CS 5204
Operating Systems
Lecture 11

Godmar Back

Virginia Tech

Announcements

- Last week: milestone meetings
  - Submit revisions where indicated before MS2
- Switched presentations – see reading list

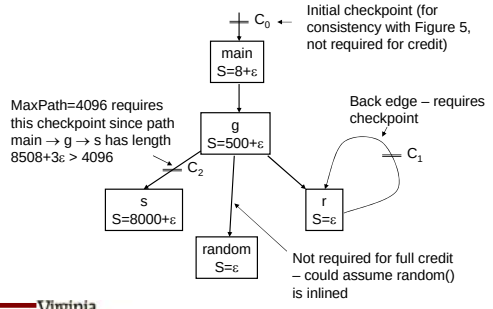
Plan for Today

- Midterm
- Brief overview of kernel systems research in 1980-2000
  - Create context for Exokernel/SPIN

Problem Review

- Problem 1: Lauer & Needham
- Problem 3: VTRR: $\{S_A=10, S_B=5, S_C=2, S_D=1\}$
  - A B C C A B A B C A B A B A B A B B
  - A B C D A B **A C** B A B A A A B A A A
  - A B C D A B A B C A B A A A B A A A
- Problem 4:
  - Write-through vs. write-back
  - False sharing for multiple file lease

Problem 2: Capriccio

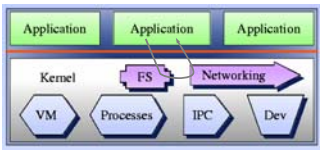


A (somewhat selective) History of OS/Kernels

- 70s: Unix (AT&T and BSD)
  - Plus many architecture-specific OSes
- 80s: Mach (followed Accent)
  - Pioneered microkernel idea
- 90s:
  - Tanenbaum vs Torvalds debate
  - Engineering of Windows NT & contemporary Unixes
  - In Parallel: decade of "Extensible OS" Research
- 00s:
  - Virtual machine monitors
  - Virtual machines

The Red Line

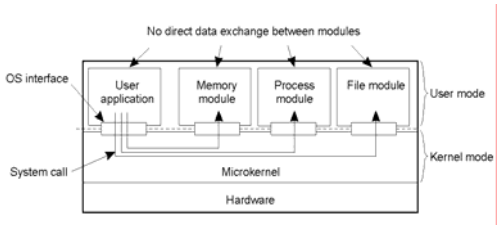
- Separates user mode & kernel mode



Cheriton 1994

- Q: what should go above the red line, and what should stay below

Microkernels



Source: Tanenbaum *Distributed Systems…*

Microkernels (II)

- Idea of "OS personality"
  - Provided on top using servers
- Noteworthy projects:
  - L4 microkernel [L4]
    - Focus on making message-passing fast
  - Fluke
- Industry:
  - NT, OSX – started with μ-Kernel approach, moved away – mostly for performance reasons

The Torvalds/Tanenbaum Debate

- Should you develop a new OS as a monolithic kernel in 1992?
- Questions [Torvalds/Tanenbaum]
  - Microkernel vs. monolithic
    - How important is OS structure?
  - Portability
    - What defines portability?
  - Free Software
    - How important is the development process?