MIMO-OFDM Wireless Communications with MATLAB®

(Intercell Interference Mitigation Techniques)

Chapter 8. Hücreler Arası Girişim Azaltma Teknikleri

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WILEY

Chapter 8. Hücreler Arası Girişim Azaltma Teknikleri

- 8.1 HÜCRELER ARASI GİRİŞİM EŞGÜDÜM TEKNİKLERİ

  Coordination

  - 8.1.1 Fractional Frequency Reuse
  - 8.1.2 Soft Frequency Reuse
  - 8.1.3 Flexible Fractional Frequency Reuse
- 8.1.4 Dinamik Kanal Tahsisi
- 8.2 HÜCRELER ARASI GİRİŞİM RASTGELELEŞTİRME TEKNİKLERİ
  - 8.2.1 Cell-Specific Scrambling
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Chapter 8. Hücreler Arası Girişim Azaltma Teknikleri

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Chapter 8. Hücreler Arası Girişim Azaltma Teknikleri

8.1 Hücreler Arası Girişim Eşgüdüm Teknikleri

8.1.1 Kısmi Frekans Yeniden Kullanımı

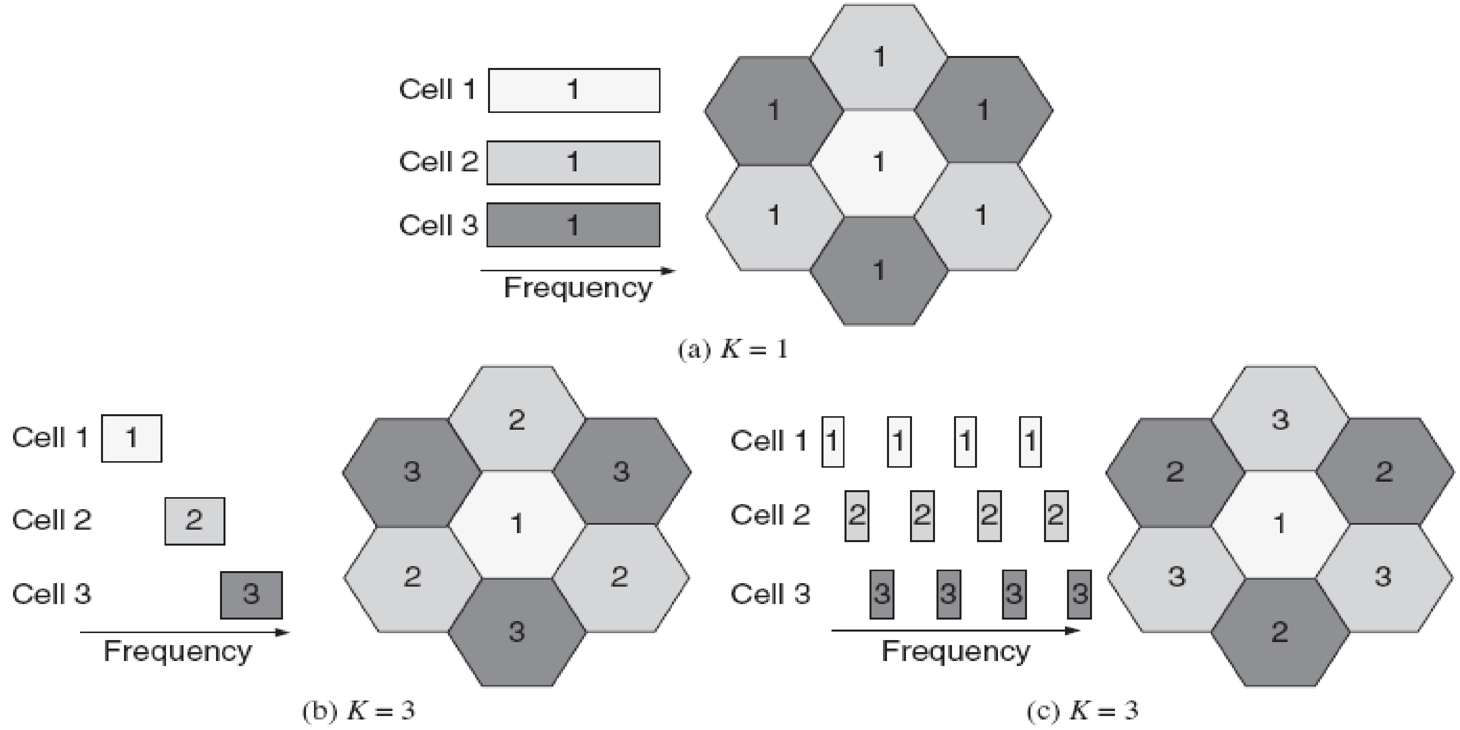

Figure 8.1 Examples of frequency reuse in an OFDMA cellular system.

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8.1.1 Kısmi Frekans Yeniden Kullanımı

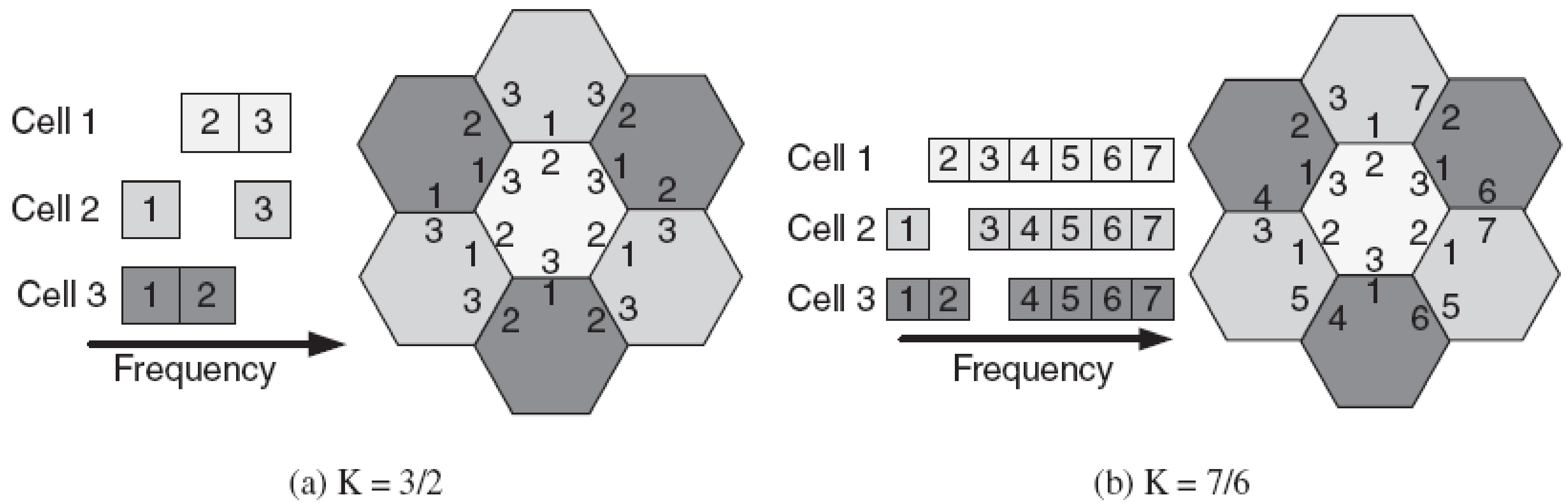
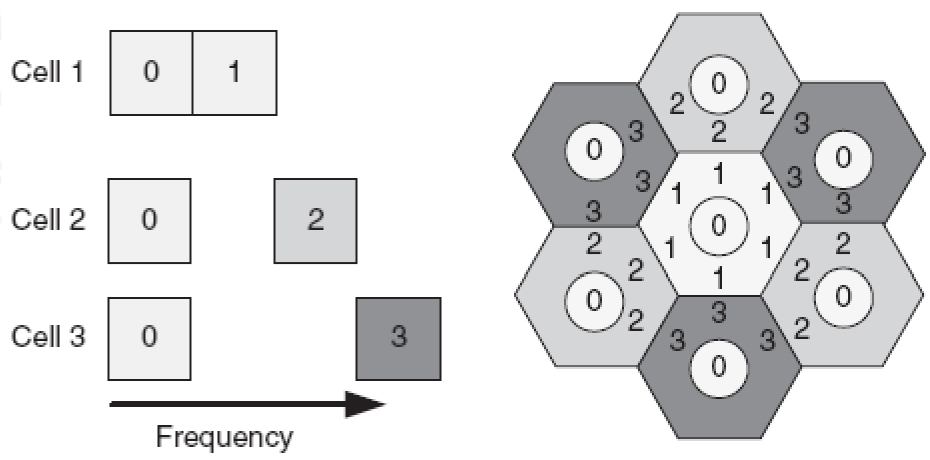


Figure 8.2 Fractional frequency reuse (FFR) in an OFDMA cellular system.

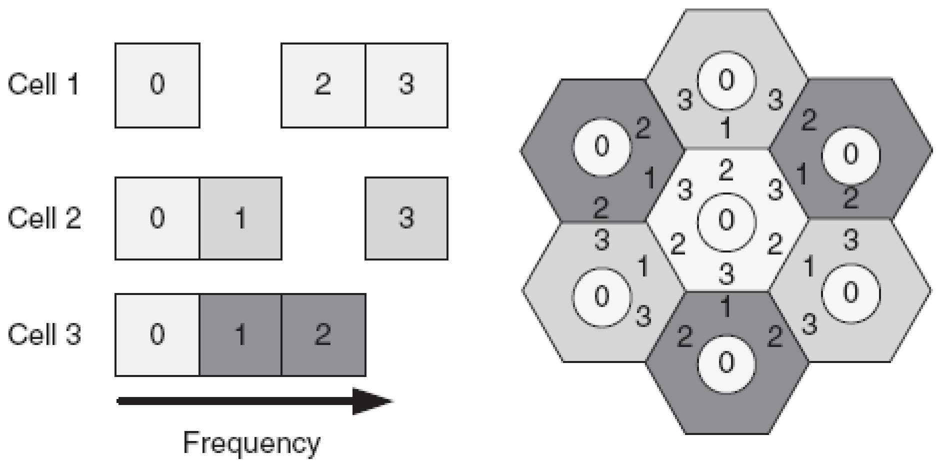
8.1.1 Kısmi Frekans Yeniden Kullanımı



(a) K = 1 for center and K = 3 for boundary

Figure 8.3 Fractional frequency reuse (FFR) with the different FRFs.

8.1.1 Kısmi Frekans Yeniden Kullanımı



(b) K = 1 for center and K = 3/2 for boundary

Figure 8.3 Fractional frequency reuse (FFR) with the different FRFs.

8.1.1 Kısmi Frekans Yeniden Kullanımı

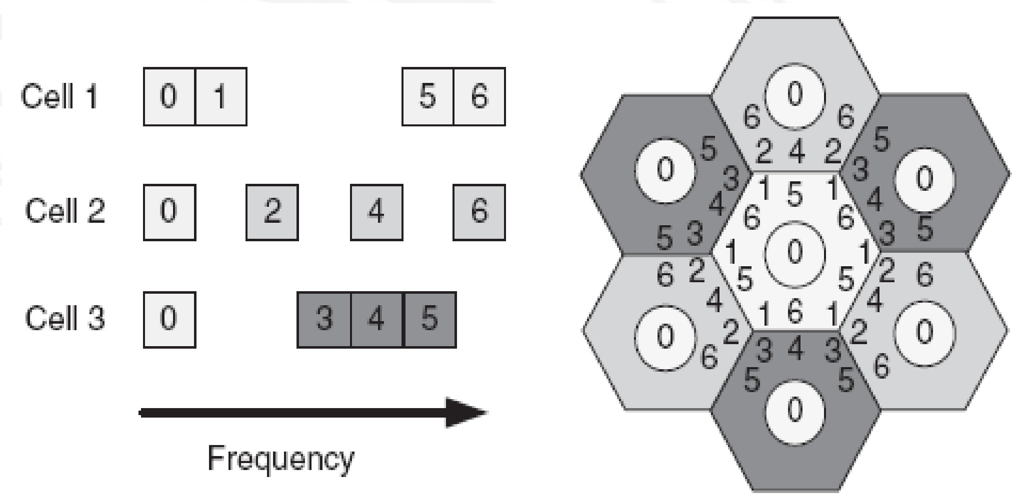
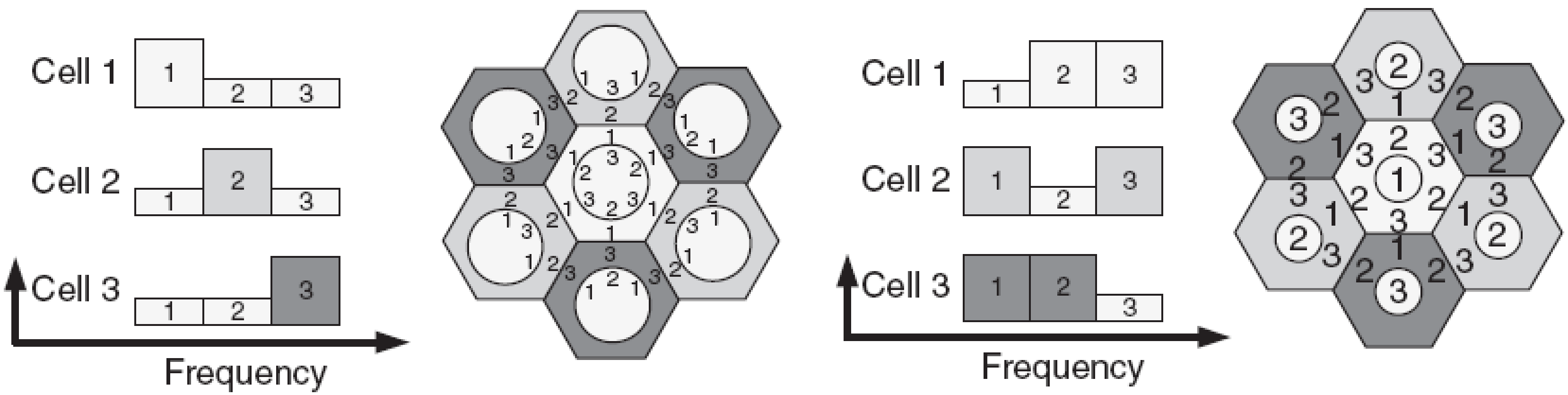


Figure 8.3 Fractional frequency reuse (FFR) with the different FRFs.

8.1.2 Yumuşak Frekans Yeniden Kullanımı



(a) Soft frequency reuse (previously 3)

(b) Soft frequency reuse (previously 3/2)

Figure 8.4 Soft frequency reuse: example with three subbands.

8.1.2 Yumuşak Frekans Yeniden Kullanımı

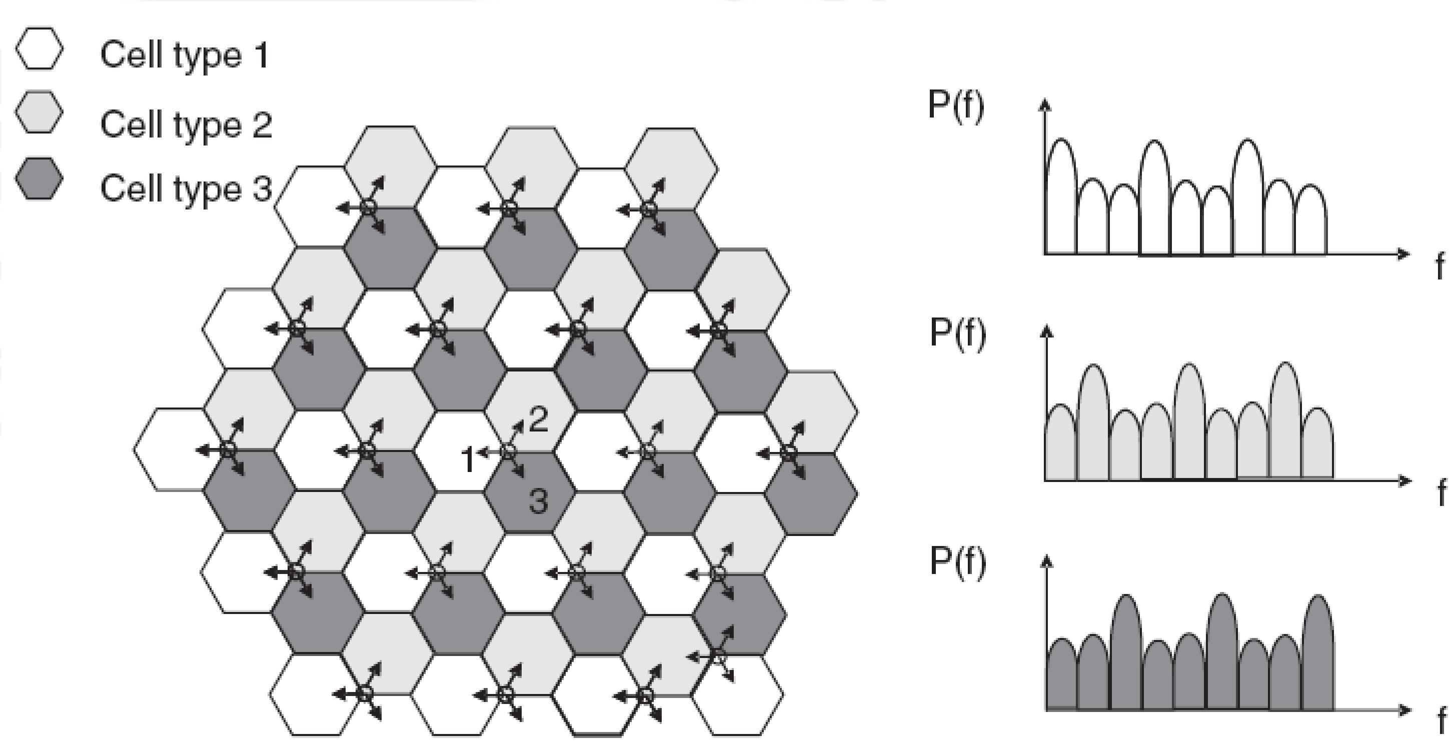


Figure 8.5 Soft frequency reuse: example with nine subbands.

8.1.3 Esnek Frekans Yeniden Kullanımı

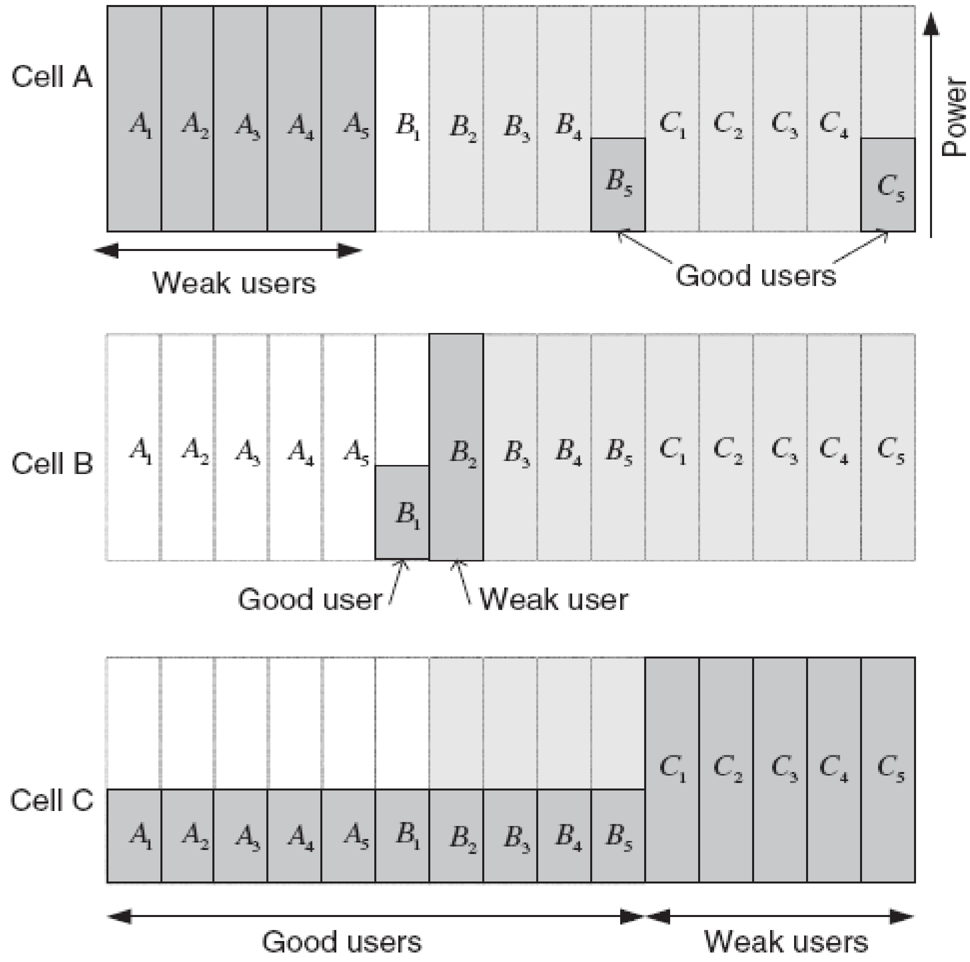


Figure 8.6 Flexible FFR with five primary subchannels in each cell.

8.2 Hücreler Arası Girişim Rastgeleleştirme Teknikleri

8.2.1 Cell-Specific Scrambling

$$Y[k] \approx \sum_{m=0}^{M-1} H^{(m)}[k]\, C^{(m)}[k]\, X^{(m)}[k] + Z[k] \tag{8.1}$$

$$Y[k] \approx H^{(0)}[k]\, C^{(0)}[k]\, X^{(0)}[k] + \sum_{m=1}^{M-1} H^{(m)}[k]\, C^{(m)}[k]\, X^{(m)}[k] + Z[k] \tag{8.2}$$

$$\begin{aligned} Y^{(0)}[k] &\approx \left(C^{(0)}[k]\right)^{*} Y[k] \\ &\approx H^{(0)}[k] X^{(0)}[k] + \sum_{m=1}^{M-1} \left(C^{(0)}[k]\right)^{*} H^{(m)}[k] C^{(m)}[k] X^{(m)}[k] + Z[k] \end{aligned} \tag{8.3}$$

8.2.1 Cell-Specific Scrambling

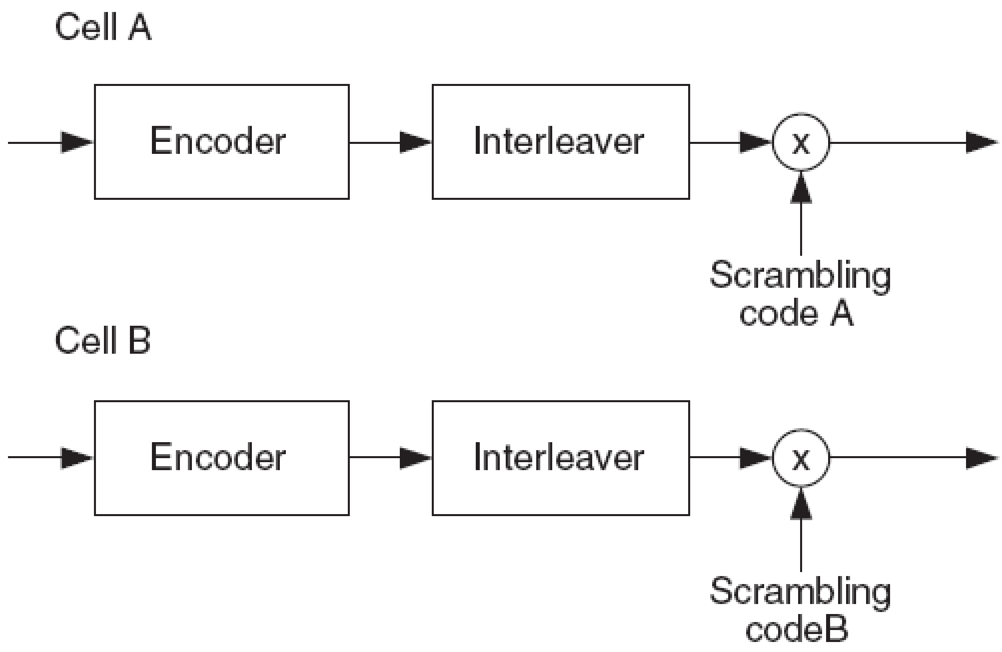


Figure 8.7 Cell-specific scrambling technique.

8.2.3 Frekans Atlamalı OFDMA

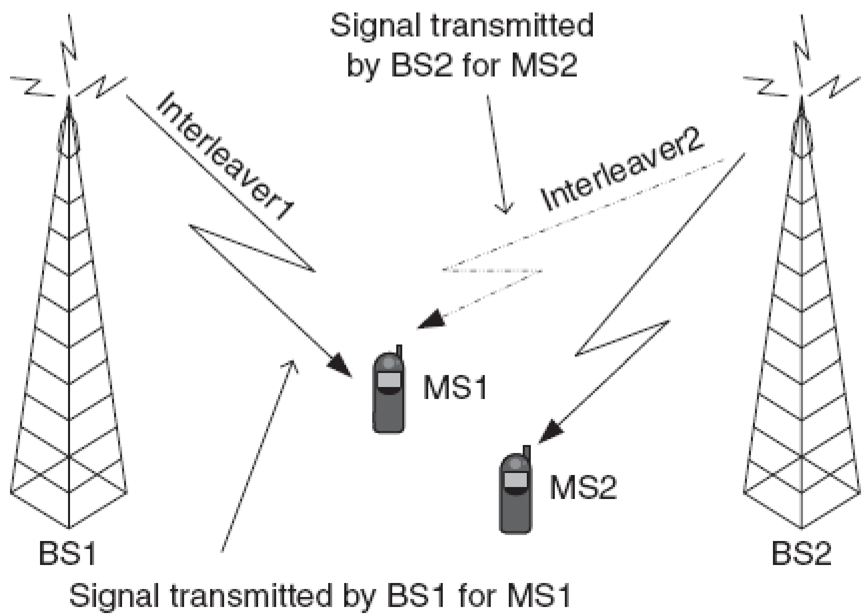
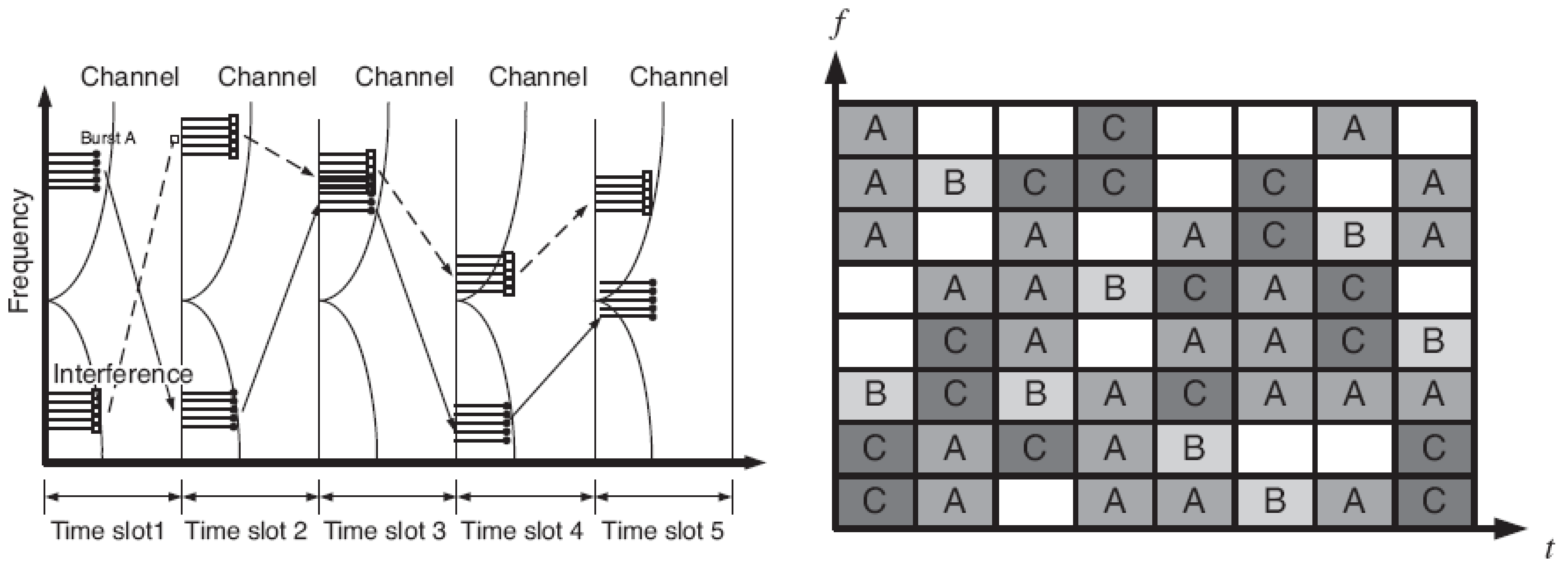


Figure 8.8 Cell-specific interleaving technique.

8.2.3 Frekans Atlamalı OFDMA



(a) Frequency-hopping

(b) Frequency-hopping pattern

Figure 8.9 Frequency-hopping OFDMA technique: an illustration.

8.2.4 Rastgele Alttaşıyıcı Tahsisi

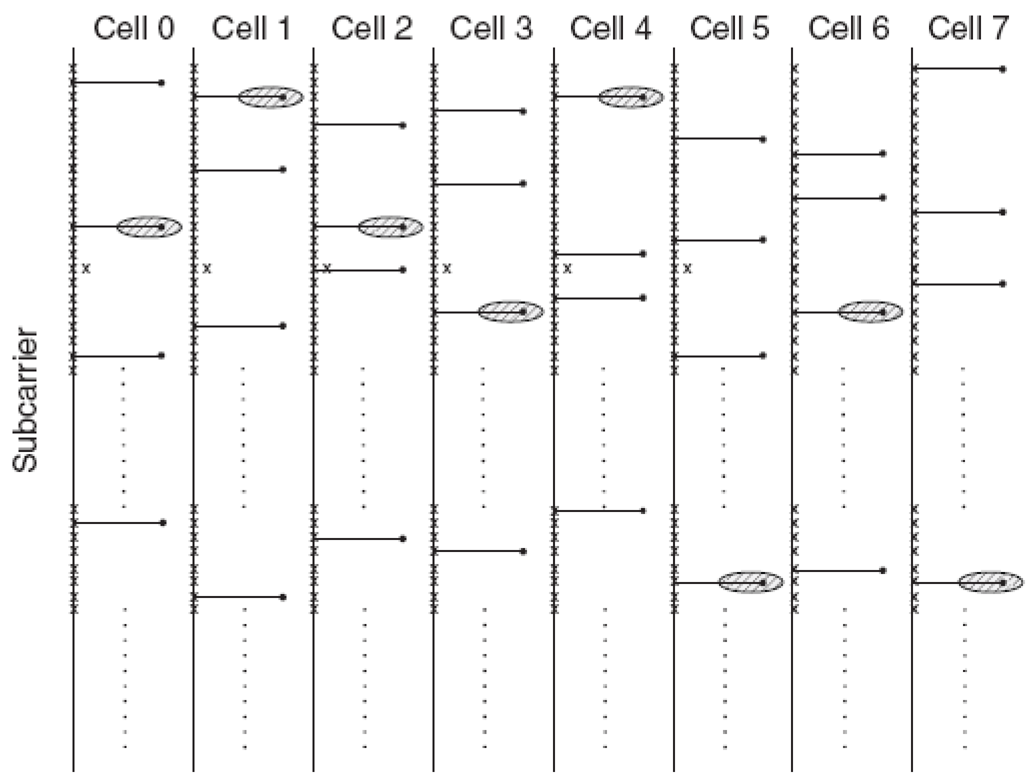


Figure 8.10 Example of random subcarrier allocation technique.

8.3 Hücrelerarası Girişim İptal Teknikleri
8.3.1 Interference Rejection Combining Technique

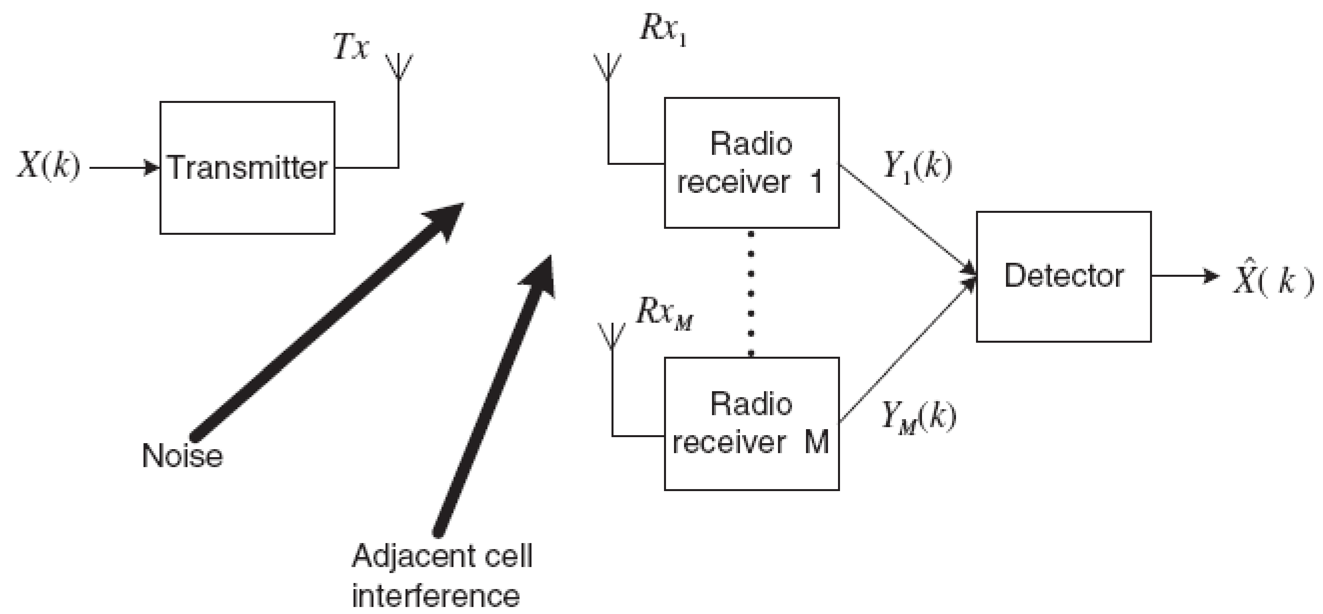


Figure 8.11 System model for interference rejection combining (IRC) technique.

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8.3.1 Interference Rejection Combining Technique

$$Y_i[k] = H_i[k]X[k] + Z_i[k], \quad i = 1, 2, \ldots, M \tag{8.4}$$

$$\mathbf{Y}[k] = \mathbf{H}[k]X[k] + \mathbf{Z}[k] \tag{8.5}$$

$$\mathbf{Y}[k] = [Y_1[k]\ Y_2[k] \cdots Y_M[k]]^T$$
$$\mathbf{H}[k] = [H_1[k]\ H_2[k] \cdots H_M[k]]^T$$
$$\mathbf{Z}[k] = [Z_1[k]\ Z_2[k] \cdots Z_M[k]]^T.$$

8.3.1 Interference Rejection Combining Technique

$$\hat{\mathbf{Q}} = \sum_{k=1}^{K} (\mathbf{Y}[k] - \hat{\mathbf{H}}[k]X[k]) \cdot (\mathbf{Y}[k] - \hat{\mathbf{H}}[k]X[k])^H \qquad (8.6)$$

$$\begin{aligned}\hat{X}[k] &= \underset{X[k]}{\arg\max} \frac{1}{\pi^M |\hat{\mathbf{Q}}|} \exp\left\{-\left(\mathbf{Y}[k] - \hat{\mathbf{H}}[k]X[k]\right)^H \hat{\mathbf{Q}}^{-1} \left(\mathbf{Y}[k] - \hat{\mathbf{H}}[k]X[k]\right)\right\} \\ &= \underset{X[k]}{\arg\min} \left(\mathbf{Y}[k] - \hat{\mathbf{H}}[k]X[k]\right)^H \hat{\mathbf{Q}}^{-1} \left(\mathbf{Y}[k] - \hat{\mathbf{H}}[k]X[k]\right) \qquad (8.7)\end{aligned}$$

8.3.2 IDMA Multiuser Detection

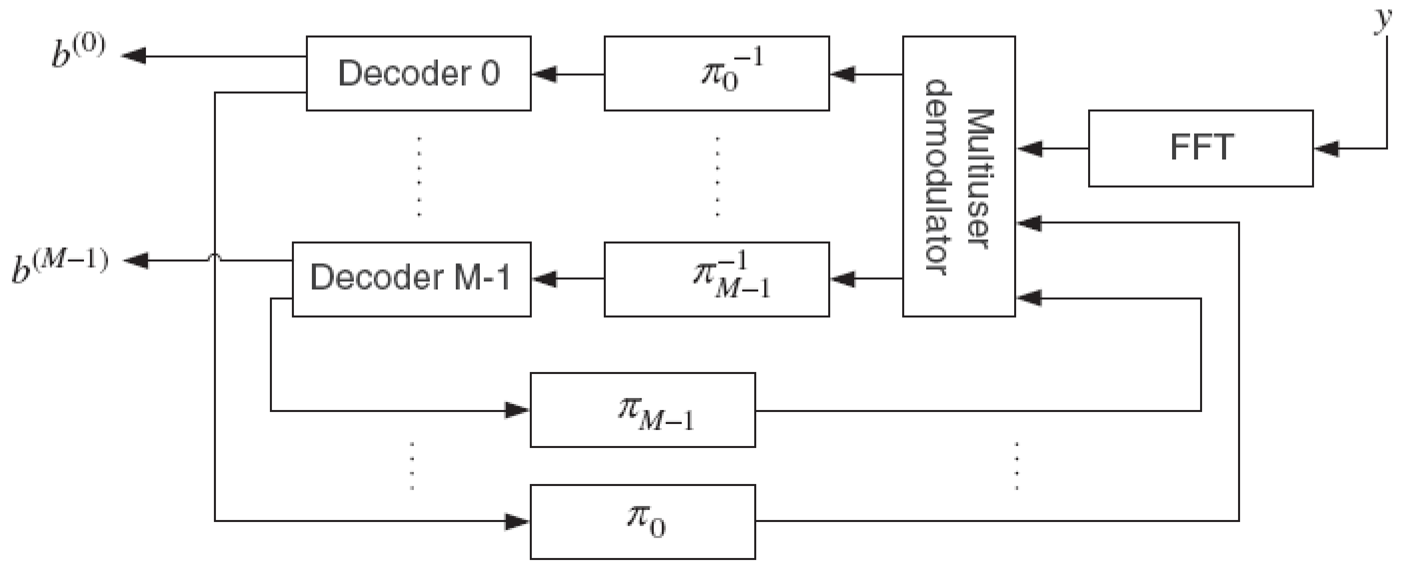

Figure 8.12 Block diagram for iterative multiuser detector in OFDM-IDMA receiver.

LTE (Interference management in LTE networks and devices Monica Paolini Senza Fili Consulting 2012)

Table 3. Managing interference in LTE				
	Advantages	What it does	Requirements	Standardization
RAN				
ICIC	Improves cell-edge performance.	Network resource coordination among neighboring cells. Fractional frequency reuse.	If the X2 interface is used, low latency backhaul is required.	LTE Rel 8
eICIC	Increases in capacity and utilization of network resources in HetNets.	Real-time traffic coordination, with alternating transmission from macro and small cells over the time domain. Power management at the small cell for range expansion.	Tight coordination between macro cells and HeNBs through the X2 interface. Low latency backhaul is required.	LTE Rel 10
CoMP	Improves cell-edge performance and cell capacity.	Used when a UE device at the cell edge receives a signal from two cells. With CS, only one cell transmits to the UE, to reduce impact from the interfering signal on the second cell. With JP, both cells transmit to and receive from the UE by coordinating the signal.	Software-based, additional complexity and processing overhead in the RAN. Higher power and network resource requirements, more signaling traffic, requiring additional backhaul capacity. Low backhaul latency is required. Ideally implemented in conjunction with MIMO.	LTE Rel 11

LTE girişim azaltma teknikleri

RAN/UE				
MU-MIMO	Improves data rates and capacity, mostly in high- SINR environments.	Concurrent transmission through multiple beams to multiple UEs.	Hardware upgrade requires additional funding and deployment time and effort. Multiple antennas in the UE mean additional cost and complexity.	LTE Rel 8 and Rel 10
SU-MIMO	Provides higher data rates for enabled UE, mostly in high-SINR environments (both at cell edge and in HetNets).	Concurrent transmission from single UE over multiple beams.		
UE				
MRC	Increases link reliability	Receiver-diversity method (time domain)	UE support	LTE Rel 8
IRC	Improves SINR	Receiver-diversity method (space and time domain)		LTE Rel 8
UE-based IC	Improves cell-edge throughput, UE data rates, and battery life.	Receiver beamforming, to direct antenna toward serving cell and ignore interfering one.	Firmware update at the UE. It does not affect the RAN or add complexity or cost to the network.	N/A

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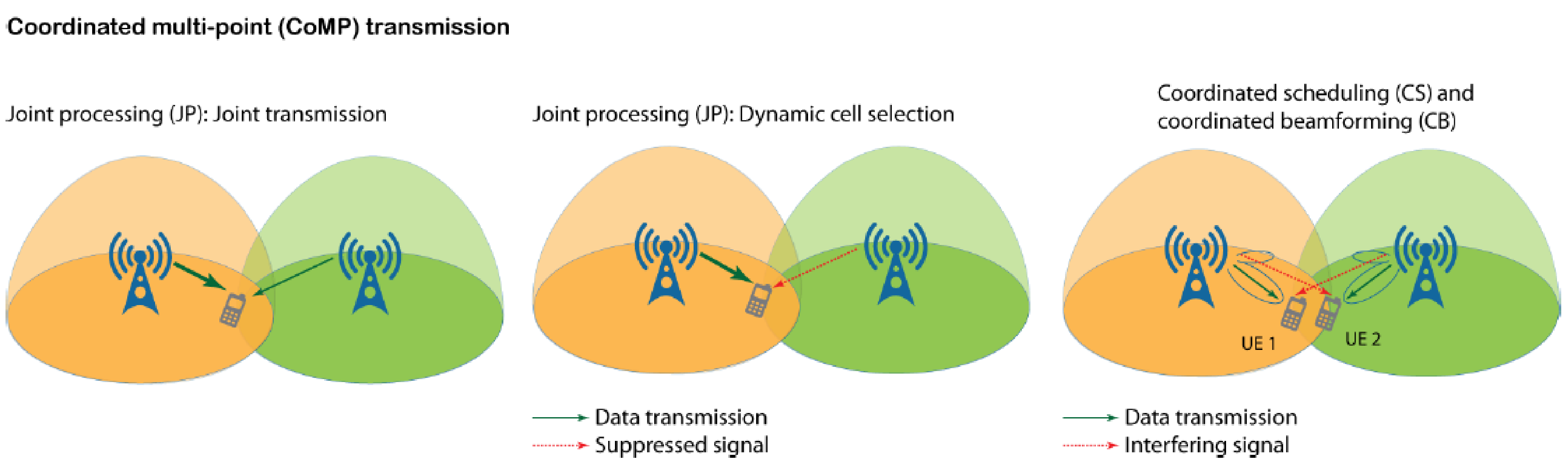
LTE'de Coordinated MultiPoint (CoMP)

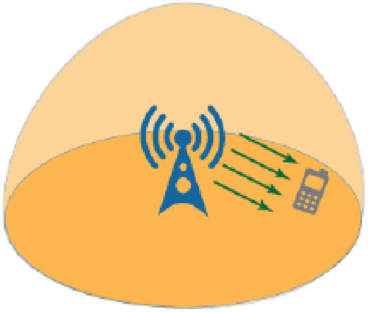


MIMO/Hüzme oluşturma ile girişim denetimi (LTE)

MIMO enhancements in LTE Advanced

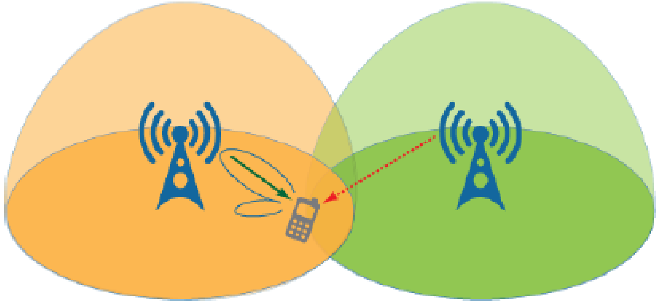
Multi-user MIMO (MU-MIMO) in the downlink

Single-user MIMO (SU-MIMO) in the downlink



Data transmission

UE-based interference cancellation (IC) with beamforming



Data transmission
Ignored signal

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