Impact of Layering and Faults on Availability and its End-to-End Implications

Ricardo Bianchini, Richard Martin, Thu Nguyen

Department of Computer Science
Rutgers University
Layers on Layers on Layers

Application
Language VM
OS VM

Operating System
Virtual FS
FS
Virtual Disk
SCSI IDE

Socket
TCP
IP
Enet WiFi
Global Layering

Tier 1
- Load Manager

Tier 2
- Web Server
- Web Server
- Web Server

Tier 3
- Database
- Database
Availability

- Correct response within accepted time bound
  - Fraction correct/90th percentile response time

- Two components:
  - Correctness
  - Time bound

- To get to 99.999 nines (5 min unavailability/year)
  - Not a lot of time to mess around
2 Second Response time

Clients

IP Network

Tier 1

Load Manager

Tier 2

Web Server

Tier 3

DataBase

DataBase
Impact of Faults and Layers

- Each layer built independently
- Intermediate layers hide exceptional conditions
  - Buffer and continue
  - Retry N
  - Crashes
  - Punt
- Hard to build available systems
  - React quickly enough?
  - Diagnosis difficult
  - Prediction

```java
try {
    do_stuff();
} catch(e) {
    freak_out();
}
```
End-to-End Implications

- **Traditional Philosophy**
  - End-to-end checks necessary for correctness,
  - Intermediate checks only a performance enhancement

- **Availability oriented:**
  - End-to-end checks necessary for correctness
  - Intermediate checks and timely cross-layer propagation of information necessary

- How to achieve these properties while maintaining layering?