, *Student Member, IEEE* , *Senior Member, IEEE* , *Member, IEEE*
, *Fellow, IEEE*

***Abstract*—** fi fi **fi** **fi** **fi** **fi** **fi** **fi** **fi** **fi** **fi** **fi** B fi fi B fi $\frac{3}{2}$ B M $\frac{BM}{2}$

***Index Terms*—**

fi fi fl fi fi

fi
fi
B
B

B $B(B-1)+1$

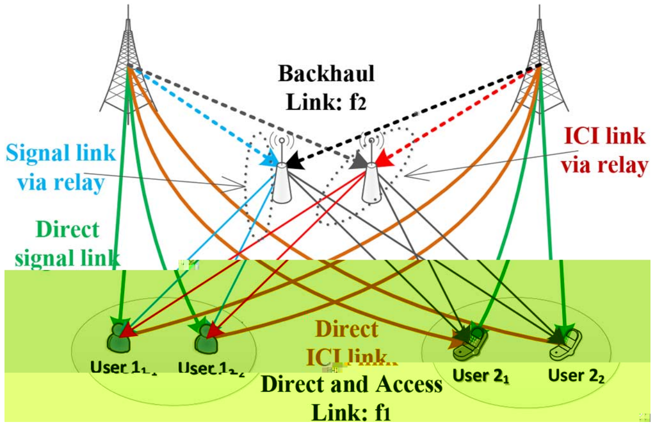
$B(B-2)$
B

B

B d

Bd

Bd
fi



$B = 2, K = 2, N_R = 2$

i.i.d.

b_k

$$\boldsymbol{Y}_{b_k} = \boldsymbol{U}_{b_k}^H \left(\boldsymbol{H}_{b_k,b} \boldsymbol{V}_{b_k} + \sum_{r=1}^{N_R} \boldsymbol{G}_{b_k,r} \boldsymbol{\Gamma}_r \boldsymbol{F}_{r,b} \boldsymbol{W}_{b_k} \right) \boldsymbol{x}_{b_k}$$
$$+ \boldsymbol{U}_{b_k}^H \sum_{k'=1, k' \neq k}^{K} \left(\boldsymbol{H}_{b_k,b} \boldsymbol{V}_{b_{k'}} + \sum_{r=1}^{N_R} \boldsymbol{G}_{b_k,r} \boldsymbol{\Gamma}_r \boldsymbol{F}_{r,b} \boldsymbol{W}_{b_{k'}} \right) \boldsymbol{x}_{b_{k'}}$$
$$+ \boldsymbol{U}_{b_k}^H \sum_{b'=1, b' \neq b}^{B} \left(\boldsymbol{H}_{b_k,b'} \boldsymbol{V}_{b'} + \sum_{r=1}^{N_R} \boldsymbol{G}_{b_k,r}$$

V

[redacted]

$\boldsymbol{W}_b^I$

ralization (CIN)

eutralization (PIN)

fi

A. Proof of Theorem 1

coordinated interference neutralization

$\boldsymbol{W}_b^I$ $(\boldsymbol{U}_{b_k}^I)^H$

$\boldsymbol{V}_b^I$ $\boldsymbol{\Gamma}_r$

$$\boldsymbol{H}_{b',b}^u \boldsymbol{V}_b^I + \sum_{r=1}^{N_R} \boldsymbol{G}_{b',r}^u \boldsymbol{\Gamma}_r \boldsymbol{F}_{r,b}^w = \boldsymbol{0},$$

$\boldsymbol{H}_{b',b}^u \triangleq (\boldsymbol{U}_b^I)^H \boldsymbol{H}_{b',b}, \boldsymbol{G}_{b',r}^u \triangleq (\boldsymbol{U}_b^I)^H \boldsymbol{G}_{b',r}$ $\boldsymbol{F}_{r,b}^w \triangleq$ $\boldsymbol{F}_r,$

fi fi $\boldsymbol{F}^{w}_{r,b}$

$\bar{\boldsymbol{E}}_{b,r}$ *i.i.d.*

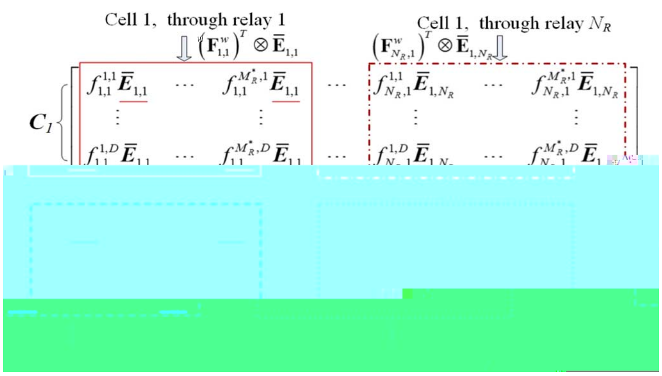
fi

fi

$f^{i,j}_{r,b}$

fi j b

i r B



fi

fi

fi $\boldsymbol{C}$ B $\boldsymbol{C}_b =$
$[(\boldsymbol{F}^{w}_{1,b})^{T} \otimes \bar{\boldsymbol{E}}_{b,1} \cdots (\boldsymbol{F}^{w}_{N_R,b})^{T} \otimes \bar{\boldsymbol{E}}_{b,N_R}], b = 1,\ldots,B$

$\boldsymbol{C}$

(■

$L - 1$ $J \times$

b

$$\bar{\boldsymbol{H}}_b^{uv} + \sum_{r=1}^{N_R} \bar{\boldsymbol{G}}_{b,r}\boldsymbol{\Gamma}_r\boldsymbol{F}_r^{w},$$

n_1

$(L - 1)M_R^*$ $L - 1$

L

Type II: $m > 1, j = 1$

[redacted]

$$\hat{\boldsymbol{C}}_b^{m,1} = \left[\begin{array}{c|c} \boldsymbol{P}_1 & \bar{\boldsymbol{E}}_{r_L^1} \\ \hline \boldsymbol{P}_2 & \bar{\boldsymbol{E}}_{r_L} \\ & \end{array}\right]$$

[redacted] [redacted] [redacted]

$n_1, \ldots, n_{L-1}$
$\boldsymbol{P}_i$ $n_1 + \cdots + n_{L-1} = m - 1$
$*$

$n = m$ *mathematical induction*

$\hat{\boldsymbol{C}}_b^{m,1}$ $rank(\hat{\boldsymbol{C}}_b^{m,1}) = mJ$
$\hat{\boldsymbol{C}}_b^{m,1}$ $\hat{\boldsymbol{C}}_b^{m,1}$
Type III: $j = m - 1$
$\hat{\boldsymbol{C}}_b^{m,m-1}$

$$= \left[\begin{array}{ccc|ccc} \boldsymbol{P}_1 & & & \bar{\boldsymbol{E}}_{r_L^1} & & \\ & & & & & \\ & \boldsymbol{P}_{m-1} & & & & \bar{\boldsymbol{E}}_{r_L^{m-1}} \\ \hline & & \boldsymbol{P}_m & \bar{\boldsymbol{E}}_{r_L^1} & \cdots & \bar{\boldsymbol{E}}_{r_L^{m-1}} \end{array}\right].$$

Rule 3

Proof: $\hat{\boldsymbol{C}}_b$ D
R_B $\hat{\boldsymbol{C}}_b$

$\hat{\boldsymbol{C}}_b$

$\lceil \frac{D}{D-}$

fi fi