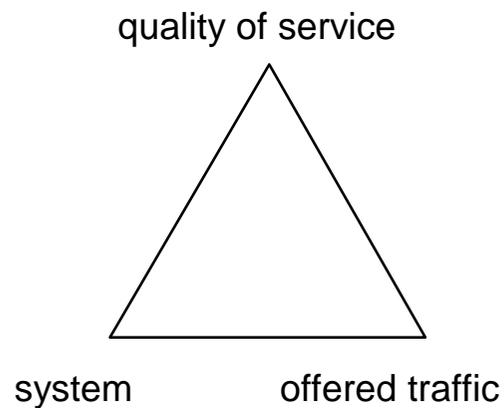


The objective of traffic theory

- To determine the relation between three components

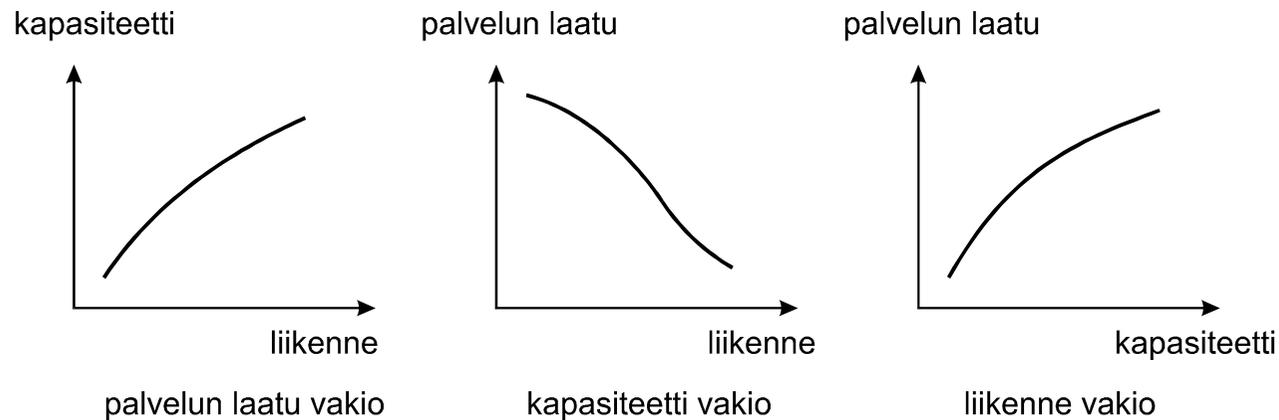


- What is the quality of service experienced by a user in a given system with given traffic load
- How the system has to be dimensioned in order to achieve a given quality of service with given traffic
- How big can the traffic load be without deteriorating the quality of service

Objective of traffic theory (continued)

- What is the quality of service experienced by a user in a given system with given traffic load
 - what is the delay of packet in its way across a network
 - which proportion of cells or packets overflow
 - which proportion of the offered calls are blocked
- How the system has to be dimensioned in order to achieve a given quality of service with given traffic
 - how many trunks are needed between the exchange and the central office
 - how many modems are needed in a service center
 - how big an output buffer is needed in a router
 - how much bandwidth has to be reserved for a virtual path in an ATM network
- How big can the traffic load be without deteriorating the quality of service
 - what is the maximum load of the system and its throughput
 - how the traffic must be controlled or shaped in order to provide a given level of service

Objective of traffic theory (continued)



- Traffic theory describes the dependencies between different factors by means of mathematical models
 - quality of service
 - offered traffic
 - the capacity of the system
- The quantities considered are often stochastic
 - distribution of the number of connections in progress
 - queue length distribution in a buffer

System and traffic models

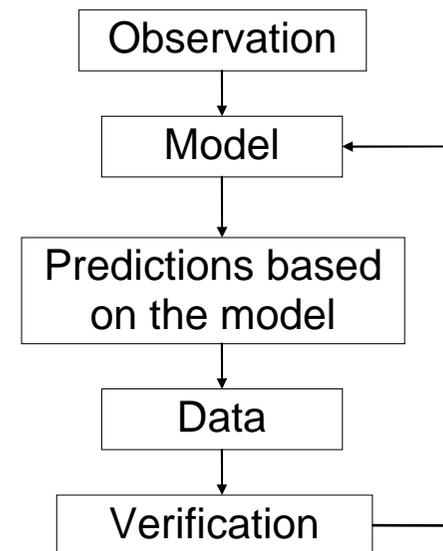
- Models are needed both for the system and the traffic offered to it
- In the system model, the most central functionalities of the system are described by means of simple basic elements
 - servers
 - queues
- Traffic model describes the behaviour of the offered traffic
 - traffic process
 - based on measurements made of the real traffic
 - aims at an economical, parsimonious description with as few parameters as possible

Traffic model

Requirements on the model

- Model must be verifiable (easily enough) and its parameters must be derivable from the measured results
- The model must be simple enough so as to be useful for dimensioning in practice

Creating a model



Traffic theory provides a challenging area

- Telecommunication field is evolving rapidly
- Many new networking concepts are introduced
- Solving traffic issues is one of the important problems
 - traffic control in ATM network
 - real time applications in the Internet
 - quality of service (QoS) in the Internet
 - efficient use of the bandwidth in cellular radio systems
 - measurement and characterization of real traffic in high speed networks
- Mathematically interesting and challenging problems

The use of traffic theory

Traffic theory forms the basis for

- Design of networks and its elements
 - dimensioning
 - optimization
 - performance evaluation

- Control actions
 - efficient operation of the networks
 - traffic control
 - routing
 - charging

To whom

- Communication system vendors
 - system design
 - dimensioning, performance analysis
 - simulation of systems
 - development of methods for traffic control
 - evaluation of new concepts
- Network operators
 - network design
 - development and evaluation of traffic control methods
 - traffic measurements, prediction and monitoring
 - design of charging schemes
- Research
 - mathematical methods
 - computational algorithms
 - simulation techniques
 - traffic models
 - traffic measurements

Traffic theory is based on the following disciplines

- probability theory
- stochastic processes
- queueing theory
- statistical analysis (analysis of measurement data)
- operations analysis
- optimization theory
- decision analysis (Markov decision processes)
- simulation techniques