

High-Assurance Security/Safety on HPEC Systems: an Oxymoron?

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Summary:

To address the need for security in high performance systems, an architecture-based on a small separation, or partitioning, kernel was proposed. This architecture, termed the MILS (Multiple Independent Levels of Security) architecture classifies the components of a system into three layers, the Partitioning Kernel, the Middleware layer (which includes many operating system functions commonly found combined with an OS kernel, as well as code more traditionally termed middleware), and the Application layer. This approach can be implemented and used effectively in high performance systems.

In MILS, basic, general-purpose security policies are enforced at lower levels by the Partitioning Kernel and middleware layer. Enforcement of these basic security policies permits the top layer to implement other, application-specific security policies-such as Bell-LaPadula (BLP), Biba, Community of Interest, etc.-with confidence that the code that implements these policies will have the characteristics of a reference monitor: Non-bypassable, Evaluatable, Always-invoked and Tamper-proof (NEAT). The ability of these systems to transfer data at high speed is not compromised by a MILS design.

These concepts are extended to a collection of MILS nodes called an enclave. The PCS (Partitioning Communication System) provides the high-assurance secure communication between the MILS nodes in the enclave. The PCS was designed with HPEC systems in mind. The PCS includes zero-copy semantics for secure communications.

Like the Partitioning Kernel, the PCS requires formal methods and mathematical models to assure correctness. The presentation will describe the performance impact and optimizations of the PCS on HPEC environments.

Report Documentation Page				Form Approved OMB No. 0704-0188	
Public reporting burden for the collection of information is estimated to average 1 hour per response, including the time for reviewing instructions, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing the collection of information. Send comments regarding this burden estimate or any other aspect of this collection of information, including suggestions for reducing this burden, to Washington Headquarters Services, Directorate for Information Operations and Reports, 1215 Jefferson Davis Highway, Suite 1204, Arlington VA 22202-4302. Respondents should be aware that notwithstanding any other provision of law, no person shall be subject to a penalty for failing to comply with a collection of information if it does not display a currently valid OMB control number.					
1. REPORT DATE 01 FEB 2005		2. REPORT TYPE N/A		3. DATES COVERED -	
4. TITLE AND SUBTITLE High-Assurance Security/Safety on HPEC Systems: an Oxymoron?				5a. CONTRACT NUMBER	
				5b. GRANT NUMBER	
				5c. PROGRAM ELEMENT NUMBER	
6. AUTHOR(S)				5d. PROJECT NUMBER	
				5e. TASK NUMBER	
				5f. WORK UNIT NUMBER	
7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES) Objective Interface Systems, Inc.; National Security Agency				8. PERFORMING ORGANIZATION REPORT NUMBER	
9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES)				10. SPONSOR/MONITOR'S ACRONYM(S)	
				11. SPONSOR/MONITOR'S REPORT NUMBER(S)	
12. DISTRIBUTION/AVAILABILITY STATEMENT Approved for public release, distribution unlimited					
13. SUPPLEMENTARY NOTES See also ADM00001742, HPEC-7 Volume 1, Proceedings of the Eighth Annual High Performance Embedded Computing (HPEC) Workshops, 28-30 September 2004 Volume 1., The original document contains color images.					
14. ABSTRACT					
15. SUBJECT TERMS					
16. SECURITY CLASSIFICATION OF:			17. LIMITATION OF ABSTRACT UU	18. NUMBER OF PAGES 7	19a. NAME OF RESPONSIBLE PERSON
a. REPORT unclassified	b. ABSTRACT unclassified	c. THIS PAGE unclassified			



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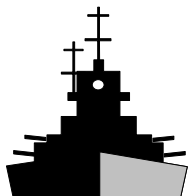
HPEC Poster
30-SEP-2004

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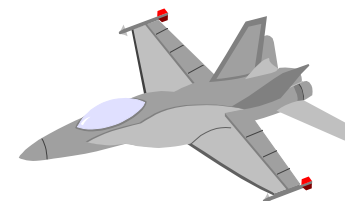
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This presentation represents joint research between the
Air Force, Army, Navy, NSA, Boeing, Lockheed Martin, Objective Interface,
Green Hills, LynuxWorks, Wind River, GD, Rockwell Collins, MITRE, U of Idaho





The Whole Point of MILS



Really simple:

- Dramatically **increase the scrutiny** of *security critical code*
- Dramatically **reduce the amount** of *security critical code*



Orange Book vs. MILS Architecture



Monolithic Applications

*User
Mode*

Monolithic Kernel

Network I/O

File systems

Information Flow

Data isolation

Auditing

DAC

MAC

Device drivers

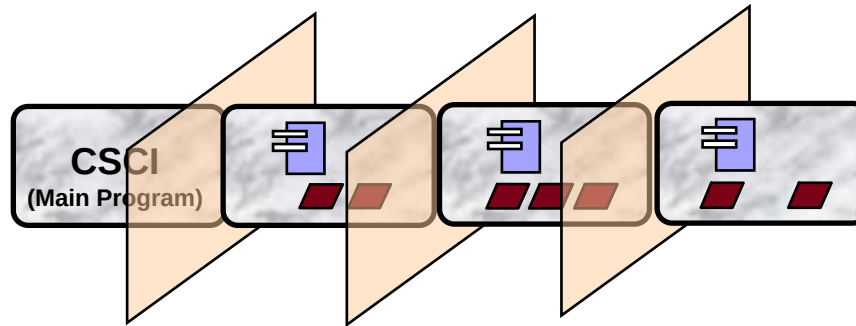
*Privilege
Mode*

Kernel

*Damage Limitation
Periods Processing*



Orange Book vs. MILS Architecture



Middleware



*User
Mode*

*Mathematical
Verification*

Partitioning Kernel

Information Flow

Data isolation

Periods Processing

Damage Limitation

*Privilege
Mode*

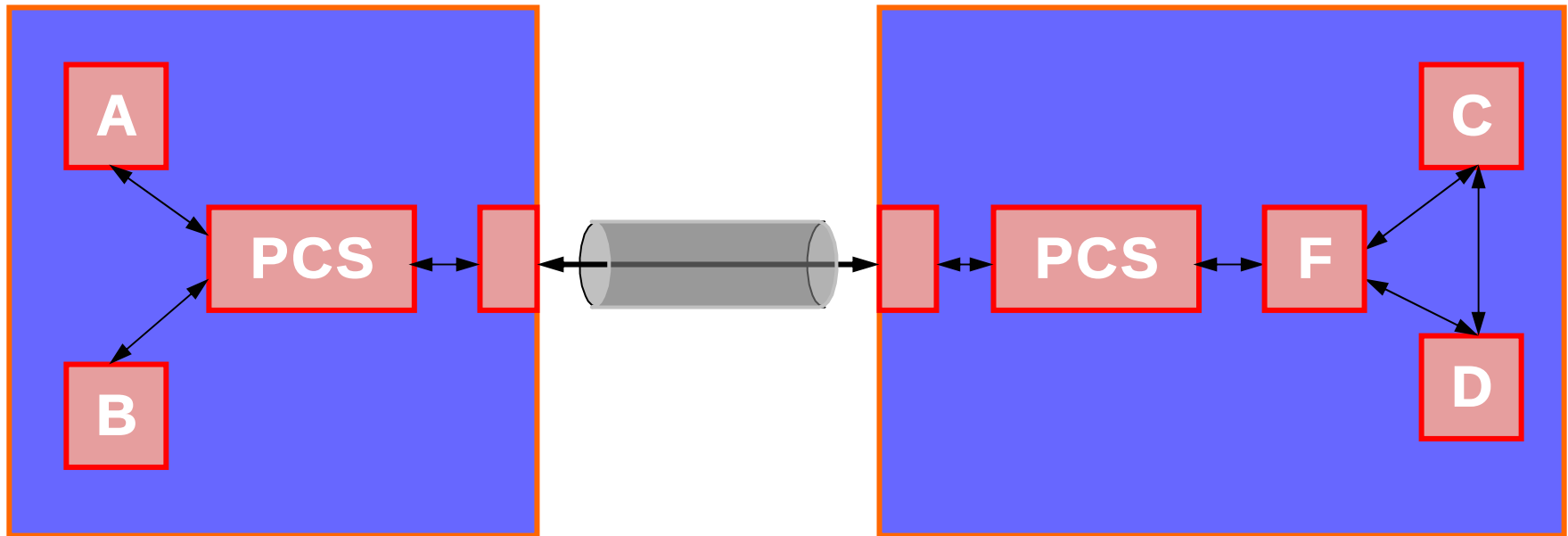
Kernel



Partitioning Communication System



Zero-copy Secure Communications Channel





Partitioning the Channel

