DDC-I’s SCORE Technology
-including Integration with OSE RTOS
Reliable  Experienced  Proven
Presentation outline

• About DDC-I
• SCORE Technology Introduction
  – Current target focus:
    • PowerPC & Intel x86
  – Multi-language
    • C/C++ & Certified Ada95 support
  – ANDF as facilitator
  – JTAG
  – OSE RTOS Integration
  – SCORECast
Dedicated to Developers of Safety-Critical Real-Time Embedded Applications

- Founded in 1985. Technology centers in Phoenix, Arizona and Copenhagen, DK
- DDC-I provides:
  - High-end Integrated Development Environments (IDEs)
    - Ada95/C/C++ Multi-Language IDE "SCORE"
    - Ada83 IDEs "DACS" & "TADS"
    - JOVIAL compiler systems
  - Extensive FAA certification experience
    - RTCA/DO-178B level C and A
  - #1 in Customer Care
    - Flexible support and training programs
  - Engineering Services
    - Ada/C/C++ Programming, Ada/C/JOVIAL porting and certification
- Our objective is to reduce your risk and costs – in short helping to ensure the success of your projects.
Successes – RAH-66 Comanche

• DDC-I’s Ada IDE’s were selected by the Boeing led Comanche Helicopter team:
  – Transition of the Mission Equipment Package software from i960 to Pentium
  – Extensive customizations to the Ada IDE ”DACS” to support multiple boards, processors and applications on shared bus
    • Multiple debug sessions:
      – Multiple applications per processor
      – Multiple processors per board
      – Multiple boards on a bus
    • Shared run-time system
    • Determinisitic task scheduling
    • Paged Virtual Memory
Successes – Boeing 777

• DDC-I Ada IDE’s were selected by many of the Boeing 777 subcontractors:
  – Honeywell
    • Airplane Information Management System (AIMS) - AMD 29000
  – GEC Avionics
    • Primary Flight Computer – Intel 80486
  – AlliedSignal
    • Sensor Controls – Intel 80186
    • Anti Vibration Controls – 1750A
  – Rockwell
    • Auto Pilot – Intel 80386
Successes – Working Closely with Customers

- Lockheed Martin
  - Many system elements in A-10, F-14, F-16, F-22 a.o. Fighters.
- Northrop Grumman
  - LONGBOW Airborne Radar
- Alenia
  - Air Traffic Control system
- Rockwell International
  - Avionics Equipment & FAA certification
- Confidential Command & Control Information System
- Terma
  - ”Oersted” Micro Satellite
## SCORE and Ada Legacy Products
- Tools for each phase of your project

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<td>• Real-Time UML</td>
<td>• SCORE multi-language system (Ada 95, C/C++)</td>
<td>• SCORECAST (Ada 95, C) AdaCAST (Ada 83)</td>
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<td>• VDMTools -Validated Design through Modeling</td>
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<td>• JOVIAL compiler systems</td>
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#1 in Customer Care
Analysis and Design Phase
- Real-time UML from ARTiSAN

- Debug UML class models
- UML-based requirements models
- UML-based solution design
- State machine generation
- State machine simulation and animation
- Generate C, C++ and Ada source code
- Reverse engineer C and C++ into UML
## SCORE Ada, C/C++ Multi-Language Integrated Development Environment

<table>
<thead>
<tr>
<th>TARGET</th>
<th>Sun SPARC/Solaris Host</th>
<th>Windows NT Host</th>
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<tr>
<td>Native</td>
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<td>Native (summer 2002)</td>
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<td>Power PC 603e, 750</td>
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Safety Critical Object-oriented Real-time Embedded

#1 in Customer Care
SCORE Compilation System
-Architecture-

- Guaranteed real-time performance
- Proven long-term strategic advantages
- Reduced life-cycle costs
- Hosted on Sun SPARC/Solaris & PC Windows NT

Future Language
Ada
Embedded C++
Pentium
80x86 (32 bit)
SPARC
PowerPC
Future Target

Multi-Language
Multi-Host
Multi-Target
SCORE: Key Features

- Scalable Run-Time System
- Stand-Alone Run-Time System
- ELF Code Format
- DWARF Debug Format
- ROM’able
- No Implicit Heap
- Contiguous Data Layout
- Fully Configurable
- Extensive Ada Library support
- Designed for Embedded Applications
SCORE: System Overview

- C Source
- Ada Source
- Root Library
- Ada Source
- Compiler
- Make
- Listing
- Ada Linker
- Library Utilities
- Ada Source
- Compiler
- Recompiler
- Make
- Object File
- Target Linker
- RTS
- LibC
- UCC
- Disassembly
- Disassembler
- Executable
- Loader
- Debugger
- PSIM
SCORE: Multi-Language Debugger

- Advanced GUI and sequential debugger
- Full support for Ada and C symbolic debugging
- Full support for machine level debugging
- Designed for true real-time debugging
- Extensive task debugging facilities
- Powerful command language
- Configurable to your hardware
- Supports debugging of optimized programs
SCORE Multi-Language Debugger

- Dedicated Windows for
  - Source Text
  - Machine Code
  - Debugger Output
  - Debugger Commands (with history)
  - Call Chain
  - Target Program Output
  - Breakpoints (editable)
  - Tracing
  - Help

- Full Symbolic Debugging
  - Setting breakpoints
  - at any statement
  - at Ada tasking events
  - when an Ada exception is raised or handled

Diagram:
- Host Computer
  - Object file
  - Information about Symbols
  - Debugger
  - User
  - Commands
- Target Computer
  - Target Program
  - Debug Monitor
  - Execution Control and Monitoring
  - State Information

#1 in Customer Care
SCORE: JTAG Debugging

- JTAG allow for communication directly with target hardware
  - No debug monitor on target required
- SCORE interfaces to Macraigor JTAG devices
  - Wiggler (serial line access)
  - Raven (parallel line access)
  - Ethernet device (Ethernet access)
Run Time Support
– Bare Board & OSE RTOS Integration

• SCORE is integrated with the commercial RTOS ”OSE” from ENEA Group/OSE Systems:
  – Proven in millions of products world-wide
  – Dominant RTOS in telecoms industry; making strong inroads into all other industry segments in recent years
  – Focus for OSE
    • Reliability
    • Scalability
    • Simplicity
  – Used primarily for
    • High-availability Applications
    • Distributed Systems
• DDC-I also offers several bare board run-time system options
  – Allows for compact and minimal overhead bare board solutions
SCORE: OSE RTOS Integration

- OSE Architecture
  - Message based (Direct Message Passing)
  - Multi-level facility for error detection
    - Increase reliability
    - Consistent exception handling facilitated
  - Monitoring of critical processes
  - Allocate memory from memory pool
    - Secure conservation of memory
    - Avoid fragmentation
- SCORE/OSE initial target integration focus
  - PowerPC
SCORE: OSE RTOS Integration

- OSE RTOS key target and host products:
  - Kernel - the heart of the system
  - BSP - Board Support Package
  - INET - the OSE TCP/IP stack
  - INETUtils - utilities such as ftp, tftp, login etc
  - WebServer - a web-server for embedded use
  - EFS - the OSE embedded file system
  - MMS - Memory management System
  - PRH - Program Handler (Loader)
  - LNH - Link Handler
SCORE Technology

SCORE: OSE RTOS Integration

- The OSE kernel is Certified according to
  - IEC 61508
    - Safety integrity level 3
    - Certification done by TÜV in 1996
  - DIN 19250 (level AK 6) + DIN 0801 (level AK 6)
    - Certification done by TÜV in 1997
- The OSE kernel is Certifiable according to
  - DO-178B (levels A-D).
• SCORECast & AdaCast
  – Source code based test system
  – Language, compiler and platform specific
  – Automatic construction of test simulation environments (component level testing)
  – Automatic building of test cases based on max/min/middle values as input parameters
  – MCDC coverage which can be utilized for FAA DO-178B level A testing
SCORE Key Benefits

- Software component reuse
  - Across programming languages
  - Extensive Ada Library facilities speed up development time
- Target processor upgrade
  - Same compilers - no major rewrite of application
- Software testing and certification
  - Extensive cross-language debugging
  - SCORECAST for automatic test case generation

Risk reduction
Cost reduction
Shorter time to market
FAA Certification Expertise

• DDC-I has developed DO-178A/B documentation for many different host/target/RTS combinations, including:
  – 1991 DO-178A 80386 non-tasking RTS
  – 1991 DO-178A 80186 non-tasking RTS
  – 1993 DO-178B 80186 non-tasking RTS
  – 1993 DO-178B 80386 non-tasking RTS
  – 1993 DO-178B 80186 tasking RTS
  – 1993 DO-178B 80386 tasking RTS
  – 1993 DO-178B 80486 non-tasking RTS
  – 1993 DO-178B 80486 tasking RTS
  – 1994 DO-178B 29050 non-tasking RTS
  – 1999 DO-178B 80386 non-tasking RTS

• These documentation sets have been developed and maintained over multiple hosts and versions of the 80x86 RTS (v4.5, 4.6 and 4.7).

• These sets have been delivered to multiple customers.
SCORE Technology Summary

- Certified Ada 95 IDE (according to ACATS 2.4F)
  - Validations see: http://www.adaic.com/compilers/ada95.html
- Market Leading Multi-Language facilities
- Market Leading Multi-languge debugger incl. JTAG
- Superb Migration tool:
  - Ada83 to Ada95
  - Ada83 to Ada95/C/C++
  - Intel x86 to PowerPC
- Bare Board or OSE RTOS focus for FAA certification needs
- Comprehensive Tool chain via partner integrations incl. ARTiSAN UML and Top Graph’X CORBA.