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Overview of MIMO Technology in LTE, LTE-A & LTE-A-Pro

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Abstract: The MIMO systems having large number of base station antennas often called massive MIMO or FD-MIMO have received much attention in academia and industry to provide High spectral efficiency, High energy efficiency, High hardware efficiency and processing complexity for future cellular systems such as 4G LTE systems, LTE-Advance, LTE-Advance Pro and Fifth generation cellular communication systems. This paper presents an overview of MIMO technology being applied in LTE and LTE-Advance.
Keywords: FD-MIMO, LTE, LTE-Advanced, MIMO.

1. Introduction

With a large number of base station antennas Multiple-input multiple-output (MIMO) systems get transformed in *massive MIMO systems.* Massive MIMO technology is a promising technology to improve the spectral efficiency, energy efficiency and channel capacity and acquisition of high dimensional channel state information (CSI). Elevation beamforming and Full Dimension MIMO (FD-MIMO) has been an active area of research in 3GPP LTE-Advance. In an FD-MIMO system, a base station with two dimensional active arrays supports multiuser joint elevation and azimuth beamforming, which results in much higher cell capacity compared to conventional systems. The purpose of this paper is to provide a brief summary of contribution of conventional MIMO in recent 3GPP activities, including 3D channel model, ongoing study on FD-MIMO scenarios, TXRU architecture, CSI feedback and performance evaluation in realistic FD-MIMO

2. Approaches Using MIMO Systems

2.1 MIMO Technology in LTE Rel.8

Release 8 specification on the radio interface of Universal Mobile Telecommunications System (UMTS) LTE referred to as “LTE Rel.8” was completed in 3GPP in December 2008. It is a mobile radio packet access system supporting a variety of traffic with low delay and low cost, so after the standard radio interface was completed, development of commercial equipment proceeded.

Downlink MIMO Technology

2.2 MIMO Technology in LTE-Advanced

2.2.1 Downlink 8-Layer SU-MIMO Technology

The target peak spectral efficiency in LTE-Advance is 30 bits/Hz. To achieve this, high order SU-MIMO with more antennas is necessary. Accordingly, it was agreed to extend the number of layers of SU-MIMO transmission in the LTE-Advance downlink to a maximum of 8 layers. The number of transmission layer is selected by rank adaptation. For CQI measurement with up-to 8 antennas, new CSI-RSs are specified in addition to cell specific RS defined in LTE

Single user MIMO was used for the downlink for LTE Rel.8 to increase the peak data rate. The target data rates of over 100 Mbit/s were achieved by using a 20 MHz transmission bandwidth, 2×2 MIMO, and 64 QAM, and peak data rates of over 300 Mbit/s can be achieved using 4×4 SU-MIMO. The multi-antenna technology used for the downlink in LTE Rel.8 is classified into following three types.

2.1.1a Closed loop SU-MIMO and Transmit Diversity.
2.1.1b Open loop SU-MIMO and Transmit Diversity.
2.1.1c Adaptive Beamforming.

2.1.2 Uplink MIMO Technology

On the uplink in LTE Rel.8, only one layer transmission was adopted in order to simplify the transmitter circuit configuration and reduce power consumption on the UE. This was done because the LTE Rel.8 target peak data rate of 50 Mbit/s or more could be achieved by using a 20MHz transmission bandwidth and 64 QAM and without using SU-MIMO

Rel.8 for up-to four antennas, but in order to maintain backward compatibility with LTE Rel.8 in LTE Advance, LTE Rel.8 UE must be supported in the same band as in that for LTE-Advanced

2.2.2 Downlink MU-MIMO Technology

In addition to the peak data rate, the system capacity and cell-edge user throughput must also be increased in LTE-Advanced compared to LTE Rel.8. MU-MIMO is an important technology for satisfying these requirements. With MU-MIMO various sophisticated signal processing

techniques are applied to mitigate the interference between transmission layers

2.2.3 Uplink SU-MIMO Technology

To minimize the difference in peak data rates achievable on the uplink and downlink for LTE Rel.8, a high target peak spectral efficiency of 15 bit/s/Hz was specified for the LTE-Advanced uplink. To achieve this, support for SU-MIMO with up to four transmission antennas was agreed upon. In particular, the two transmission antenna SU-MIMO function is required to satisfy the peak spectral efficiency.

2.3 MIMO Technology in LTE-Advanced Pro

In recent times, 3rd generation partnership project also abbreviated as 3GPP standard body initiated the standardization activity to employ tens of antennas at base station with an aim to satisfy the spectral efficiency requirements of future cellular systems with a two dimensional array structure as a starting point. MIMO enhancement in 3GPP named Full-Dimension MIMO (FD-MIMO), this system targets to utilize up to 64 antenna port sat the transmitter side. From the LTE to LTE-Advanced, In order to support the beamformed CSI-RS scheme, new there has been substantial improvement in the RS scheme for transmitter architecture called transceiver unit (TXRU) has MIMO systems which is depicted in the figure 1. The FD- been introduced. By TXRU architecture we mean a hardware MIMO which uses up to 64 antennas at the transmitter end is connection between the baseband signal path and antenna also known as LTE-Advanced Pro which is much improved array elements. Since this architecture facilitates the control than the previous LTE system i.e. Rel.10.LTE-Advanced Pro of phase and gain in both digital and analog domain, more is the LTE marker that is used for the specifications from accurate control of the beamforming

Release 13 onwards by 3GPP. LTE-Advanced Pro will deal with the realistic issues in standardization process, including TXRU architectures, beamformed CSI-RS, 3D beamforming, details of CSI feedback, and performance evaluation in realistic FD-MIMO scenarios with new feedback schemes. MIMO evaluation in LTE systems are shown here.

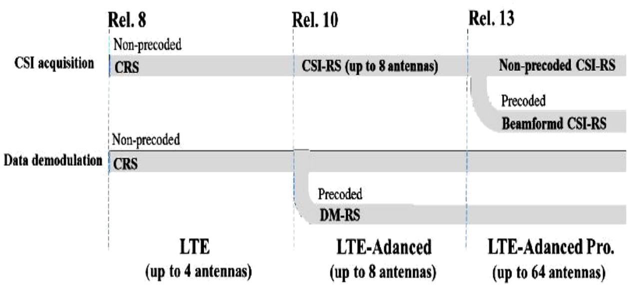

Fig. 1 (a) RS evolution in LTE systems

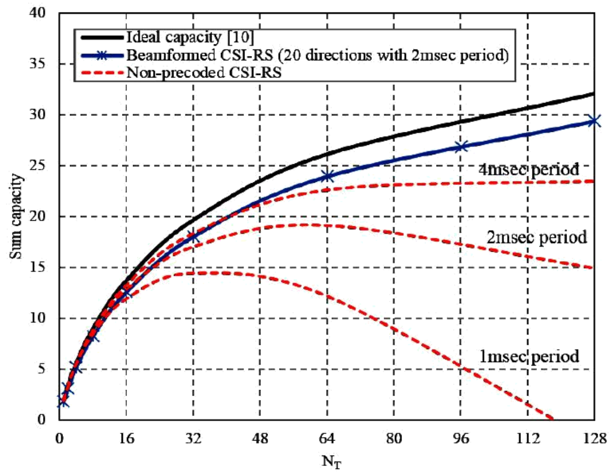

Fig.1 (b) Uplink feedback overhead (SNR=10dB)

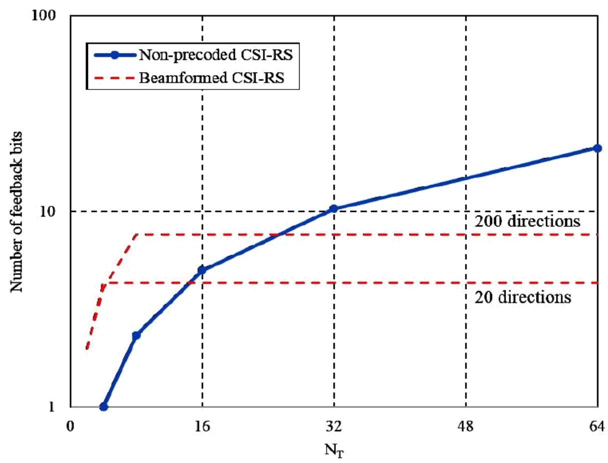

Fig.1 (c) MU-MIMO capacity with CSI-RS overhead (SNR=10dB

3. Upcoming Communication System

The upcoming communication system demands for high spectral efficiency, high grade hardware, lower cost, size and less power consumption. Overall we can say that a high Throughput network will be survive in future communication systems. The expected performance parameters for 5G Networks is listed in table

Table : 1

5G Performance Metrics	*Expectation*
Average rate (bit/s/active user)	10-100x
Average area rate (bit/s/km^2)	1000x
Active devices (per km^2)	10-100x
Energy efficiency (bit/joule)	1000x

To attain the expected performance from next generation communication system, *Massive* MIMO system will be used which delivers High Spectral Efficiency per cell by optimization and higher energy efficiency

4. Conclusion

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This paper gives an overview that how conventional MIMO system is being applied for next generation communication systems such as LTE, LTE-Advanced and LTE-Advanced Pro. The standard specifications for LTE are completed in Rel.8, and the standardization of LTE-Advanced in Rel.10. We have provided an overview of FD-MIMO systems in 3GPP LTE recently named as LTE-Advanced Pro which is currently advancing in the form of LTE Rel.13 which will deal with technical implementation issues, such as antenna configuration and scheduling methods. There are still many issues for the successful deployment of FD-MIMO systems in future, including pilot overhead reduction, beam adaptation and optimization, and advanced channel estimation exploiting time and angular domain sparsity.

Abbreviations

MIMO	Multiple Input Multiple Output
FD-MIMO	Full Dimension MIMO
LTE	Long Term Evolution
LTE-A	LTE Advanced
LTE-A-Pro	LTE Advanced Pro
CSI	Channel State Information

References

[1] Hyoungju Ji, Younsun Kim, and Juho Lee, Eko Onggosanusi, Y. Nam, J. Zhang, " *Overview of Full-Dimension MIMO in LTE-Advanced Pro",* To appear in IEEE Communications Magazine Aug. 2016.

[2] T.L. Marzetta, *Massive MIMO: "An introduction",* Bell Labs Technical Journal, 2015.

[3] E. Onggosanusi, Y. Li, M.S. Rahman, Y.H. Nam, J. Zhang, J.Y. Seol and T.Y. Kim, "*Reduced space channel feedback for FD-MIMO* ", IEEE International Conf. On Communnication, 2015.

[4] E.G. Larsson, F. Tufvesson, O. Edfors, and T.L. Marzetta, *Massive MIMO for Next Generation Wireless Systems*, IEEE commun. Mag.,2014.

[5] L. Lu, G.Y. Li, A.L. Swindlehurst, A. Ashikhmin, R. Zhang, "*An Overview of massive MIMO:benefits and challenges",* IEEE JSAC, Oct.2014.

[6] Y.H. Nam, Y. Li and J. Zhang , "3D channel models for elevation beamforming and FD-MIMO in LTE-A and 5G", Asilomar conference on signals, Systems and Computers, November 2014.

B. Lee, J. Choi, J. Seol, D. Love, and B. Shim, "*Antenna grouping based feedback compression for FDD-based massive MIMO Systems",*IEEE Trans. on Communication, vol. 63, no. 9, pp. 3261-3274, Sept.2015