The 17th European Conference on Antennas and Propagation (EuCAP)
26 - 31 March 2023

Base Station Antennas for Stand Alone and Non-Stand Alone, 5G Systems

Abstract

The course explains underlying theoretical and practical implementation aspects of base station antennas in mobile communication systems in general and for 5G networks in particular. First the fundamental parameters of a base station antennas are discussed in the context of radio network design. In particular, we discuss parameters such as gain, radiation patterns, frequency bands and beam-forming, and put them in the context of cell planning, propagation and capacity. Thereafter, we give an overview of the underlying theory of diversity, MIMO and massive MIMO. In particular, we look in detail at the implementation of multiple antennas the various transmission modes in the 3GPP standard. In the last part we discuss the design of antenna systems for Stand Alone (SA) and Non-Stand Alone (NSA) 5G networks

Graphical abstract

Recommended prerequisites

The course is aimed at microwave, RF- and antenna engineers in the wireless area, but also useful for researchers looking for relevant research topics and system engineers needing a deeper understanding of the antenna component of their system

Learning objectives

This short course gives the participants an overview of the application, implementation and design of base station antennas for 4G and 5G. In particular we discuss the implementation in NSA and SA 5G networks

Course outline

The course is divided into five parts:

1. Introduction to and Fundamentals of Base station antennas
2. Beam Shaping for Cellular Networks
3. Multi-band and array types
4. MIMO and massive MIMO antennas in cellular systems
5. Antenna systems for Stand Alone (SA) and Non-stand Alone (NSA) 5G Networks

In the first parts the fundamental parameters of a base station antenna are discussed in the context of radio network design. In particular we discuss parameters such as gain, radiation patterns, frequency bands and beam forming and put them in the context of cell planning, propagation and capacity.

Thereafter, we give an overview of the underlying theory of diversity, MIMO and multi beam antenna systems. In particular we look in detail at the implementation of multiple antennas the various transmission modes in the 3GPP standard.

In the last part, we discuss the design of advanced antenna systems (AAS) for low-, mid- and millimeter wave bands as well as for Stand Alone (SA) and Non-stand Alone (NSA) 5G Networks

Instructor 1 – biography

Claes Beckman is a Swedish antenna and microwave engineering professor, a technical expert, early investor and a certified board member. He received his MSc and PhD in Engineering Physics from Chalmers University of Technology in 1989 and 1994, respectively. He was appointed professor at the University of Gävle in 2004 and at KTH Royal Institute of Technology in 2013.
His area of expertise include medical, radar and communication applications of both Radio and Optics. He has more than 35 years of experience from both academia and Industry, and has held industry positions as Microwave Engineer for Ericsson, Research Manager for Allgon AB and Technical Expert for Icomera AB.

In 2001 he was the founding director of the research center Wireless@kth and since then he has been the adviser of close to 100 M.Sc. students, 7 licentiate and 3 PhD thesis and has published 100+ journal articles

and conference reports. Over the years, he has trained hundreds of engineers and engineering student in the areas of radio networks, antennas and microwave engineering.

Currently he is a part time senior researcher in the Radio Systems lab, while serving as a technical expert for Icomera AB, board member of Medfield Diagnostics AB (Public) and technical board member of Skysense AB and Proant AB. Previously he has been board member of Allgon AB (Public), InCoax AB (Public) and H&E Solutions AB (EVAM).

Key bibliography

C. Beckman and B. Lindmark, "The Evolution of Base Station Antennas for Mobile Communications," 2007 International Conference on Electromagnetics in Advanced Applications, 2007, pp. 85-92, doi: 10.1109/ICEAA.2007.4387244.

Emil Björnson, Jakob Hoydis and Luca Sanguinetti (2017), “Massive MIMO Networks: Spectral, Energy, and Hardware Efficiency”, Foundations and Trends® in Signal Processing: Vol. 11, No. 3-4, pp 154–655. DOI: 10.1561/2000000093.