

SERENADE

Satellite Precoding Hardware Demonstrator

SERENADE is a demonstrator of Full Frequency Reuse for Multibeam Satellite Systems using Multi-User Multiple Input Multiple Output (MU-MIMO, also known as Precoding). This includes the Symbol Level Precoding algorithm which optimizes the precoding process in real time for every transmitted symbol. This technique exploits the constructive interference among multiuser links and gives a phenomenal improvement in throughput, availability and energy efficiency.

Market Opportunities

As we move towards the 5G era, many developed countries have considered recognizing broadband connectivity as a public utility. However, broadband connectivity is not ubiquitous and there are numerous cases where internet is unreliable or unavailable due to immature technology and difficult to reach locations. According to recent studies, it is expected that there will be 980 connected **commercial aircrafts** in Middle East & Africa by 2023 and 26000 **global vessels** connected by 2016. It should also be noted that enabling ubiquitous access for smartphones over the above application areas is one of the **5G** objectives for the **2020 networks**. Another prominent use case is broadband service over **developing countries** (e.g. in Africa, Latin America or Asia) where broadband connectivity has just begun to take off but the infrastructure is unavailable. According to GSMA, more than 400 million new **smartphone connections** are expected in Africa by 2020, growing the installed base to over half a billion. The market addressed by the proposed technology is focused on ground equipment for **satellite multibeam broadband systems**, which includes at least one ground based gateway and multiple user

Competitive Advantages

The implementation of Precoding techniques on the Gateway allows multibeam satellite systems to operate in aggressive frequency reuse modes, giving a phenomenal performance gain over the non-precoded counterpart while maintaining a reasonable complexity at the receivers. This performance gain can be translated into a **4x improvement of the system throughput**, **2x improvement of the availability**, **2x improvement of the energy efficiency**.

Additionally, symbol level precoding keeps the average transmit power of the waveform bounded within a smaller range, reducing the non-linear effects of the communication payload chains and allowing the on-board amplifiers to operate in the maximum of their capabilities.

Symbol level real time optimized Precoding technologies

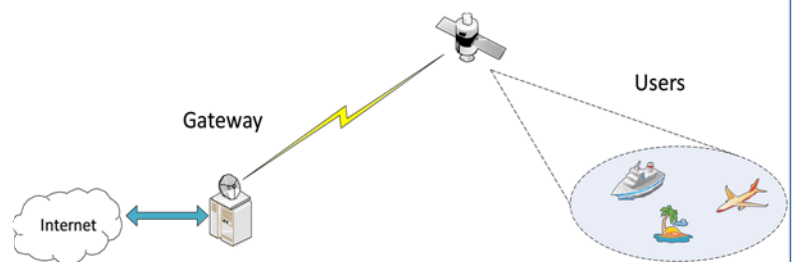
Precoding, commonly known as Multi-User Multiple Input Multiple Output (MU-MIMO), exploits the spatial degrees of freedom offered by multi-antenna transmitters to manage interferences among multiple co-channel users. The transmitted waveforms are controlled by a set of precoding coefficients obtained from the the Channel State Information (CSI) which is estimated and feedback by the user terminals.

With the advanced symbol level Precoding technologies, the precoding coefficients are caclulated using not only the CSI but also the transmitted symbols themselves. In this way, the transmission is modified in order to optimize the constructive interference among multiuser links.

Deploying Scenario & Challenges

The ground based gateway enables the exchange of information with the user terminals by going through the satellite. The proposed technology focuses on the algorithms used by the modem chips to produce the signals needed for the wireless communication.

The precoding process is a real time optimization problem (Quadratic or Linear Programming) and can be very power demanding. This operation is performed in the gateway in order to save power in the satellite, and exploits powerful hardware processors to ensure minimum latencies.



Intellectual property status

Status:	Patent protection pending
Title:	System and Method for Symbol-level Precoding in Multiuser Downlink Channels.
Earliest Date:	01.09.2015
Patent No:	EP 15186548.2

Contact:

Dr. Symeon Chatzinotas
Interdisciplinary Centre for Security, Reliability and Trust
University of Luxembourg
4, rue Alphonse Weicker
L-2721 Luxembourg
tel: (+352) 46 66 44 5767
email: symeon.chatzinotas@uni.lu