A Self-Adapting Web Server Architecture:

Towards Higher Performance and Better Utilization

(Part I)

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Agenda

1. Objectives
2. What is Performance?
3. Improving Performance
4. Performance and I/O
5. Two Original Architectures
6. Need for New Ideas
7. Conclusion

Objectives

1. Define performance
2. Introduce I/O classes
3. Explain the two original approaches
4. Motivate new ideas

What is Performance ?

- Macro-Performance
  - Throughput and response time
- Micro-Performance
  - Clock per Instruction (CPI)
  - Cache miss rate
  - I/O handling
  - Utilization of resources

“Benchmarking web server architectures: A simulation study on micro performance,” 2002.

Improving Performance

- Enhancing what users perceives
  - Ex. Replication
  - Pro’s: Simple & provides multiples of throughput
  - Con’s : Issues continue to exist
- Enhancing internal operation
  - Ex. Scheduling similar computations together
  - Pro’s: Much more effective
  - Con’s: More work, but is worth that

“SEDA: An Architecture for Well-Conditioned, Scalable Internet Services,” 2001.

Performance and I/O

- Job is to deliver contents
  - Pages, images, scripts, database contents …etc
  - Can be either cached, or read from disk
- Can’t have everything in cache
  - Disk I/O becomes a must
  - Concurrency is also a must
  - 4 classes of disk I/O

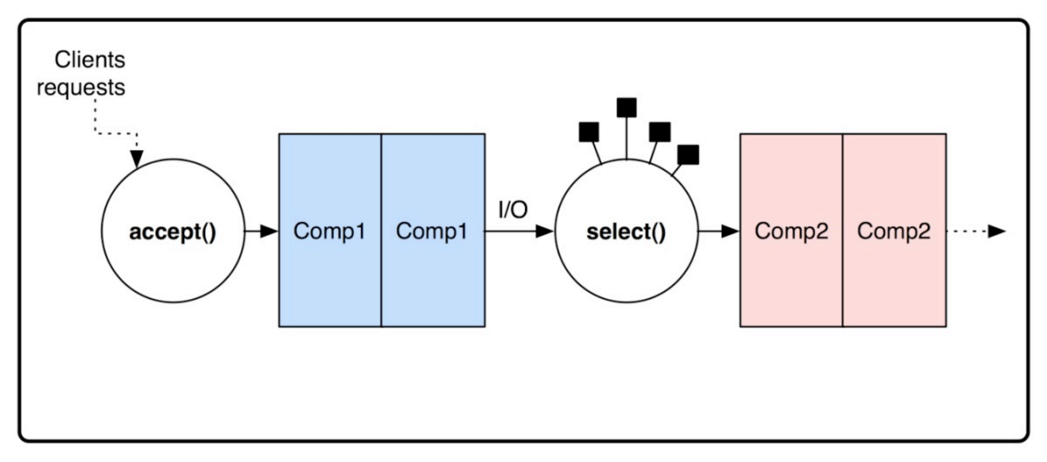
	Blocking	Non-blocking
Synch.	Read/Write	Read/Write (O_NONBLOCK)
Asynch.	IO Multiplexing Select/Poll	AIO

http://www.ibm.com/developerworks/linux/library/l-async/

Two Original Architectures

1) Single-Process Event-Driven (SPED)

- Analogy
  - Single instance
  - Processing based on events
- Architecture layout



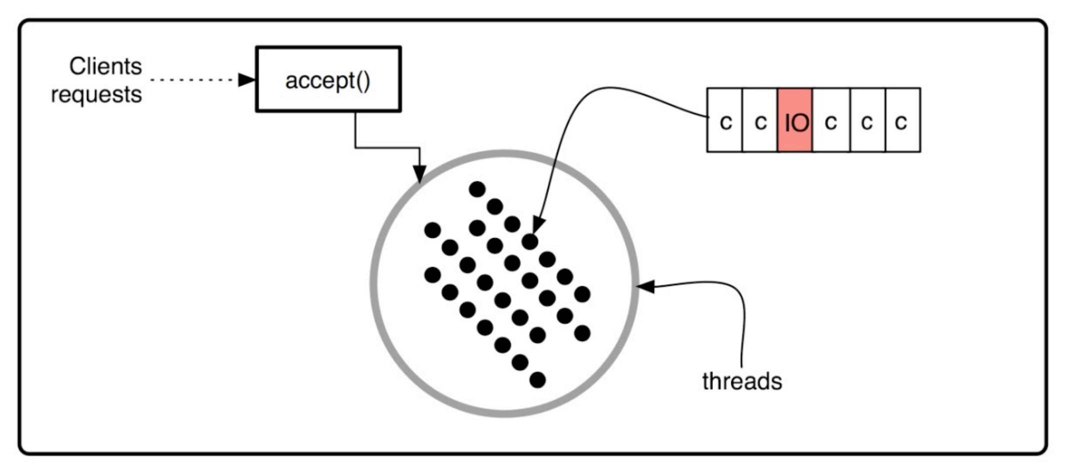
Two Original Architectures

- **SPED Pro’s:**
  - **Event-Driven is effective**
- **Con’s:**
  - **No mature Asynch. I/O built-in libraries**
  - **Too restrictive I/O scenarios**

Two Original Architectures

2) Multi-Threaded and Multi-Process
   - Differences between the two
     - Sharing
     - Scheduling

- ❖ Analogy
- ❖ Architecture layout



Two Original Architectures

- Multi-Threaded Pro’s
  - Simple operation
  - Easy coding
- Con’s:
  - Low utilization (blocking IO, and no events)
  - Limited scalability

Need for New Ideas

- Serious limitations in original models
- New models should have:
  - Power and availability (Multi-Threaded)
  - Effectiveness and high utilization (Event-Driven)

Conclusion

- Concurrency is highly desirable
    - Single process with Asynch. IO
        - Limitation of Asynch. system calls
    - Multiple instances of server (threads)
        - Limited scalability and utilization
- There is a need for new models
- Next, we :
    - Survey existing models
    - Propose a new architecture