LUNDS UNIVERSITET
Lunds Tekniska Högskola

Course syllabus

Högpresterande fibernät
High Performance Fiber Networks

EITP10, 7,5 credits, A (Second Cycle)

Valid for: 2023/24
Faculty: Faculty of Engineering, LTH
Decided by: PLED C/D
Date of Decision: 2023-04-18

General Information

Language of instruction: The course will be given in English

Aim

The aim of the course is to give a deep understanding in how fiber networks are built and how they work in different parts of the communication chain. The student will get an understanding of how the networks are constructed and what requirements there are on the transmission, depending on which part of the network is considered. From that they should be able to decide what type of fibre technology is appropriate and why. They should have an understanding of how fibre technology is constructed, from the physical units up to the network architectures.

Learning outcomes

Knowledge and understanding
For a passing grade the student must

- Be able to describe the construction of fiber networks, regarding e.g. architecture and topology.
- Be able to describe different optical elements and their properties.
- Be able to describe different types of impairments in a fiber network.
- Know how modern fiber networks are constructed at different levels.

Competences and skills
For a passing grade the student must

- Reason how a fiber network is built up in different parts, and weigh pros and cons of different types of architectures in different situations.

- From a given topology be able to decide what type of infrastructure is suitable, both from a technical and an economical point of view.

Judgement and approach
For a passing grade the student must

- From a network type be able to decide what types of requirements there are on the equipment, and what type of architecture is suitable.
- Be able to evaluate possibilities and limitations in present and coming fiber networks.

Contents

Introduction

New services like 5G shopping, digital industries or cloud robotics bring new challenges for the networks, like increased data rates for 4K video or increased requirements on latencies for 5G services, requirements that can only be met by fiber networks. The course will give insights of how modern networks are designed, both fixed access networks and mobile networks, to handle these requirements. This gives requirements on the different parts of the network, which in most cases only can be handled by fiber optical communication.

Architecture and topology

The architecture in the fiber networks is based on the different structures; tree, ring, point-to-point (P2P), point-to-multi-point (P2MP). These structures have different characteristics and are suitable for different purposes. For short connections with high requirements on data rate and latency, such as data centers and mobile fronthaul, mainly P2P is used, while for example the access networks with cables up to 10 km are built with either P2P or P2MP, so called Passive Optical Network (PON). The core networks are often built using rings in combination with wavelength multiplexing (WDM) to seprate the traffic. The course illustrates the pros and cons for the technologies at given situations.

Optical elements

There are two main categories of elements, passive and active. The passive components are based on optical properties. Here, for example, are the fiber itself, splitters (i.e. MUX/deMUX), Bragg grating and optical filters. The active components are e.g. lasers, receivers, amplifiers and switches. The course gives and understanding of how these elements are used, as well as their properties and how they are constructed. The course also treats technologies that further can enhance the data rates, such as higher modulations.

Management and monitoring

For network management and network optimisation methods, it is vital to read in relevant data from the networks, so called monitoring. For this either passive or active methods can be used, which is true for all networks. The course will treat different fiber monitoring methods to measure e.g. power spectrum, wave length and polarisation of the light. Also active methods will be treated, such as Optical Time Domain Relectometry (OTDR).

Examination details

Grading scale: TH - (U,3,4,5) - (Fail, Three, Four, Five)
Assessment: Approved course requires approved hand in problems and projects. The results from the hand in problems and rating from the project are weighted to give the final grade.

The examiner, in consultation with Disability Support Services, may deviate from the regular form of examination in order to provide a permanently disabled student with a form of examination equivalent to that of a student without a disability.

Parts
Code: 0118. **Name:** Hand-in Assignments.
Credits: 5. **Grading scale:** TH. **Assessment:** Approved hand in problems. **Contents:** Web based examination in form of quizzes and hand in problems.
Code: 0218. **Name:** Project.
Credits: 2,5. **Grading scale:** UG. **Assessment:** Assessment of the understanding of the chosen subject **Contents:** Project in form of a scientific article in the subject. Participation in a study visit to network nodes in the close area.

Admission

Assumed prior knowledge: A basic course in communication systems, such as EITF45 Data Communications, EITA55 Communication Systems, ETSF15 Communication Systems and Networks or EITF25 Internet - Technology and Applications.
The number of participants is limited to: No

Reading list

- R Ramaswami, K N Sivarajan and G H Sasaki: Optical Networks, A Practical Perspective (3rd Ed). Elsevier / Morgan Kaufman, 2010, ISBN: 978-0-12-374092-2.
- Extra material.

Contact and other information

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