It should be noted that a guard interval is necessary to avoid interblock interference (IBI) in the received signal. The guard interval insertion is performed by the matrix $T \in \mathbb{R}^{P \times M}$, where $P = M + L_{gi}$ and $L_{gi}$ is the length of the guard interval. For the most commonly used guard intervals, cyclic prefix (CP) and zero padding (ZP), the matrix $T$ is defined as [22]:

$$T_{cp} = \begin{bmatrix} 0_{L_{gi} \times (M-L_{gi})} & I_{L_{gi}} \\ I_M & 0_{L_{gi} \times M} \end{bmatrix},$$

$$T_{zp} = \begin{bmatrix} I_M \\
0_{L_{gi} \times M} \end{bmatrix}. $$

![Diagram of Space-Time Block-Coded CDMA Transmission System](image)

Figure 1. Space-Time Block-Coded CDMA Transmission System

The frequency-selective channel from the $j$-th ($j = 1, 2$) transmission antenna to the receiver can be modeled using a finite-impulse response (FIR) filter with $L$ taps, whose gains are samples, taken at the chip rate, of the equivalent baseband complex channel impulse response. Assuming that during two symbol periods the impulse response of both channels remain constant, that is, $h_j(2i) = h_j(2i + 1) = [h_{j,0}(2i) \ldots h_{j,L-1}(2i)]^T$, $E[\|h_j(2i)\|^2] = 1$, the transmission through the frequency-selective MIMO channel can be represented by a $P \times P$ lower triangular Toeplitz convolution matrix $H_j(2i)$, whose first column is $[h_{j,0}(2i) \ldots h_{j,L-1}(2i) 0 \ldots 0]^T$.

As we assume a downlink scenario, where the users experience the same channel condition, the received signal collected over two consecutive symbol periods is represented by the two