Ksplice+ : Rebootless kernel updates in a distributed system

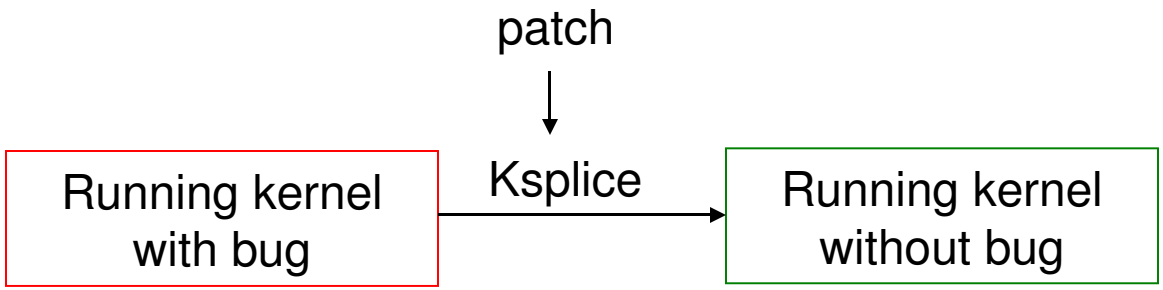
Sanjay Kulhari
PhD Student, Dept. of CSE
U C Riverside

UCR
UNIVERSITY OF CALIFORNIA, RIVERSIDE

Outline

- Ksplice: Overview
- Distributed environment: Ksplice failure scenario
- Ksplice^{+}: Solution by extending Ksplice
- Project activities/progress
- References and Future work
- Questions

Ksplice



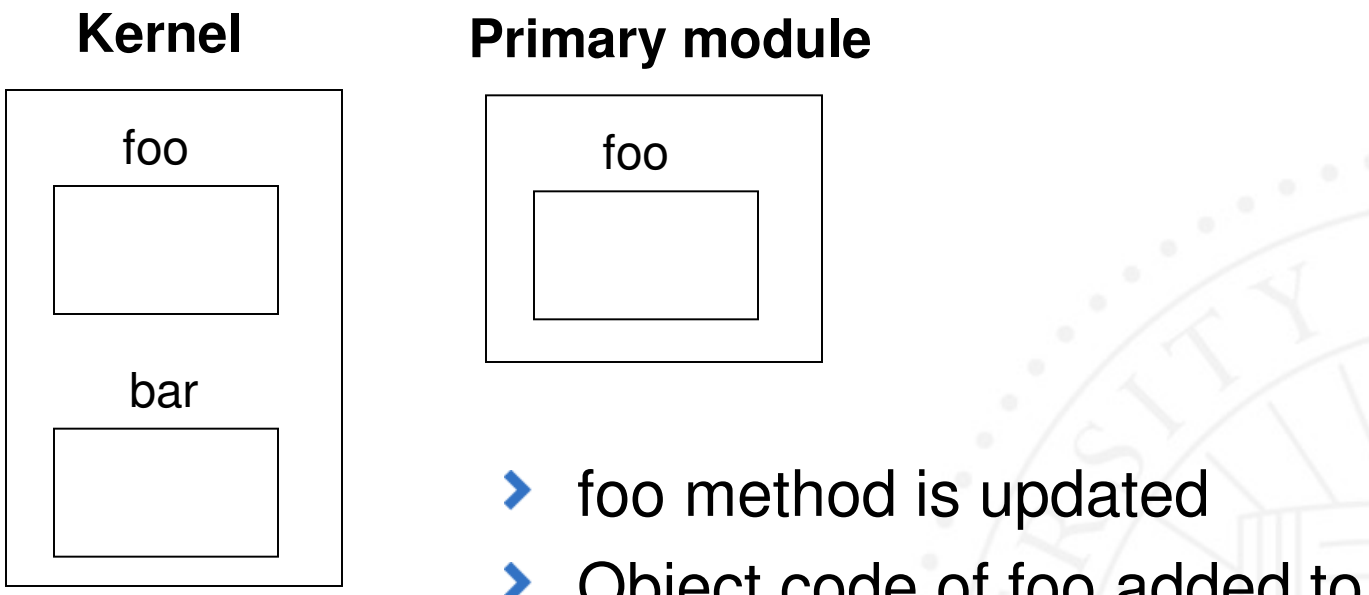
Update the kernel without restart

- Prevents Loss of state/network connections
- Avoids downtime and unexpected problems due to restart

Ksplice

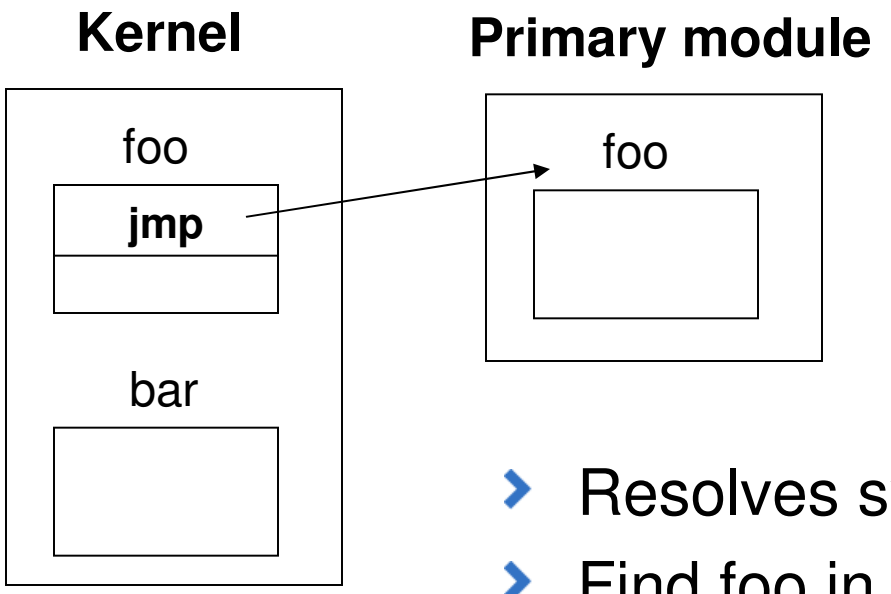
- Building an update
  - Find what has been changed
  - Build pre and post source code to get object code
  - Compare to find the list of changed functions
- Applying an update
  - Match pre code to running kernel
    - Discover symbol values
    - Safety check
  - Call stop_machine
    - Perform “safe time” check
    - Insert jmp instructions

Ksplice



- foo method is updated
- Object code of foo added to Ksplice's primary module

Ksplice



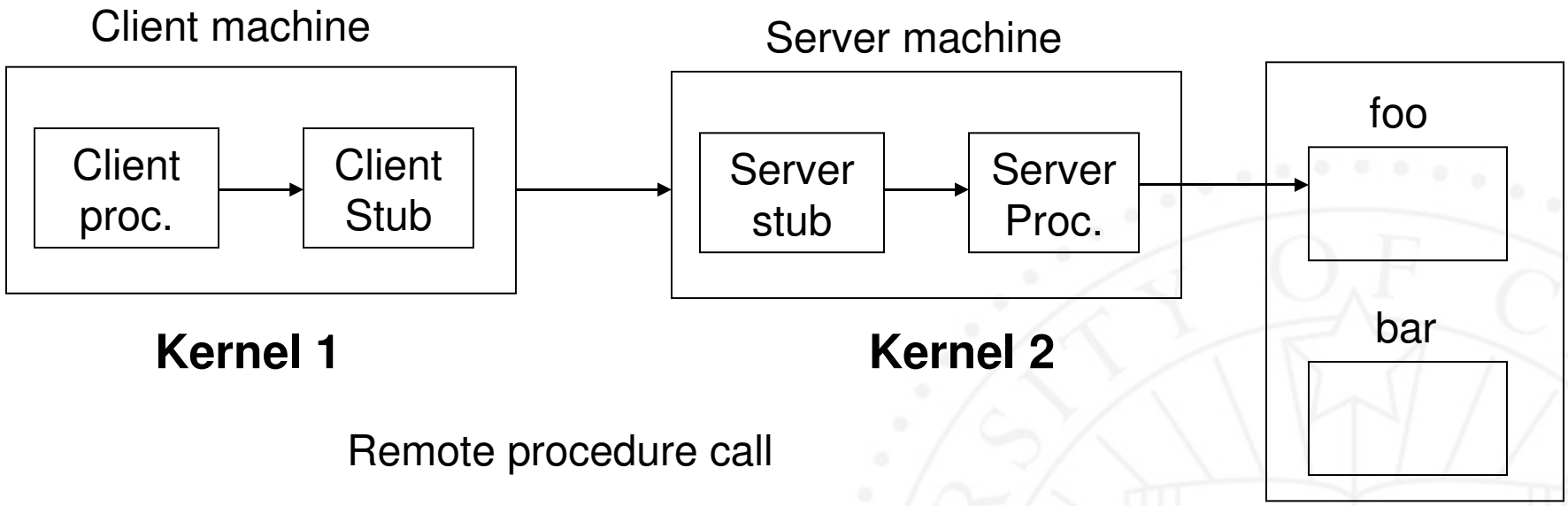
- Resolves symbols in Post code
- Find foo in running kernel
- Find a safe time to insert jmp

An example scenario

- Signature of function *foo* is changed and it returns a different type
- Object code of updated foo function is added to Ksplice's primary module, symbols are resolved and jmp statement inserted
- All the functions calling foo are updated to use new signature of foo

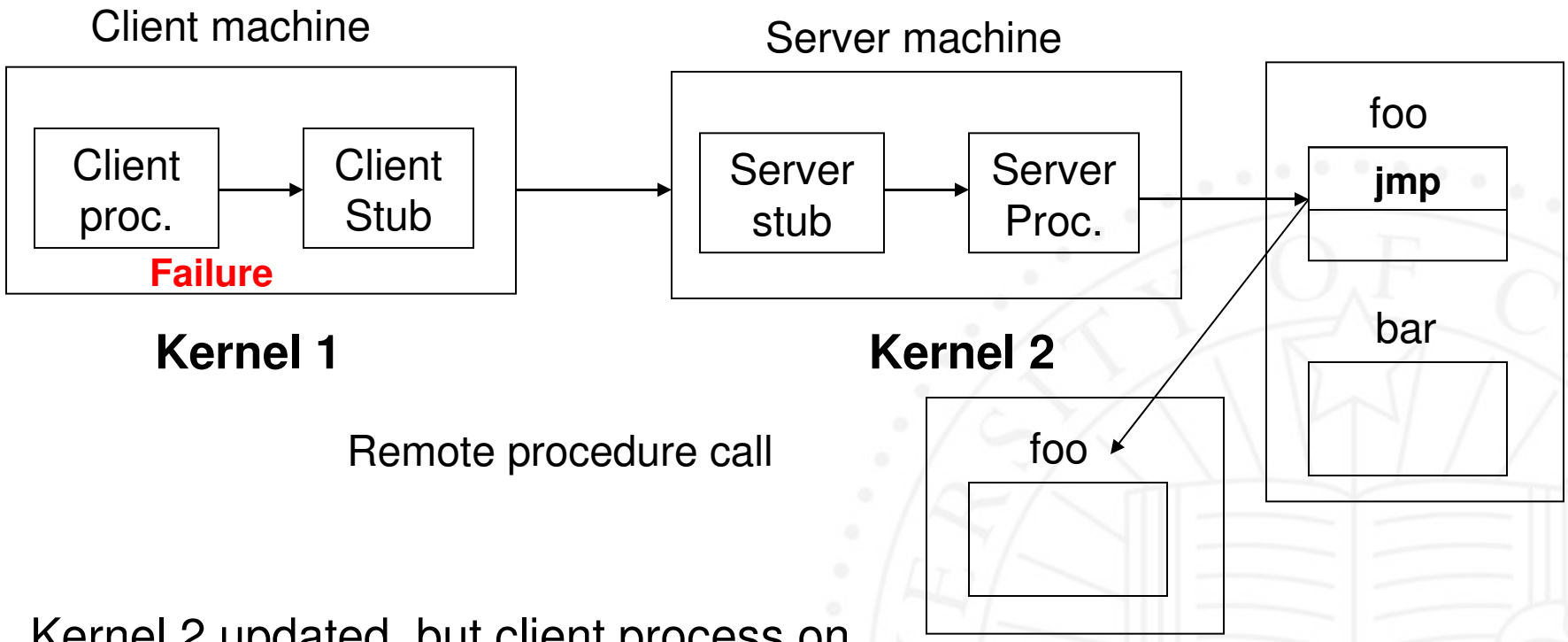
- **Question**: What to do when the calling function is from a different kernel ?

Distributed system



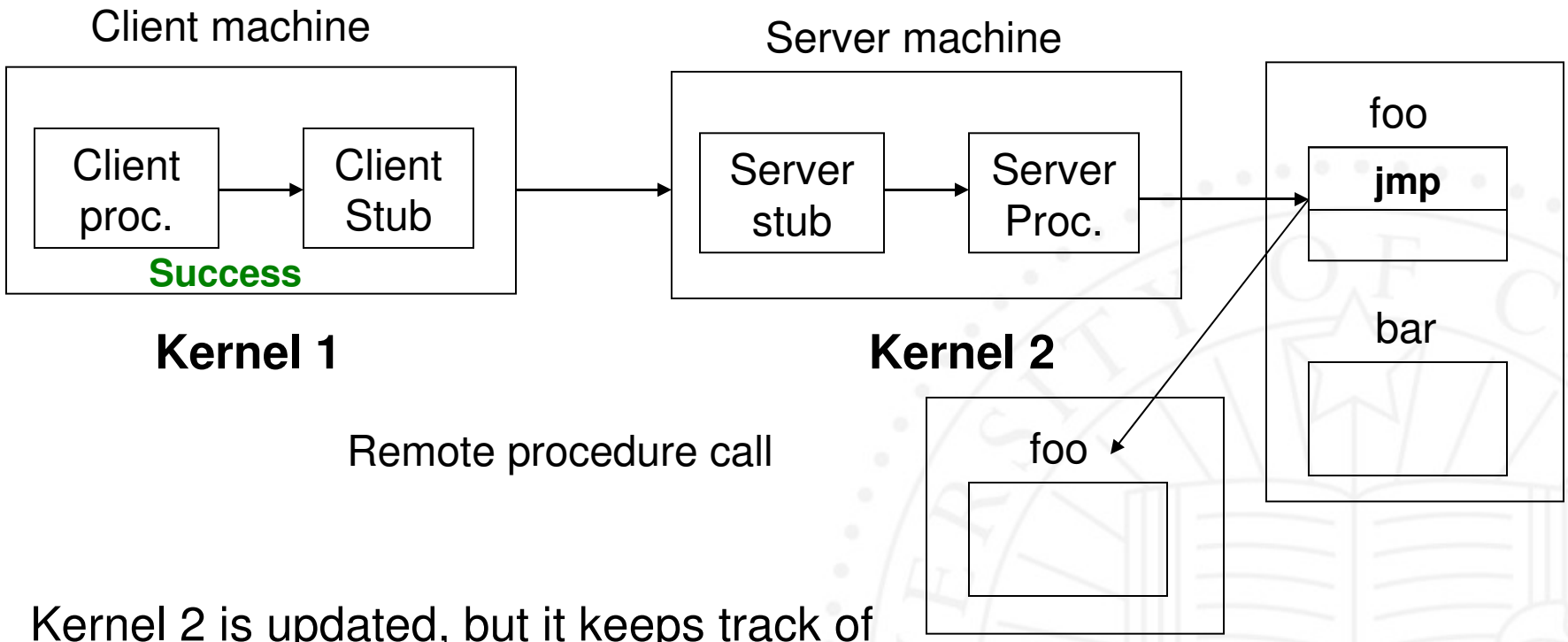
- Expected behavior
  - Two machines should continue to execute in parallel using old functionality until kernel on both of them is updated

Failure scenario



- Kernel 2 updated, but client process on Kernel 1 fails due to incompatibility.

Success scenario



- Kernel 2 is updated, but it keeps track of the state of the calling function. When calling function on client process gets updated, Kernel 1 jumps to new version otherwise not

Required changes in Ksplice

- Ksplice core kernel module to track if the calling function is patched or not.

- Implement conditional jump based on state of calling function.

Ksplice+ : Enhancement to Ksplice

- Allow normal execution to a call from unpatched Kernel.
- When the state of calling Kernel is ‘Patched’ allow the jump statement and execute patched version of the function.
- No failure as the systems communicate using unpatched functionality till both the systems are updated (Lazy update)

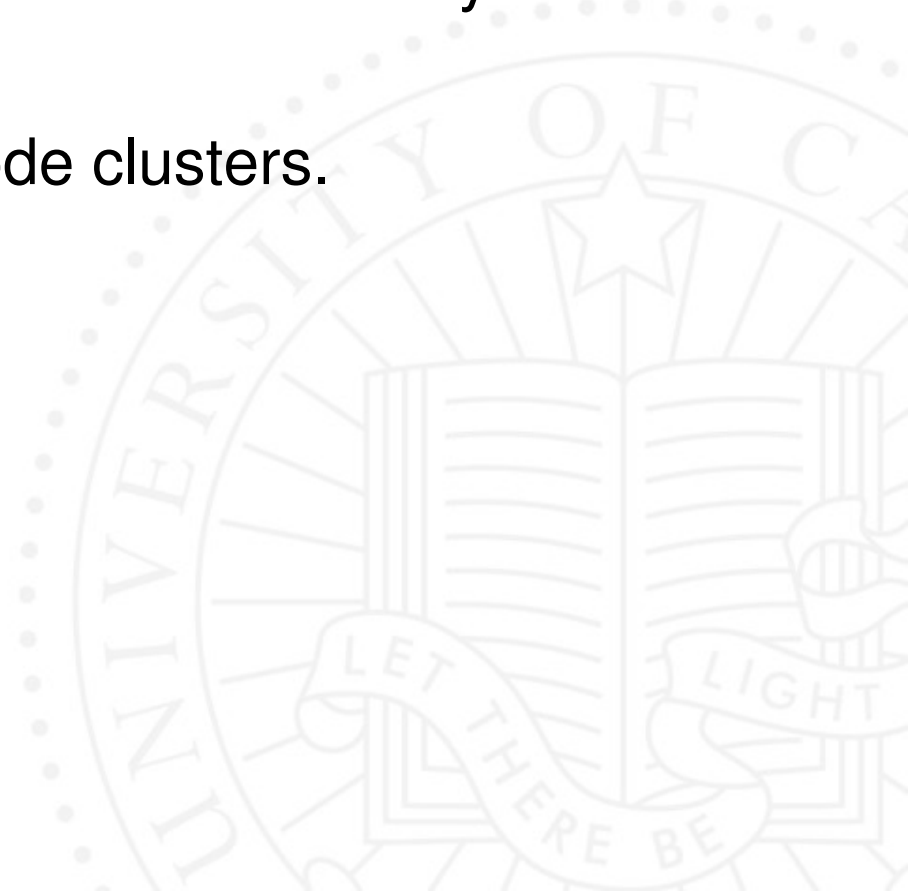
Project activities

- Built Linux kernel version 2.6.30.1 and added a custom system call.
- Updated the custom system call and created a patch using diff command.
- Executed Ksplice-create to create update file
- Applied the patch by executing Ksplice-apply on the update file
- Executed remote procedure call on unpatched/patched kernel
- Simulated failure scenario in a distributed system
- Tried to understand Ksplice code and make changes.

Future work

- Make appropriate code changes to Ksplice core kernel module that performs run-pre matching and inserts jump instruction and thoroughly test the functionality

- Enhance solution for multi-node clusters.



References

- Ksplice: Automatic rebootless kernel Updates by *Jeff Arnold and Frans Kaashoek*. *In Proc. Eurosys, 2009*
- On-the-Fly Kernel Updates for High-Performance Computing Clusters by *Kristis Makris, Kyung Dong Ryu*. *In IEEE, 2006.*
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Questions