

SIGGRAPH 1990

**17th International Conference
On Computer Graphics and
Interactive Techniques**

**Dallas Convention Center
August 6th—10th**

COURSE NOTES

19

**X3D-PEX (PEX): THREE-
DIMENSIONAL GRAPHICS
IN A DISTRIBUTED
WINDOW SYSTEM**

Chair

**Marty Hess
Sun Microsystems, Inc.**

Lecturers

**Dave Plunkett
Solbourne Computer, Inc.
Randi Rost
Digital Equipment Corp.
Jeff Stevenson
Hewlett-Packard Co.**

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"PHIGS Input Support in the X/PEX Environment", David J. Plunkett	N-12
"Understanding the PEX Rendering Pipeline", Randi J. Rost	N-22

PEX Documentation

"PEX v5.0C Protocol Specification", PEX Design Team	
"PEX v5.0C Encoding Document", PEX Design Team	

Additional Material

"Supporting PHIGS+ Color Mapping in PEX", Jeff Friedberg	
Reprinted Articles About PEX	

Course Abstract

X3D-PEX (PEX) is a network protocol extension to the X11 Window System. PEX, the PHIGS and PHIGS+ Extension, adds three dimensional (3D) capability to X11. PHIGS, the Programmers Hierarchical Interactive Graphics System, is an international standard for 3D graphics. PHIGS+ is an extension to PHIGS being proposed in the international community to support additional features for lighting, shading, depth cueing, and advanced curve and surface primitives. The PEX effort marks a major milestone in marrying important industry standards, making it possible to use standard programming interfaces to transmit 3D graphics efficiently across a network to an X Window System display.

This course is for technical professionals who are either applications or graphics-system designers or developers. It is recommended that attendees be comfortable with the concepts of the X Window System and be very familiar with the fundamentals of the existing PHIGS graphics standard, and the proposed PHIGS standard extensions, PHIGS-PLUS (or their equivalent.)

Attendees should be versed in a programming language and be familiar with PHIGS programming. (Simple C language and PHIGS program examples will be used.)

With the exception of PHIGS, the material is of moderate difficulty due to the volume and complexity of information, not due to depth of the technical content.

Introduction to the Course Notes

This course will examine advanced graphics concepts such as those of PHIGS and PHIGS-PLUS in light of the additional capabilities of a heterogeneous, distributed window system environment.

Each of the speakers for this course have been involved with the design of the PEX protocol since its early stages, and most are involved with implementations of PEX in one form or another.

We hope that the information presented through the notes and talks will not only serve to inform you about PEX, but that it will encourage thinking in the directions of the future of effective distribution of complex operations such as high-end graphics.

Speaker Biographies

Course Organizer / Speaker

Name: Marty Hess

Affiliation: Sun Microsystems, Inc.

Biography:

Marty Hess has been a member of Sun's Graphics Standards Department since early 1987. He is a member of the original multi-vendor architecture team that designed PEX — the PHIGS (and PHIGS-PLUS) Extension to X. Marty is the manager responsible for the design and development of the PEX Sample Implementation (PEX-SI) to be distributed to the public through the X Consortium at the Massachusetts Institute of Technology.

Marty has been involved in computer graphics for twelve years in the areas of MCAD, ECAD, business graphics, and graphics standards. He holds a BSE in Computer Engineering from the University of Michigan.

Speakers

Name: Dave Plunkett

Affiliation: Solbourne Computer, Inc.

Biography:

Dave Plunkett is a Member of Technical Staff at Solbourne Computer in graphics software development. He has six years industry experience with PHIGS and PHIGS-like interfaces, and has spent the past two years working with PEX. He is a member of the PEX Architecture Team. Dave received his B.S. and M.S. in Mechanical Engineering from Purdue University.

Name: Randi Rost

Affiliation: Digital Equipment Corp.

Biography:

Randi Rost is a principal engineer in the Workstation Systems Engineering group at Digital Equipment Corp. and has been with Digital since 1986. He is a co-architect of PEX, a member of the PEX Architecture Team, and document editor for the PEX specification documents. He received his B.S. degree in Computer Science/Math from Mankato (MN) State University in 1981, and received his M.S. in Computing Science from the University of California/Davis in 1983.

Name: Jeff Stevenson

Affiliation: Hewlett-Packard Co.

Biography:

Jeff Stevenson has been a member of the technical staff at Hewlett-Packard for six years. His work has been primarily in the area of windowing systems and graphics. He is one of the original members of the multi-vendor PEX architecture team. Jeff has worked in the area of windowing systems and graphics for seven years. He holds a B.S. in computer science from the University of Idaho.

Course Outline

- **8:00 – Introduction/Hess (0.75 hour)**
 - Day's Logistics and Introductions
 - Short History of PEX
 - Design Goals of PEX
 - PEX Terms
- **8:45 – Technical Overview (1.25 hour)**
 - The X Window System Concepts and Architecture/Rost
 - PEX Overview/Rost,Plunkett
 - Ramifications of Diverse Goals (X versus PHIGS)
 - PEX Resources
 - PEX Requests and Output Commands
- 10:00 – Break (0.25 hour)**
- **Architectural Examination of PEX**
 - 10:15 – Protocol Considerations/Plunkett (0.75 hour)**
 - Relationship to Core X
 - Flexibility and Extensibility
 - 11:00 – "Client's/Application's View"/Stevenson (1.00 hour)**
 - Standard PHIGS API (Application Programming Interface)
 - PHIGS as a PEX Client API
 - Impact of the X Windowing Environment
 - Programming Examples
- 12:00 – Lunch (1.5 hours)**
 - 1:30 – "Server's-Eye View"/Rost,Hess (1.25 hour)**
 - Server Architecture
 - Relationship to Core X
 - Relationship to PHIGS/PHIGS-PLUS
 - 2:45 – Implementation Considerations/Plunkett (0.5 hour)**
 - Device Range of Implementations
 - Hardware Acceleration
- 3:15 – Break (0.25 hour)**
- **3:30 – Application Programmer's Considerations/Stevenson (0.5 hour)**
 - "Generic" Applications
 - "PEX-Aware" Applications
 - Additional Considerations
 - PEX Benefits for Application Developers
- 4:00 – PEX-SI Overview and Status/Hess (0.50 hour)**
- 4:30 – <Wrap-up>/All (0.50 hour)**
- **Live PEX Demonstrations**
 - Q & A