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Lahetkangas et al.

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(54) **CONTROLLING A MODULATION AND CODING SCHEME FOR A TRANSMISSION BETWEEN A BASE STATION AND A USER EQUIPMENT**

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H04L 27/04 (2006.01)

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(58) **Field of Classification Search**
None
See application file for complete search history.

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(57) **ABSTRACT**

It is described a method for controlling a modulation and coding scheme for a transmission between a base station and a user equipment, wherein the modulation and coding scheme is selectable based on a first modulation and coding scheme table including entries corresponding to a plurality of modulation and coding schemes with a first maximum modulation order or based on a second modulation and coding scheme table including entries corresponding to a plurality of modulation and coding schemes with a second maximum modulation order. The method comprises selecting, by the base station, the first modulation and coding scheme table or the second modulation and coding scheme table, and controlling, by the base station, the modulation and coding scheme for the transmission between the base station and the user equipment based on the selected modulation and coding scheme table.

16 Claims, 2 Drawing Sheets

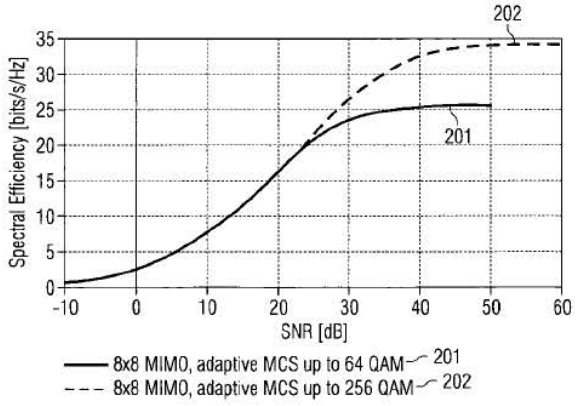

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FIG 1

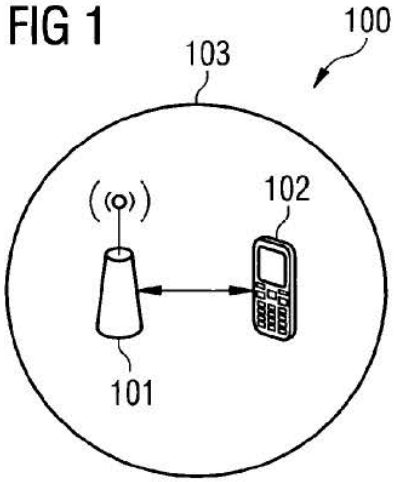


FIG 2

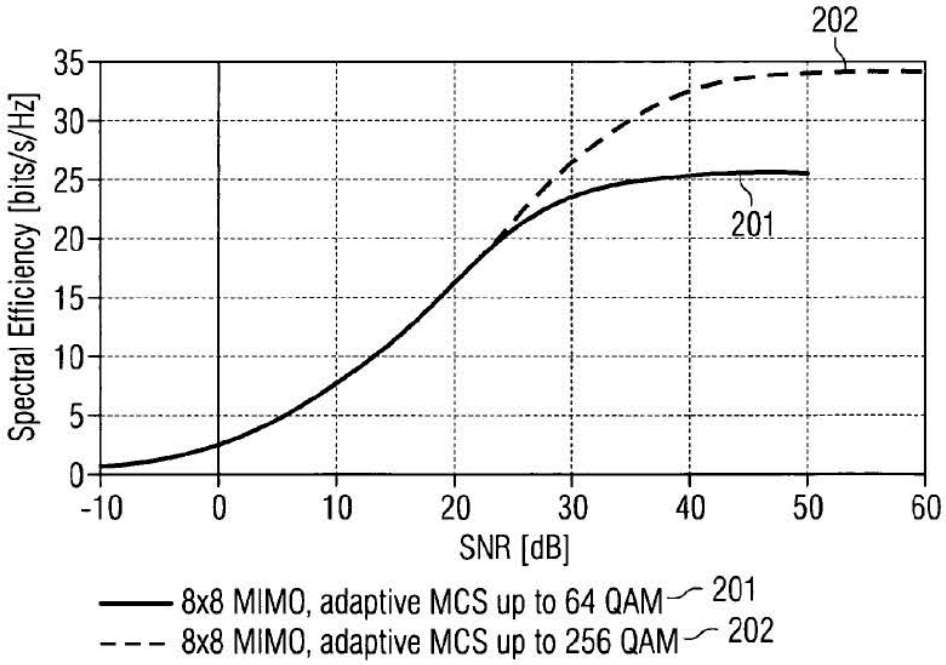


FIG 3

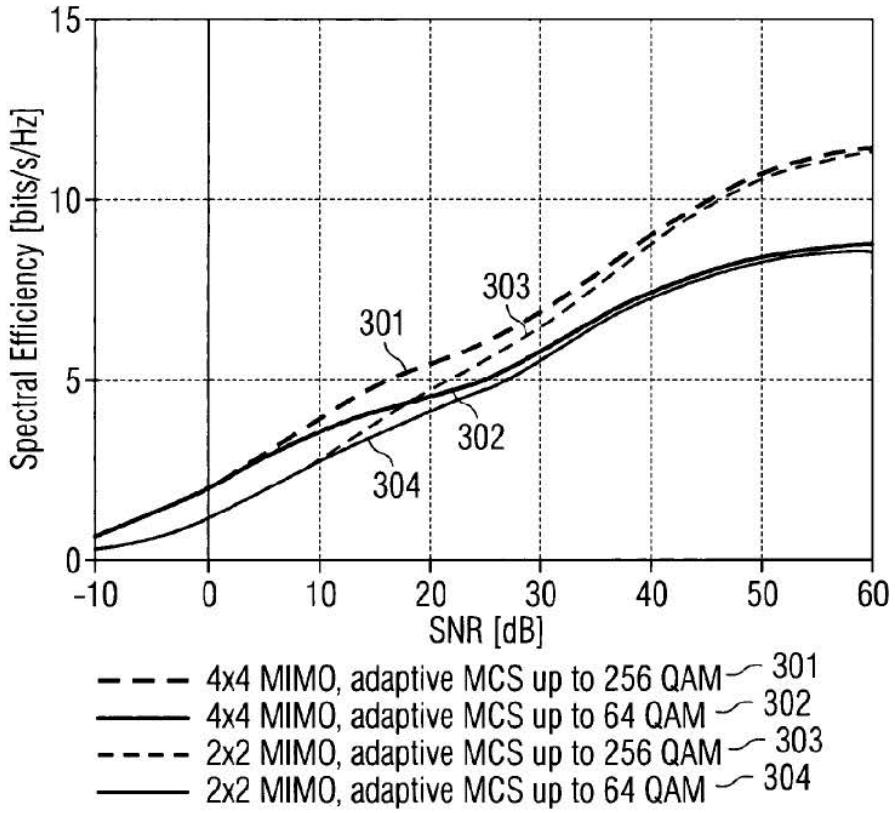
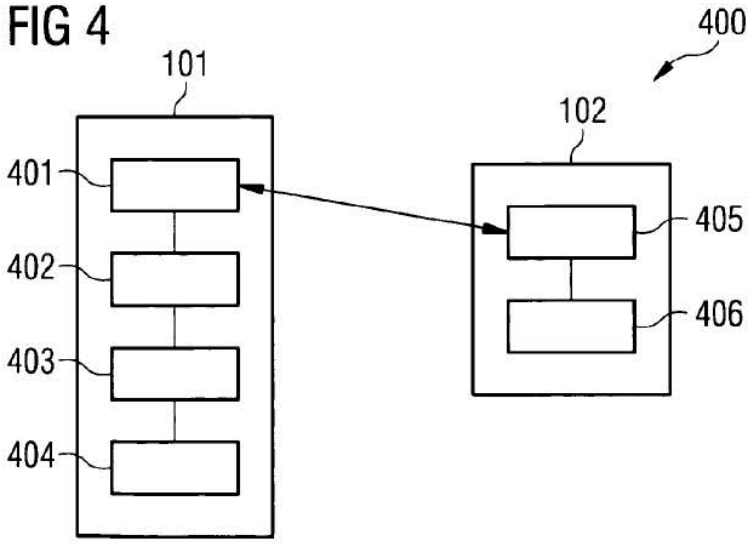


FIG 4



CONTROLLING A MODULATION AND CODING SCHEME FOR A TRANSMISSION BETWEEN A BASE STATION AND A USER EQUIPMENT

FIELD OF INVENTION

The present invention relates to the field of cellular networks, especially to an evolution of LTE networks, and in particular to networks comprising LTE networks and evolved LTE networks.

ART BACKGROUND

There have been further developments for LTE, for instance relating to a Beyond 4G (B4G) radio system which is assumed to be commercially available in 2020. It might however also be introduced in an evolution of LTE at any date within any new release.

LTE provides a peak bit rate of 30 bps/Hz by using 64QAM modulation and 8×8 MIMO transmission. As a result, B4G may require a higher order modulation, for instance 256QAM, than 64QAM in order to meet future requirements. Higher order modulations may be relevant for example in relay backhaul due to better channel quality and better radio frequency (RF) properties which are more easily feasible for relays than for user equipments (UEs) or for isolated indoor cells where the UEs are close by and therefore both having a good link to the access point and no or very little interference from other access points due to attenuation by the walls.

The modulation order determination of LTE Release 10 is described in TS 36.213 V10.3, chapter 7.1.7 and CQI definition in chapter 7.2.3. In LTE (and LTE-Advanced), theoretical spectral efficiency is restricted by 64QAM modulation. An improved spectral efficiency may be gained with extension to 256QAM.

In the LTE standard, there is defined a MCS (modulation and coding scheme) index and modulation table and CQI (channel quality indicator) table. These are used for determining and selecting appropriate modulation and coding schemes. The current tables support up to 64QAM. The problem is how to introduce a 256QAM extension or any other higher order modulation extension for LTE while maintaining backward compatibility and avoiding too much complexity.

There may be a need for an improved and flexible system and method being adapted to allow an extension to a higher order modulation while remaining backward compatible for LTE. In particular it is desirable to maintain signaling formats in particular utilize the same number of bits as otherwise different encoding schemes need to be used and potentially so called blind decoding has to be applied.

SUMMARY OF THE INVENTION

This need may be met by the subject matter according to the independent claims. Advantageous embodiments of the present invention are described by the dependent claims.

According to a first aspect of the invention there is provided a method for controlling a modulation and coding scheme for a transmission between a base station and a user equipment, wherein the modulation and coding scheme is selectable based on a first modulation and coding scheme table comprising entries corresponding to a plurality of modulation and coding schemes with a first maximum modulation order or based on a second modulation and coding scheme table comprising entries corresponding to a plurality of modulation and coding schemes with a second maximum modulation order. The method comprises selecting, by the base station, the first modulation and coding scheme table or the second modulation and coding scheme table, and controlling, by the base station, the modulation and coding scheme for the transmission between the base station and the user equipment based on the selected modulation and coding scheme table.

This aspect of the invention is based on the idea to extend the modulation and coding scheme table to a higher order modulation while remaining backward compatible. The first table may support for instance up to 64QAM (quadrature amplitude modulation) and the second table may support for instance up to 256QAM, or any other higher order modulation extension. It should be noted that although 256QAM is explicitly mentioned herein, any other higher modulation order than that used for the first table may be used, for instance also 128QAM or in general a higher modulation and coding scheme (MCS) which may be characterized by either modulation order or coding scheme of both.

The idea of this method is to introduce a higher order modulation while still supporting a modulation and coding scheme (MCS) table being introduced for a lower modulation order.

The term "modulation order" in this context may be determined by the number of the different symbols that can be transmitted using it. In general MCS also considers different code rates and thus indicates the average number of payload bits that can be transmitted per symbol. The first maximum modulation order and the second maximum modulation order may be the same or may be different.

The term "modulation and coding scheme table" may refer to the MCS table being defined in LTE and being used for determining and selecting appropriate modulation and coding schemes. The second table may be an extended MCS table being based on the MCS as defined in LTE but comprising entries corresponding to a higher order modulation. For instance, the backward compatibility may be ensured by having a first table exactly as it is currently defined in the LTE standard.

The first and the second table may be different in some respects. For instance, one table may be biased more towards low MCS and the second towards high MCS values. For example, one table may have more MCS values below a certain threshold MCS. Also the density of MCS values at lower MCS may be higher in one table or the center of gravity or average of the MCS values may be lower in one table. In one embodiment, one table is a mirror image of the other, for instance being mirrored at the middle MCS.

The term "base station" in this context may denote any kind of physical entity being able to communicate with a user equipment or any other network device by selecting a modulation and coding scheme from such a MCS table. A base station in this context may be any kind of network device providing the required functionality for the method, it may also be a transceiver node in communication with a centralized entity. The base station may be for example a NodeB or eNB.

The base station may either inform the UE explicitly about a change of the used MCS table or may inform and select the MCS table implicitly as part of the capability enquiry procedure.

According to an embodiment of the invention, the second maximum modulation order is higher than the first maximum modulation order. In particular, the first maximum

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