كلية الصفوة الجامعة
قسم هندسة تقنيات الحاسوب

أسم المادة: محاكيات شبكات **المرحلة: الثالثة**

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الملاحظات:

Introduction to Network Simulators

Network system : is a set of network elements , such as routers, switches, links, users, and applications working together to achieve some tasks.

The state of a network system is the set of relevant variables and parameters that describe the system at a certain time that comprise the scope of the study.

Simulation is one of the most widely used techniques in network design and management to predict the performance of a network system or network application before the network is physically built or the application is rolled out .

A network simulator is a piece of software or hardware that predicts the behavior of a network, without an actual network being present.
Network simulator used to:

- Evaluate performance of existing network protocols
- Prototyping and evaluation of new protocols.
- Large-scale simulations not possible in real experiments.

1.1 Types of network simulators

Simulation models can be classified in many ways. The most common classifications are as follows:

1) Static and dynamic simulation models: A static model characterizes a system independently of time. A dynamic model represents a system that changes over time.
2) Stochastic and deterministic models: If a model represents a system that includes random elements, it is called a stochastic model. Otherwise it is deterministic. Queuing systems, the underlying systems in network models, contain random components, such as arrival time of packets in a queue, service time of packet queues, output of a switch port, etc.
3**) Discrete and continuous models:** A continuous model represents a system with state variables changing continuously over time. ***Examples*** are differential equations that define the relationships for the extent of change of some state variables according to the change of time.

4) **A discrete model** characterizes a system where the state variables change instantaneously at discrete points in time. At these discrete points in time some event or events may occur, changing the state of the system.

For instance, the arrival of a packet at a router at a certain time is an event that changes the state of the port buffer in the router.

1.2 Simulation versus Emulation

The purpose of ***emulation*** is to mimic the original network and reproduce every event that happens in every network element and application.
In ***simulation***, the goal is to generate statistical results that represent the behavior of certain network elements and their functions

1.3 Network Simulation Objectives:

- **Performance modeling:** Obtain statistics for various performance parameters of links, routers, switches, buffers, response time, etc.
Failure analysis: Analyze the impacts of network element failures.-
- **Network design:** Compare statistics about alternative network designs to evaluate the requirements of alternative design proposals.
- **Network resource planning**: Measure the impact of changes on the network's performance, such as addition of new users, new applications, or new network elements.

1.3 Network Simulation Attributes

1. ***Link capacity*** Channel or link capacity is the number of messages per unit time handled by a link. It is usually measured in bits per second.
2. ***Bandwidth*** is the difference between the highest and lowest frequencies available for network signals. Bandwidth is also a loose term used to describe the throughput capacity of a specific link or protocol measured in Kilobits, Megabits, Gigabits, Terabits, etc., in a second.
3. ***Response time*** is the time it takes a network system to react to a certain source's input. The response time includes the transmission time to the destination, the processing time at both the source and

destination and at the intermediate network elements along the path, and the transmission time back to the source.

4. ***Delay or latency*** is the amount of time it takes for a unit of data to be transmitted across a network link.
5. ***Routing protocols*** The route is the path that network traffic takes from the source to the destination.
6. ***Traffic engineering*** implies the use of mechanisms to avoid congestion by allocating network resources optimally, rather than continually increasing network capacities.
7. ***Protocol overhead*** Protocol messages and application data are embedded inside the protocol data units, such as frames, packets, and cells. A main interest of network designers is the overhead of protocols
8. ***Burstiness*** The most dangerous cause of network congestion is the burstiness.
9. ***Frame size*** Network designers are usually worried about large frames because they can fill up routers buffers much faster than smaller frames resulting in lost frames and retransmissions
10. ***Dropped packet rate*** Packets may be dropped by the data link and network layers of the OSI architecture. The transport layer maintains buffers for unacknowledged packets and retransmits them to establish an error-free connection between sender and receiver.

1.4 Examples of Network Simulators

Ns2- Command based
Opnet- Graphical
OMNET++
QualNet
GlomoSim
Cisco Packet tracer