transmission pattern (unicast, multicast, broadcast, or a mixture of them) among the stations.

Before delving into technical details, we provide a simple example to illustrate the scenario of interest to us here. Consider a network with three stations, 1, 2, and 3. The traffic flows among them are shown in Fig. 1: station 1 wants to transmit "a" to both stations 2 and 3; station 2 wants to transmit "b" and "c" to stations 1 and 3, respectively; station 3 wants to transmit "d" and "e" to stations 1 and 2, respectively. Pairwise data exchange as in [2] and [3] is not effective in this case because when the number of stations is odd, one station will always be left out when forming pairs. That is, when the number of stations is odd, the connectivity pattern realized by a switch/permutation matrix does not correspond to pairwise communication. Full data exchange is not appropriate either, since in our example, station 2 (as well as station 3) transmits different data to the other two stations. Under our framework, the traffic flows among stations can be met as shown in Fig. 2. In the first slot, station 1 transmits "a" to station 3; station 2 transmits "b" to station 1; station 3 transmits "e" to station 2. In the second slot, station 1 transmits "a" to station 2; station 2 transmits "c" to station 3; station 3 transmits "d" to station 1.

In Section III.C, we will present the details on how to realize the switch matrices. To limit the scope, this paper focuses on the use of amplify-and-forward relaying and zero forcing (ZF) in establishing the permutations among stations. However, we do generalize the ZF method to one that exploits physical-layer network coding [6], [7], [8], [9] for performance improvement.

The rest of the paper is organized as follows: Section II describes the framework of wireless MIMO switching and introduces the ZF relaying method for establishing permutation among stations. A fair switching scheme is proposed in Section III. In Section IV, we generalize the ZF method to one that exploits network coding. In Section V, we propose two enhanced schemes of MIMO switching. Section VI presents and discusses our simulation results. Section VII concludes this paper.

II. System Description

A. System Model

Consider N stations, $S_1, \cdots, S_N$, each with one antenna. The stations communicate via a relay R with N antennas and there is no direct link between any two stations as shown in Fig. 3. Each time slot is divided into two subslots. The first subslot is for uplink transmissions from the stations to the relay; the second subslot is for downlink transmissions from the relay to the stations. For simplicity, we assume the two subslots are of equal duration. Each time slot realizes a switching permutation, as described below.