



Computer Networks

-An Engineering Design Approach

Lecture-11:

Select Aspects of Performance Evaluation of Computer Networks

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Interaction Points

- A Recap of the Hypothetical Five-Layer Network Reference Model
- Topics of concern in Performance in Analysis
- An Overview of Performance Evaluation of Computer Networks
- Common Errors / Mistakes
- The Correct Approach
- Models of Inter-Protocol Communication
- Summary



Network Performance Evaluation: Some Parameters <recap>

- Bandwidth
- Throughput
- Delay
 - Queuing
 - Processing
 - Transmission
 - Propagation
- Jitter
- Bandwidth x Delay product
- RTT
- MTU
- Hops



Quality of Service Considerations

- Per-Flow or Aggregate Flow QoS (DiffServ, IntServ)
- **Priority of Service**
- **Maximum Acceptable Delays**
- **Minimum Acceptable Throughput**
- **Mean Time Between Failures (MTBF)**
- **Maximum Acceptable AL-initiated Abnormal Termination of Service**
- **Security Specifications**

Topics of Concern in Performance in Analysis

- Specification of performance requirements
 - Evaluating design alternatives
 - Comparison of multiple choices
 - Determination of the parameters' optimal values
 - Identification of the performance bottleneck
 - Characterization of the workload on the system
 - Determining the number and sizes of components
 - Forecasting the performance in near and distant
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Common Mistakes in Performance Evaluation

- Missing out on Some of the Important Parameters
- Ignore Significant Factors
- Inappropriate Experimental Design
- Inappropriate Level of Detail
- No or Erroneous Analysis
- No or Erroneous Sensitivity Analysis
- Ignoring Variability
- Ignoring Social Aspects
- Omitting Assumptions and Limitations

The Correct Approach

- Clear Identification of goals, parameters, candidate models, provision of accommodating / modelling future changes in the system and workload
- Ensuring about level of detailing
- Analysis of experimental design efficiency
- Verification of methodology
- Presentation of generated data with proper analysis
- Proof of statistically correctness of analysis

A Systematic Approach to Performance Evaluation

- State Goals and Define the System
 - List Services and Outcomes
 - Select Metric
 - Related to speed, accuracy and availability of services
 - List Parameters
 - System parameters and workload parameters
 - Select Factors to Study
 - Factors – parameters to be varied in various ‘levels’
 - Select Evaluation Technique
 - Analytical modelling, simulation or measuring a real system
 - Select Workload
 - Design Experiments
 - Analyze and Interpret Data
 - Present Results
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Summary of the Concepts & Terms learnt so far



Mechanisms of Inter-Protocol Communication within a Protocol Stack

- **Mechanism / Model-1:**
 - Process-per-Protocol Mechanism / Model *or* Process-to-Process communication based on Context Switching
- **Mechanism / Model-2:**
 - Process-per-Message Mechanism / Model *or* Procedure-to-Procedure communication based on Procedure Calls



Concluding remarks

- Networking support of some kind is already inside most of the operating systems we use today in variety of forms on Notebooks, Laptops, Workstations and Servers. All Smart-phones and several set-top boxes support it too.
 - Most multi-layer network switches from major vendors around the world can now support IP.
 - However, the degree of IP-readiness may vary.
 - Internet Exchanges like the NIXI are already providing interconnectivity between Networks.
 - Subsequent lecture shall introduce you to the following topics:
 - Performance
 - Quality of Service
 - Reliability
 - Security
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Any question please?

Thank you for your kind attention!

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- IEEE 802 standards issued so far PLUS amendments like:
 - 802.3ap-2007: IEEE Standard for LAN/MAN — Specific Requirements
Part 3: CSMA/CD Access Method and Physical Layer Specifications —Amendment 4: Ethernet Operation over Electrical Backplanes
 - 802.11-2007 IEEE Standard for LAN/MAN — Specific Requirements
Part 11: Wireless LAN Medium Access Control (MAC)and Physical Layer (PHY) Specifications
 - 802.15.4a-2007 IEEE Standard for Telecommunications and Information Exchange Between Systems; PART 15.4: Wireless MAC and PHY Specifications for Low-Rate Wireless PANs (LR-WPANs) — Amendment 1: Add Alternate PHY
 - 802.1ag-2007 IEEE Standard for LAN/MAN — Virtual Bridged LANs — Amendment 5: Connectivity Fault Management

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