Faculty of Health, Science and Technology
Computer Science

Syllabus

Future Internet Design and Service Quality

Course Code:	DVAD60
Course Title:	Future Internet Design and Service Quality *Framtidens Internet: Design och tjänstekvalitet*
Credits:	6
Degree Level:	Master's level
Progressive Specialisation:	Second cycle, has only first-cycle course/s as entry requirements (A1N)

Major Field of Study:
DVA (Computer Science)

Course Approval
The syllabus was approved by the Faculty of Health, Science and Technology 2018-09-09, and is valid from the Spring semester 2019 at Karlstad University.

Prerequisites
Upper secondary level English 6 or B, or equivalent. Computer Science 30 ECTS cr, or three years of work experience in the IT sector, or equivalent.

Learning Outcomes
Upon completion of the course, students should be able to:
- explain the relation between latency and data rate and the impact on quality of these parameters for different internet applications,
- give an account of latency sources and possible solutions to reduce latency,
- explain how a selection of active queue management algorithms work and how they interact with congestion control.

- explain how web pages are designed, how they have developed over time and what demands they put on the network,
- give an account of the different protocols used to access the web and the limitations of the various protocols,
- describe important design choices and mechanisms in QUIC and identify in what situations QUIC works well.

- describe how multi-access communication can be realised at different protocol layers and its advantages and disadvantages,
- explain different solutions for central components in multi-access communication such as path management, scheduling and congestion control,
- give examples of how multi-access communication can be implemented,
- identify for which applications and in which communication situations multi-access solutions can be expected to provide benefit.

- give an account of the concept "Internet ossification" and its underlying causes,
- explain the purpose of transport services and how these can help counteract the ossification of the internet stack,
- give examples of how transport services can be implemented and used.

Content
The course comprises four modules.

Module 1 Reducing Internet Latency: Why and How, 1.5 ECTS cr.
The module explains the importance of latency for current internet applications. Different sources of delay and types of solutions for reducing latency are treated. Special emphasis is on queueing delay and how active queue management can reduce the problem and how it interacts with congestion control.

Module 2 QUIC and the Evolution of the Web, 1.5 ECTS cr.
The module deals with the evolution of the web and its interaction with underlying communication protocols. The demands of modern web applications on the network are analysed and the various protocols used in web communication are introduced. Focus is on QUIC, its design and key mechanisms.

Module 3 Multi Access Solutions, 1.5 ECTS cr.
The module deals with the challenges and opportunities of multi-access communication. Examples of how multi-access communication can be realised at different layers in the protocol stack are discussed and key mechanisms such as path management, scheduling and congestion control are described. How to implement multi-access communication is illustrated on the basis of MPTCP and MPQUIC.

Module 4 Internet Stack Evolution: Challenges and Opportunities, 1.5 ECTS cr.
The module deals with how the internet stack can be further developed to meet the demands of new applications and communication environments. The present challenges and the risk of ossification are described. How transport services can help counteract ossification and be dynamically tuned based on application requirements and networking context are discussed. Examples of how to implement and use transport services are presented.

Reading List
See separate document.

Examination
Assessment is based on hand-in assignments and an oral exam.

Grades
One of the grades Distinction (VG), Pass (G), or Fail (U) is awarded in the examination of the course. Engineering students are awarded one of the grades Pass with Distinction (5), Pass with Some Distinction (4), Pass (3) or Fail (U).

Quality Assurance
Follow-up relating to learning conditions and goal-fulfilment takes place both during and upon completion of the course in order to ensure continuous improvement. Course evaluation is partly based on student views and experiences obtained in accordance with current regulations and partly on other data and documentation. Students will be informed of the result of the evaluation and of any measures to be taken.

Course Certificate
A course certificate will be provided upon request.

Additional information
The courses DVAD61, DVAD62, and DVAD63 cannot be included in the same degree programme as DVAD60.

The local regulations for studies at the Bachelor and Master levels at Karlstad University stipulate the obligations and rights of students and staff.