

# A Shrink-Wrap Robustness Test Suite for Unix Operating Systems

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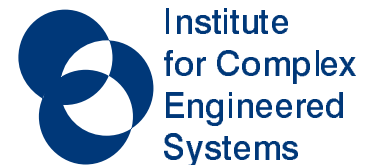
*<http://www.ices.cmu.edu/ballista>*



**Carnegie  
Mellon**

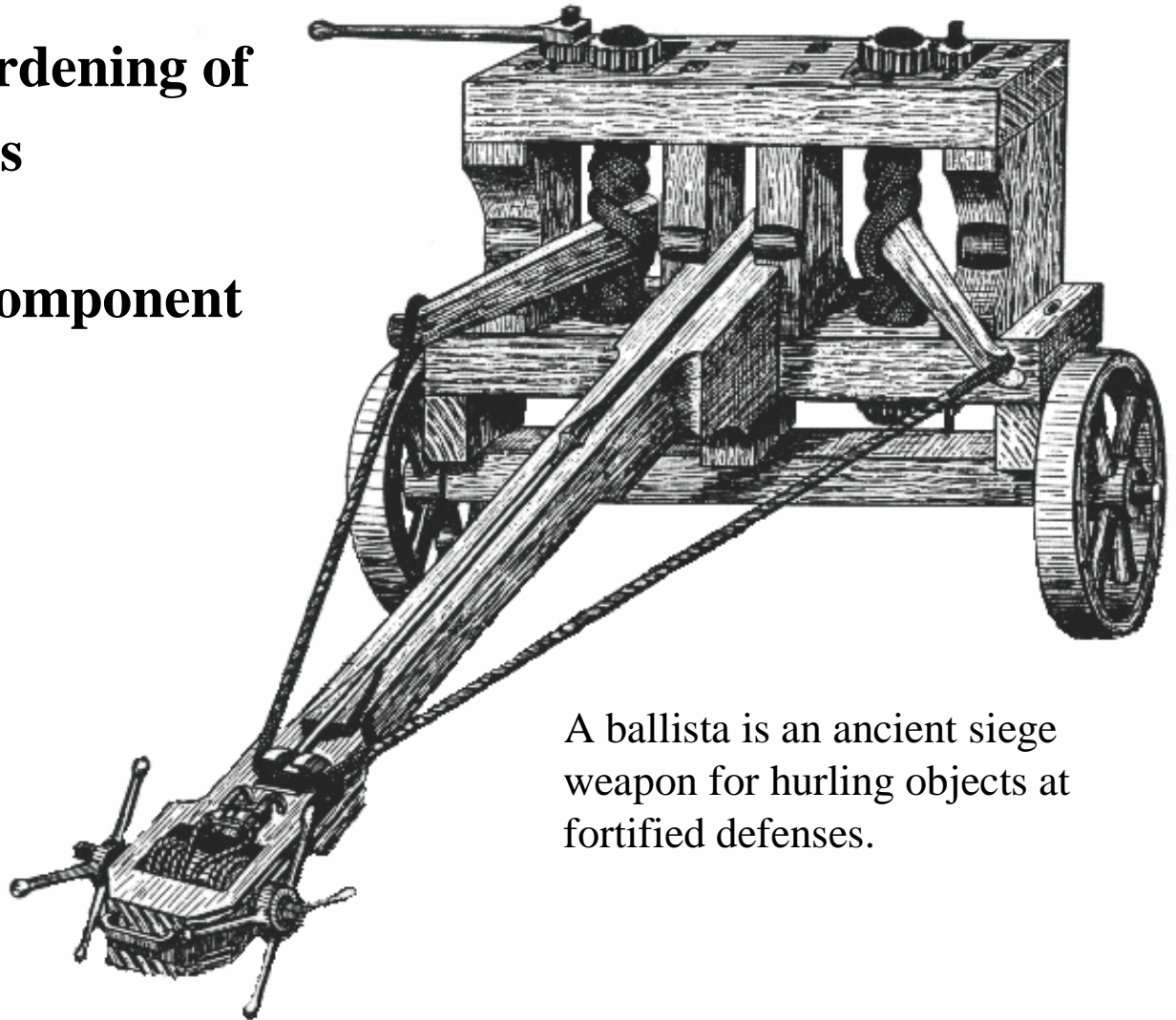


Electrical & Computer  
**ENGINEERING**



# Ballista: Automated Robustness Testing

- ◆ Automated testing & hardening of COTS software components
- ◆ Minimal knowledge of component
- ◆ Highly scalable
- ◆ Repeatable results
- ◆ **CRASH scale:**
  - Catastrophic (crash)
  - Restart
  - Abort (e.g., core dump)
  - Silent (no error when should be)
  - Hindering (incorrect error code)



A ballista is an ancient siege weapon for hurling objects at fortified defenses.

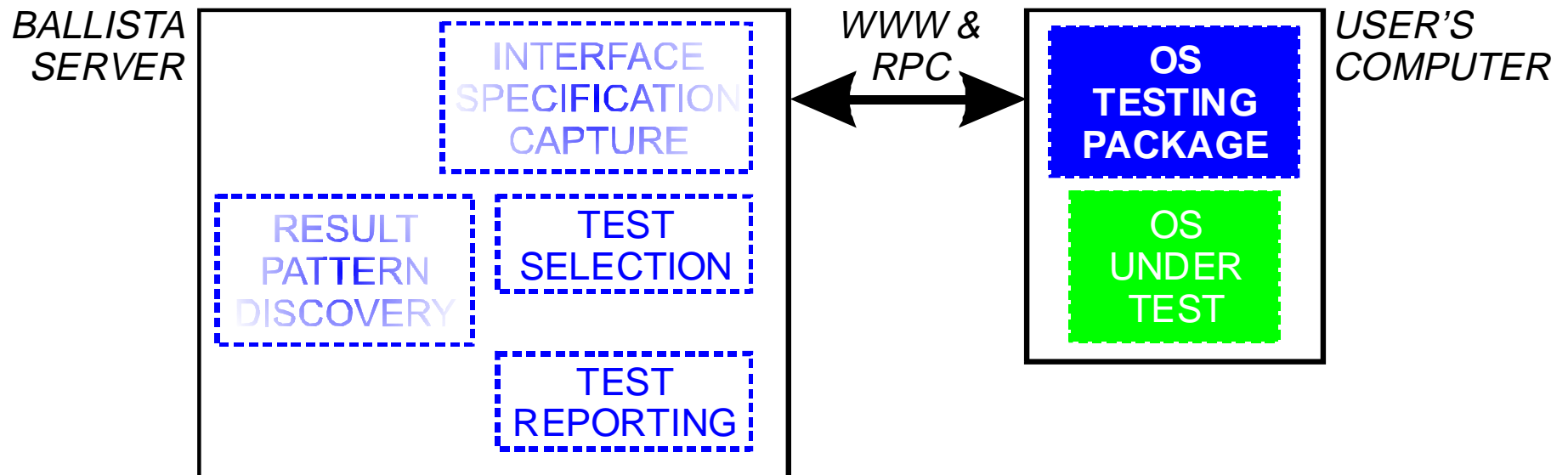
# Based on Generalized Client-Server Architecture

## ◆ Ballista Server

- Selects tests
- Performs pattern analysis
- Generates “bug reports”
- Never sees user’s code

## ◆ Ballista Client

- Links to user’s SW under test
- Can “teach” new data types to server (defn. language)



## ◆ Customized for OS testing:

- Pre-defined tests for known interfaces
- More thorough than previous testing results / random sample large space

# Ballista: Scalable Test Generation

API `write(int filedes, const void *buffer, size_t nbytes)`

TESTING  
OBJECTS

FILE  
DESCRIPTOR  
TEST OBJECT

MEMORY  
BUFFER  
TEST OBJECT

SIZE  
TEST  
OBJECT

FD\_CLOSED  
FD\_OPEN\_READ  
FD\_OPEN\_WRITE  
FD\_DELETED  
FD\_NOEXIST  
FD\_EMPTY\_FILE  
FD\_PAST\_END  
FD\_BEFORE\_BEG  
FD\_PIPE\_IN  
FD\_PIPE\_OUT  
FD\_PIPE\_IN\_BLOCK  
FD\_PIPE\_OUT\_BLOCK  
FD\_TERM  
FD\_SHM\_READ  
FD\_SHM\_RW  
FD\_MAXINT  
FD\_NEG\_ONE

BUF\_SMALL\_1  
BUF\_MED\_PAGESIZE  
BUF\_LARGE\_512MB  
BUF\_XLARGE\_1GB  
BUF\_HUGE\_2GB  
BUF\_MAXULONG\_SIZE  
BUF\_64K  
BUF\_END\_MED  
BUF\_FAR\_PAST  
BUF\_ODD\_ADDR  
BUF\_FREED  
BUF\_CODE  
BUF\_16  
BUF\_NULL  
BUF\_NEG\_ONE

SIZE\_1  
SIZE\_16  
SIZE\_PAGE  
SIZE\_PAGEx16  
SIZE\_PAGEx16plus1  
SIZE\_MAXINT  
SIZE\_MININT  
SIZE\_ZERO  
SIZE\_NEG

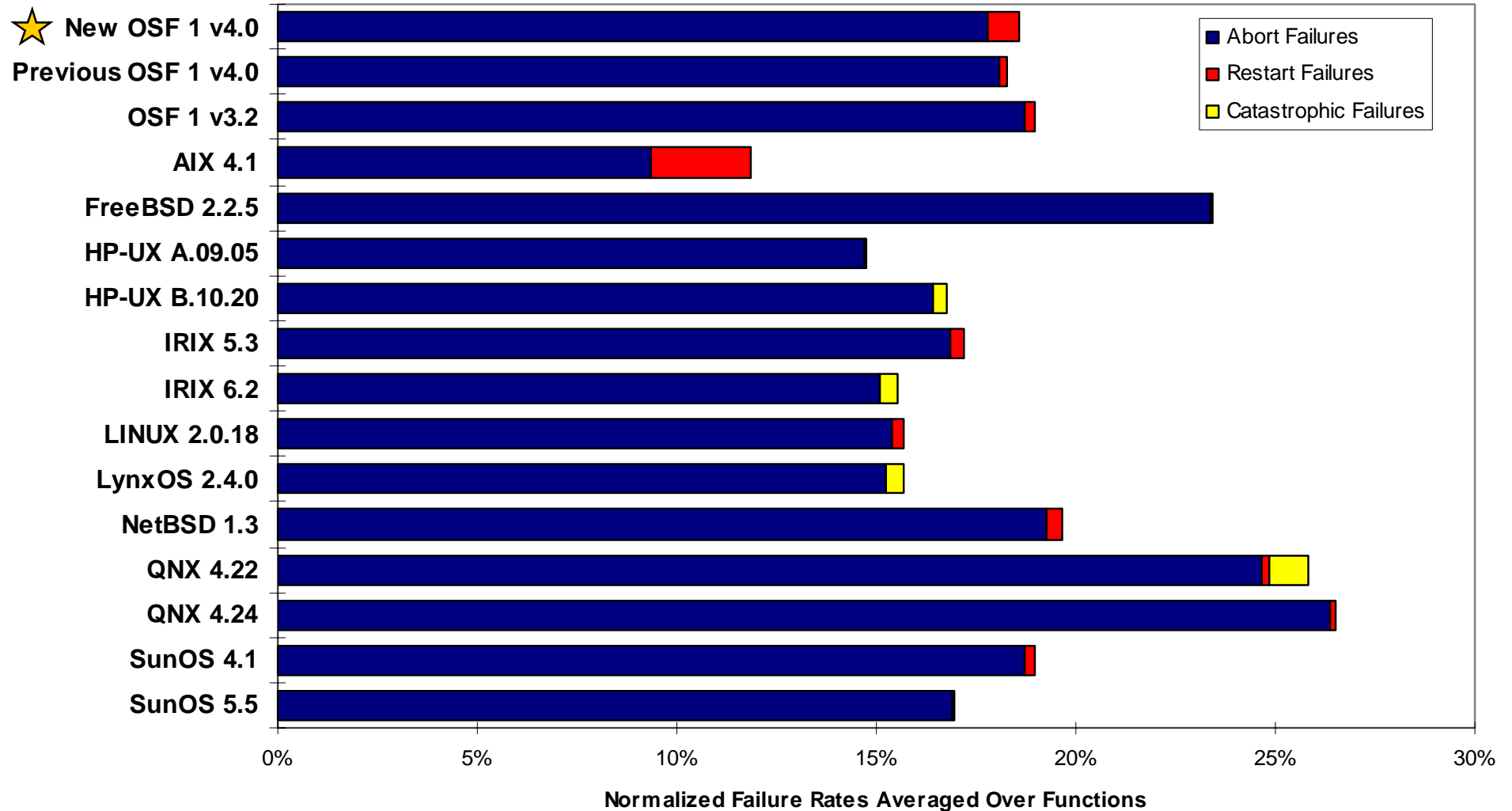
TEST  
VALUES

TEST CASE

`write(FD_OPEN_RD, BUFF_NULL, SIZE_16)`



# Results Comparable to Previous Research



◆ But now you can do it from the comfort of your own lab