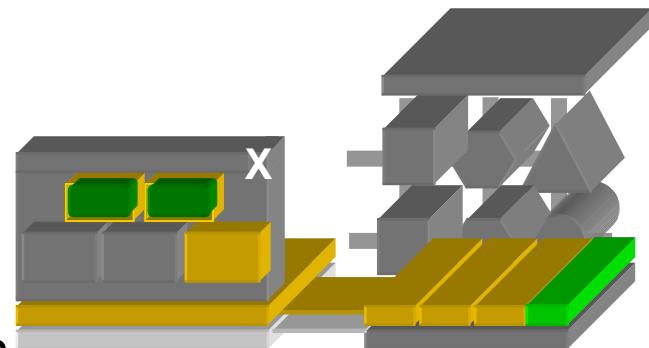
Elizabeth Keate
DSP/BIOS Applications Manager



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



SPDX

SPECTRON
MICROSYSTEMS

\$20,000+

DSP BIOS



DSP/BIOS II

TMS320 DSP

bundled, royalty-free, pervasive

1988

1996

1998

2000

Mix-and-Match Modules

DSPS Fest
2000

► Real-time capture

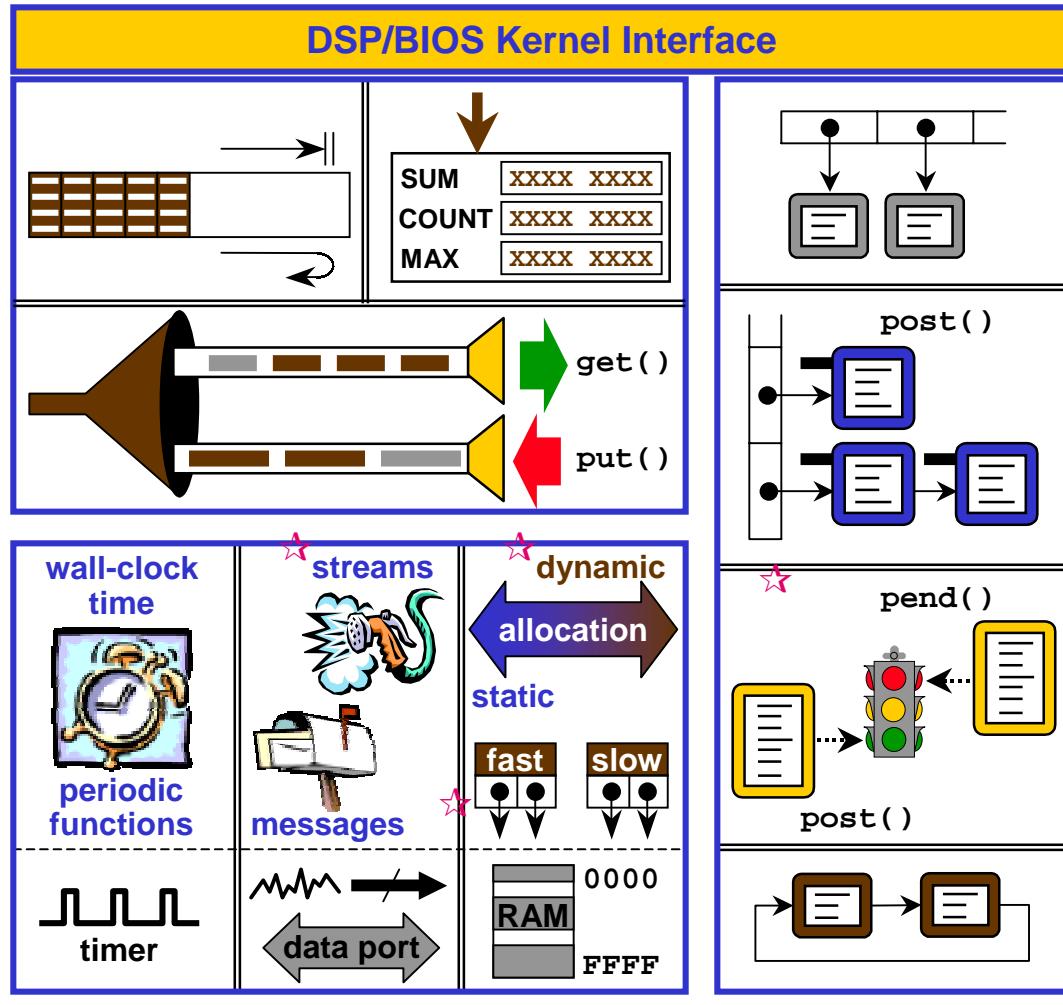
- Software event logs
- Statistics accumulators
- Host cmd/data channels

► Hardware abstraction

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

► Multiple threads

- HW + SW interrupts
- Synchronized tasks
- Background routines



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

Making it easier to be successful with DSP/BIOS

► Shorten learning curve

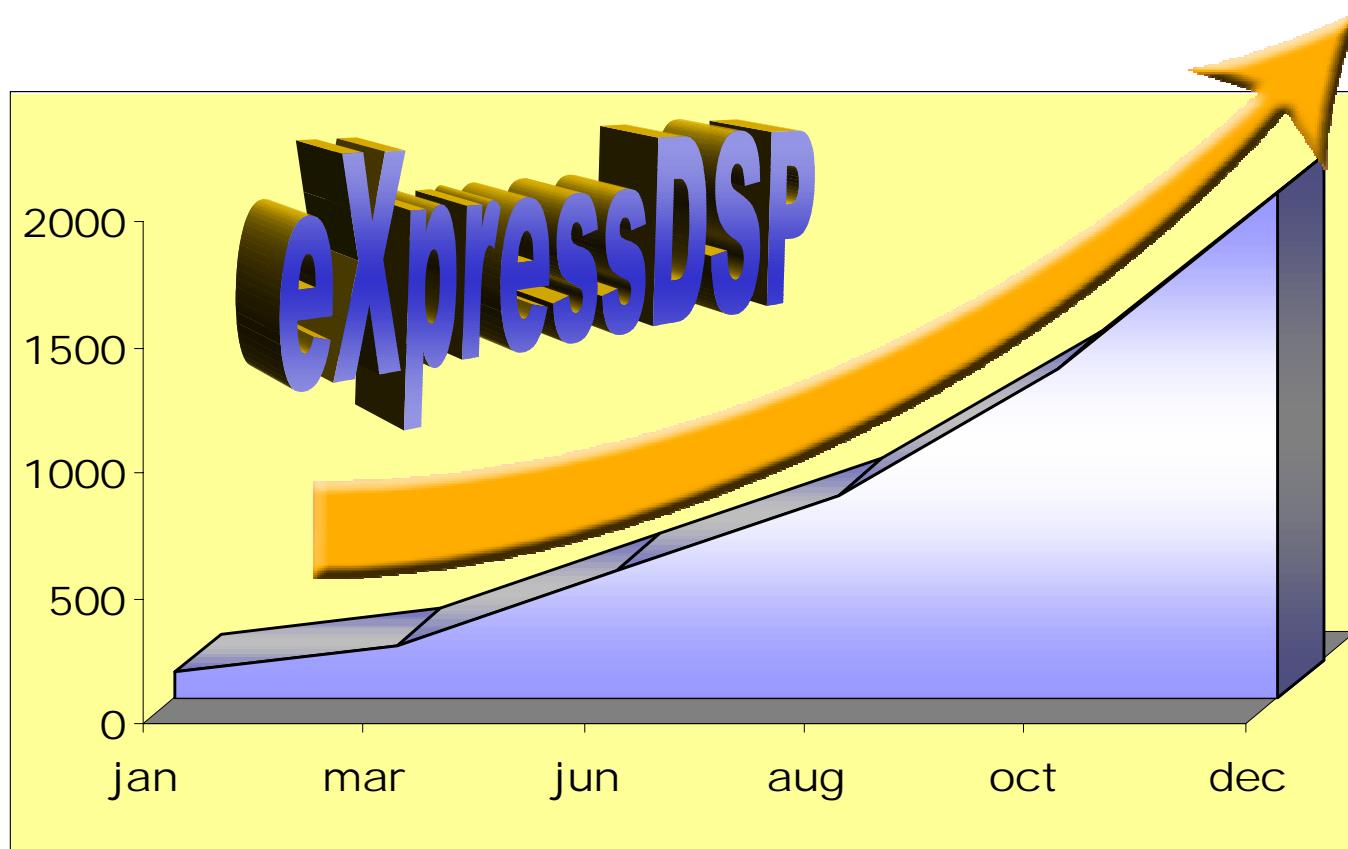
- ▶ Improved online help and documentation
- ▶ New DSP/BIOS II Tutorial
- ▶ On-line training
- ▶ 1 and 3 day classes DSP/BIOS II
- ▶ Product support and DSP/BIOS II users group on www.dspvillage.com
- ▶ Improved product support with product information center and the hotline
- ▶ Application notes and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

► Easy product updates

- ▶ Online update advisor to download the latest product updates

Who is Using DSP/BIOS II?

DSPS Fest
2000



DSP/BIOS
real-time
scalable
instrumented
kernel
optimized
for TI's DSPs

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

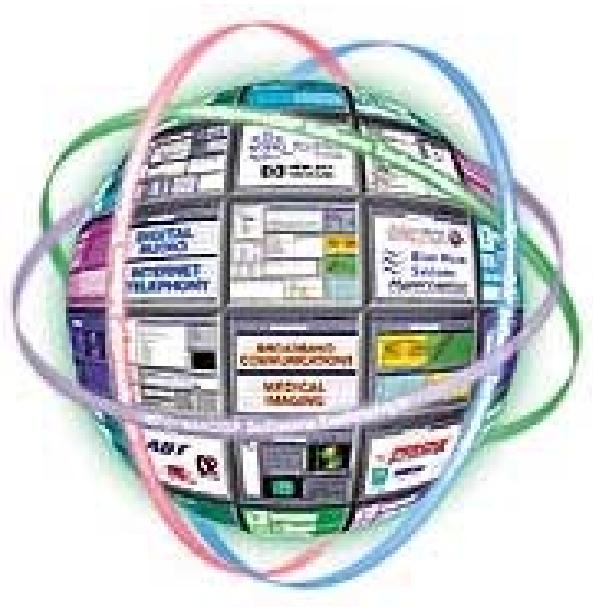
Code Composer Studio

Joseph Facca

Product Manager, SDS

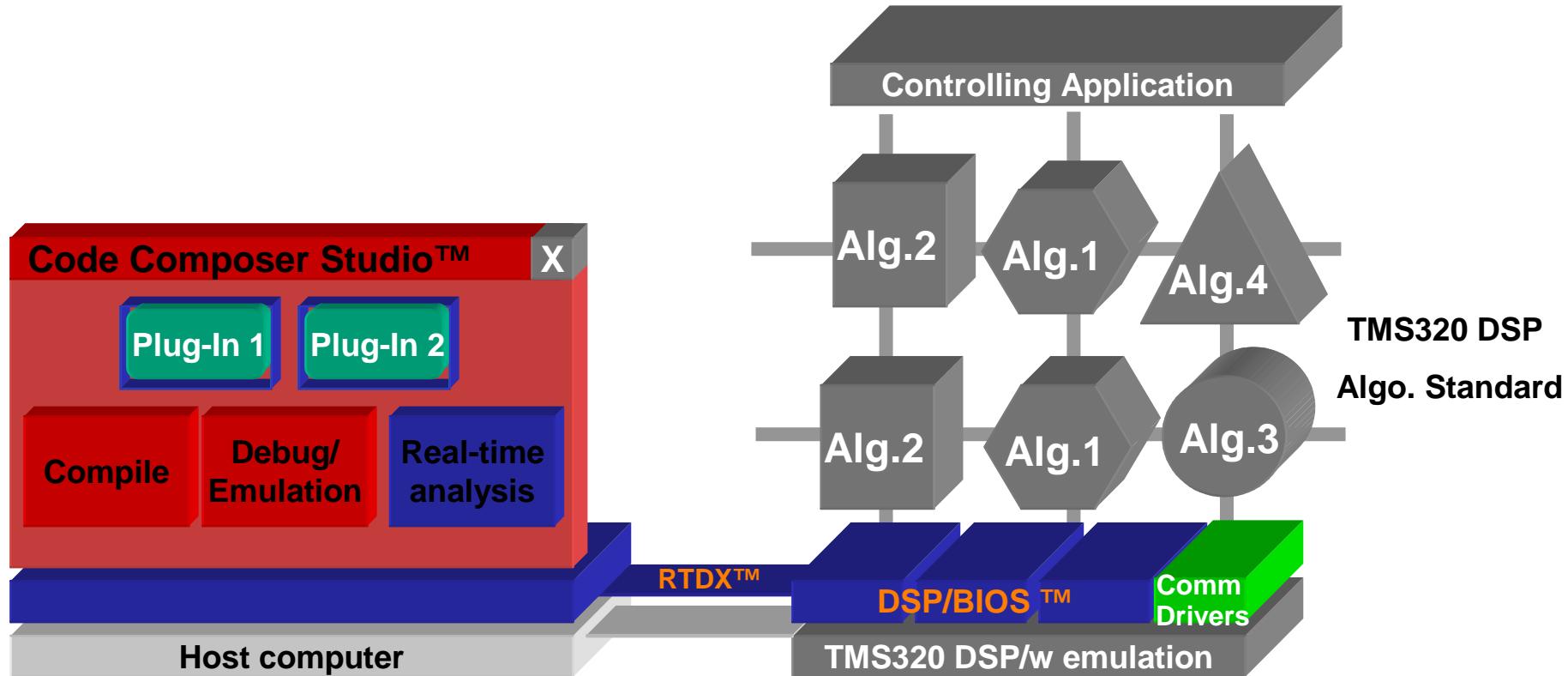
j-facca@ti.com

(416) 599-6868



Code Composer Studio

DSP Fest
2000



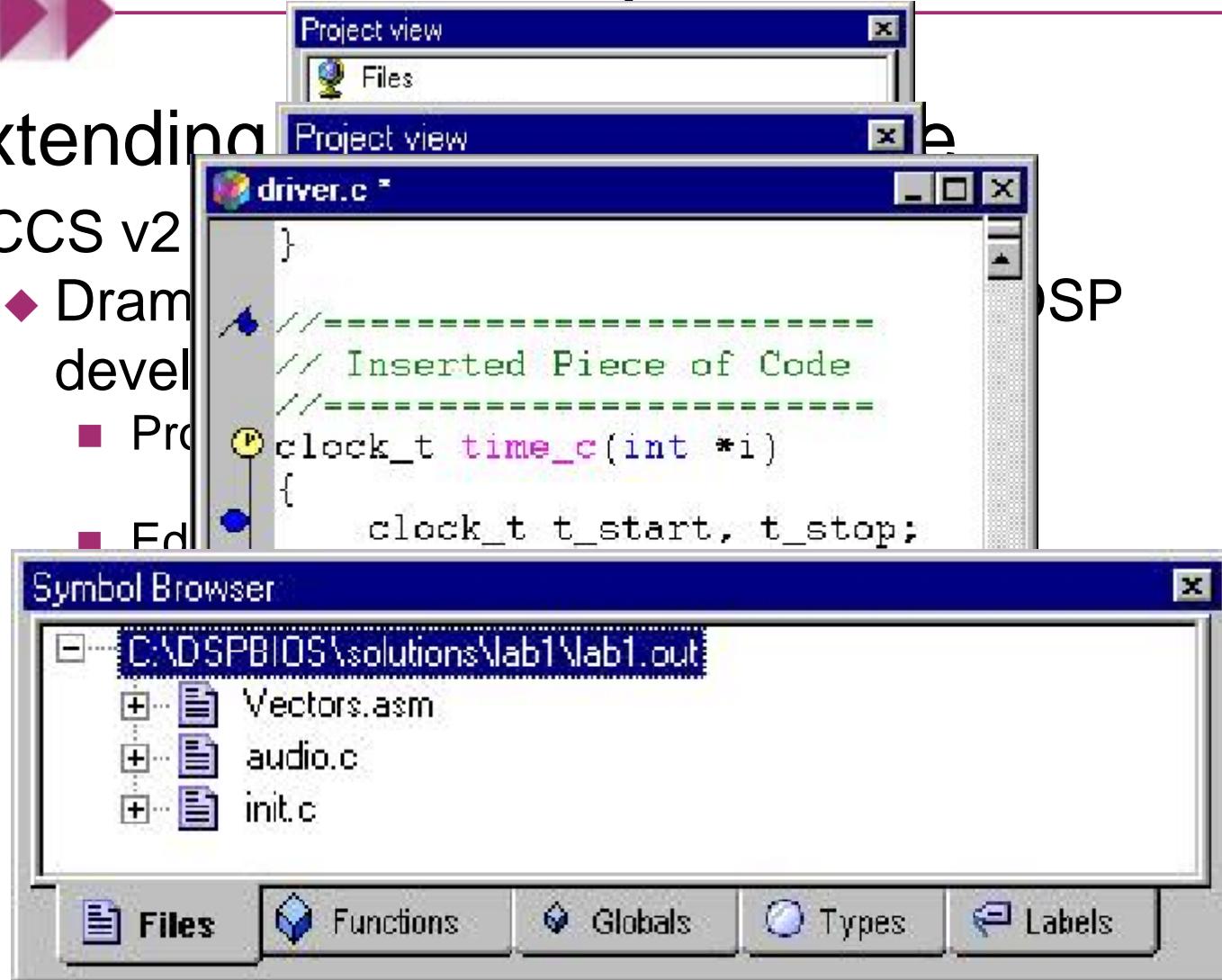
Code Composer Studio v2

► Extending

► CCS v2

- ◆ Dramatically improves developer productivity

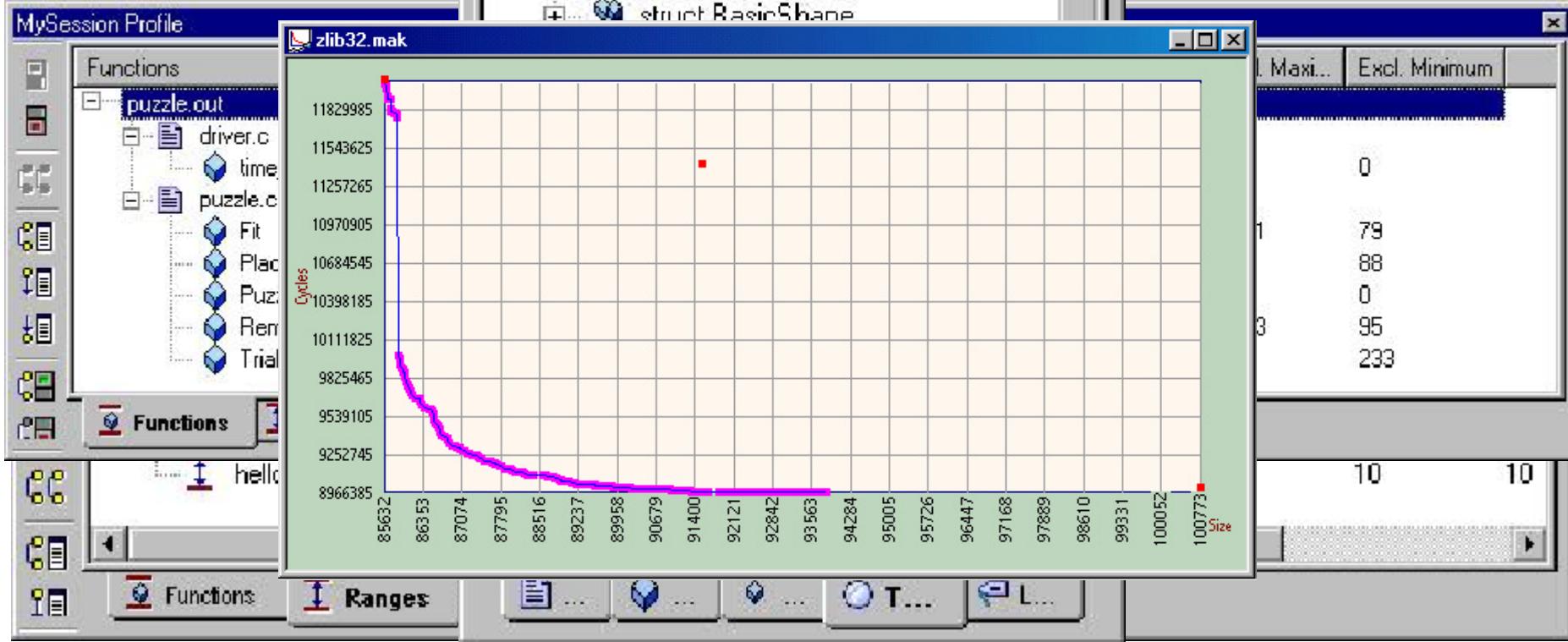
- Project Manager
- Editor



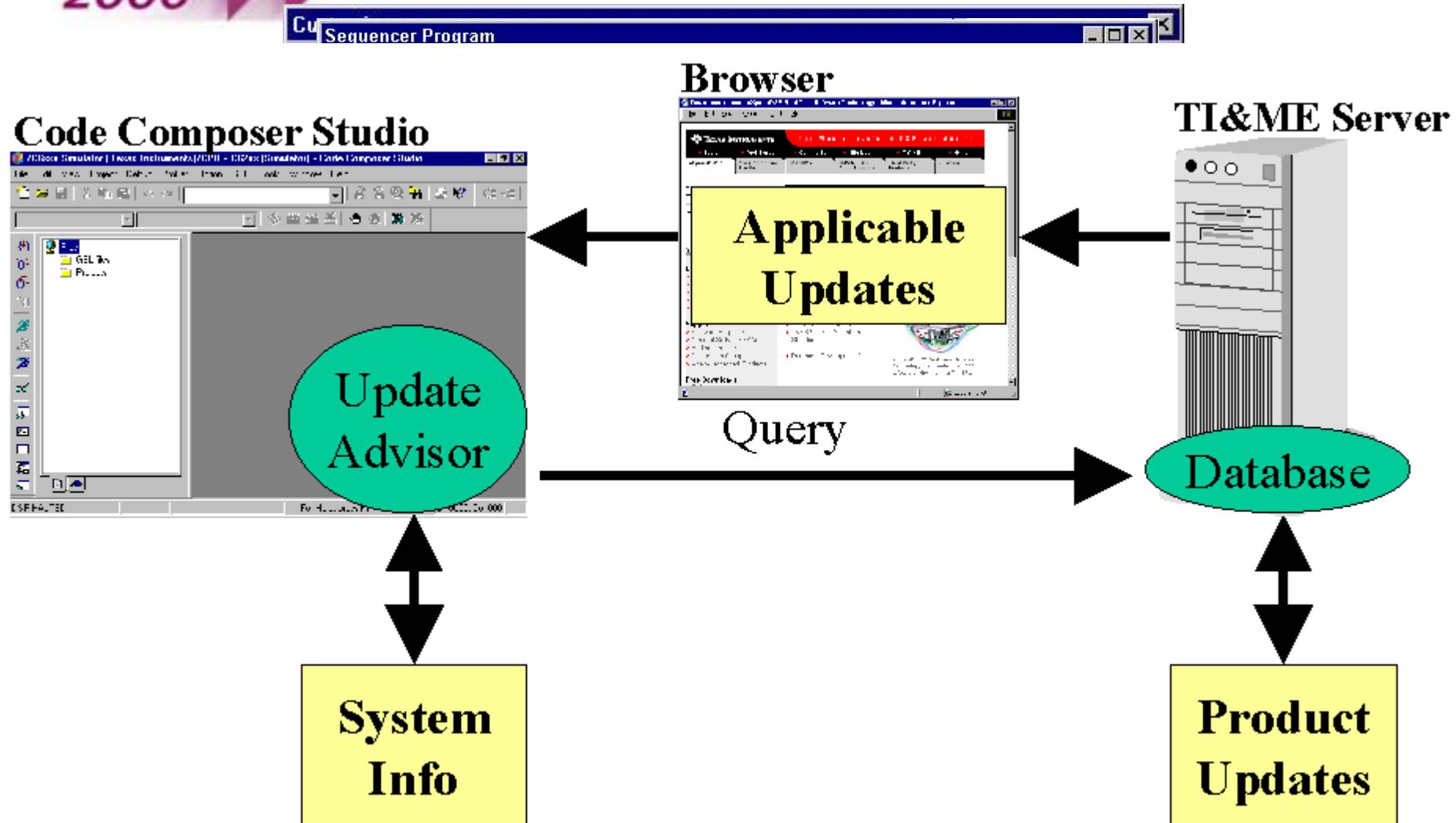
Code Composer Studio v2

► Range profiling

► Loop, single line



Code Composer Studio v2



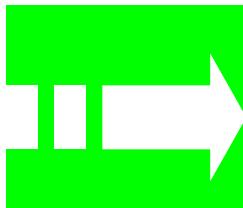
► So when can I get the CCS v2?

- ▶ 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

► 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

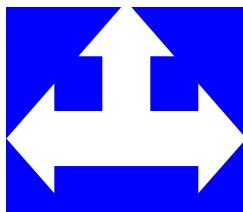
Emulation Capabilities



Real-Time Emulation

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

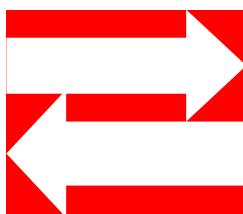
- Basic debug
- Computational problems
- Code design problems



Advanced Event Triggering

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

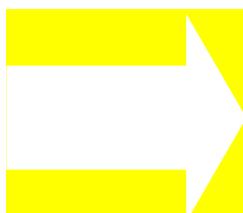
- Benchmarking
- Event/sequence identification
- Ext. trigger generation
- Stop program execution
- Activate Trace and RTDX



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

► 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

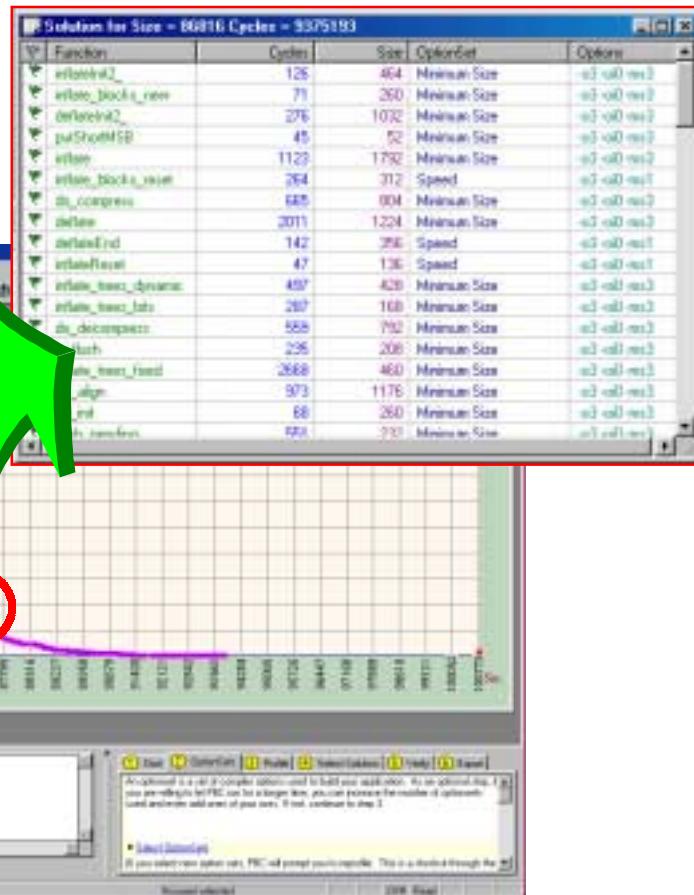
Summary

- ▶ 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

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_ve
        *(.tex
        *(.sw
        cinit
        *(.cir
        .+=1;
        .+=1;
        }
        fill
        > P
        .vectors
        version
        entry_p
        isq
        .start
        pag
    }
}

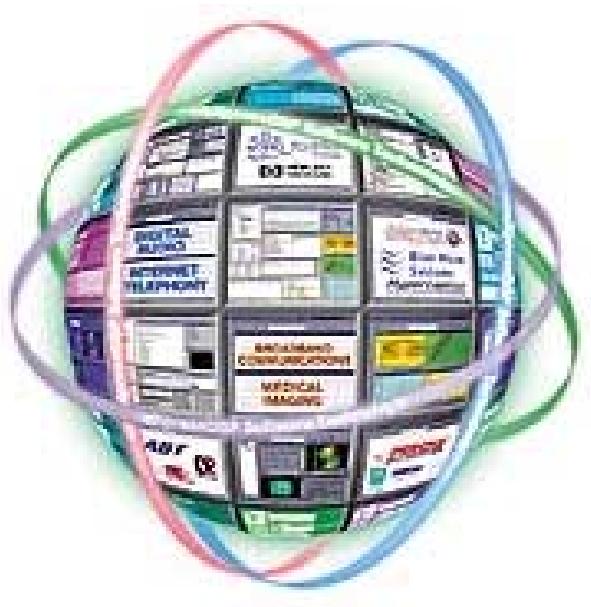
/* SAGE800 memory map */

MEMORY
{
    PAGE 0: EXT_PM  :origin= 00000h, length = 0F000h
    PAGE 1: I_RAM   :origin= 080h, length = 010h
    PAGE 1: W_Q_RAM :origin= 090h, length = 770h
    PAGE 1: ABU_0   :origin= 0800h, length = 800h
    PAGE 1: M_Q_RAM :origin= 1000h, length = 800h
    PAGE 1: ABU_1   :origin= 01800h, length = 800h
    PAGE 1: I_STACK :origin= 02000h, length = 0490h
    PAGE 1: P_SHADOW :origin= 02490h, length = 0010h
    PAGE 1: BIN_DATA :origin= 02500h, length = 6800h
    PAGE 1: EXT_DM   :origin= 08D00h, length = 7300h
}

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
.systemm   :{}    > EXT_DM   PAGE = 1
.ext_data  :{}    > EXT_DM   PAGE = 1
```

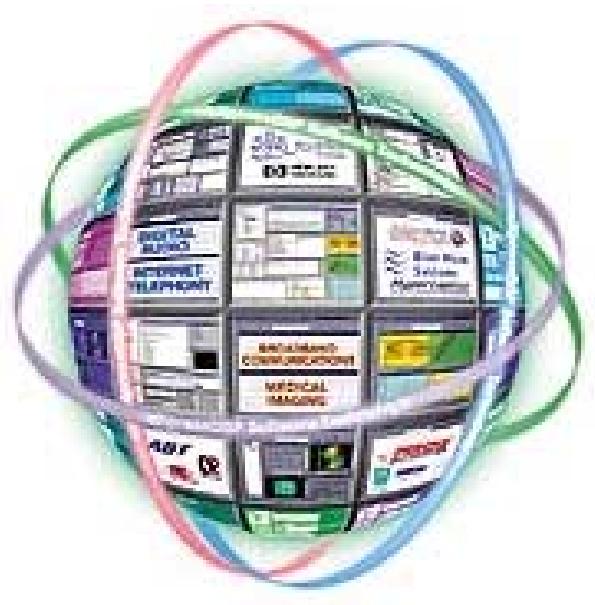
Code Composer Studio Plug-ins

Omar Fattah
Plug-in Strategy Manager



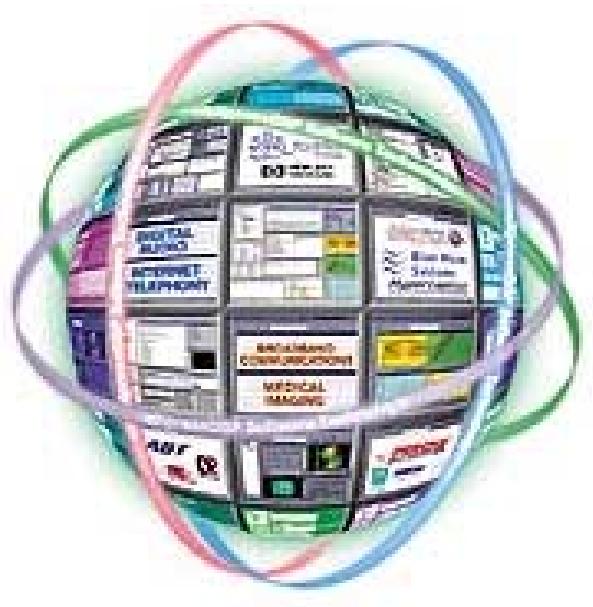
New DSP Starter Kit (DSK) Strategy

Lori Vidra
C5000 Tools Product Manager



Software Beta Programs

David Friedland
SDS Beta Program Manager





Questions?