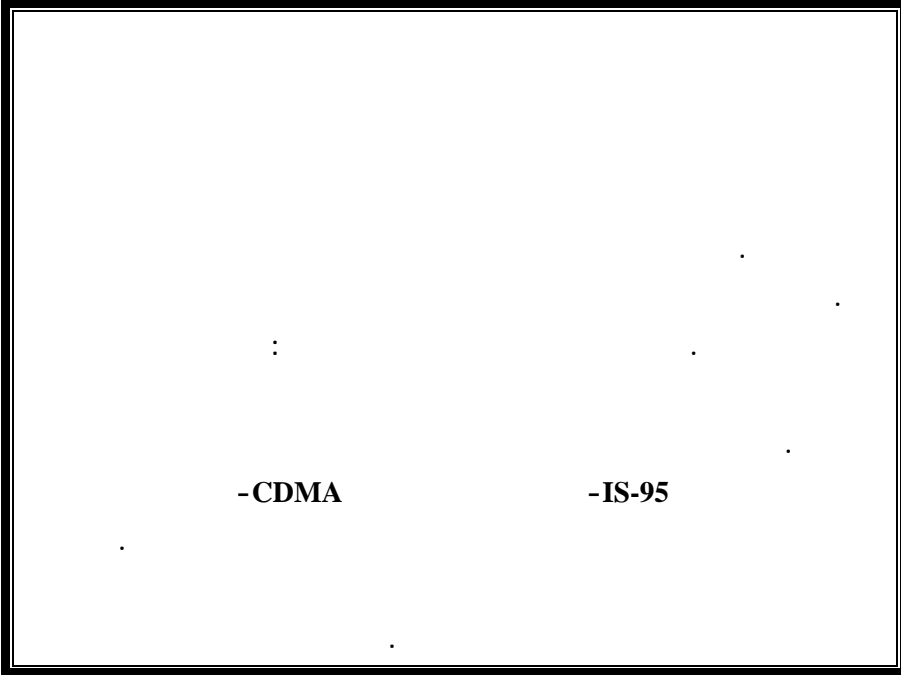


1

3

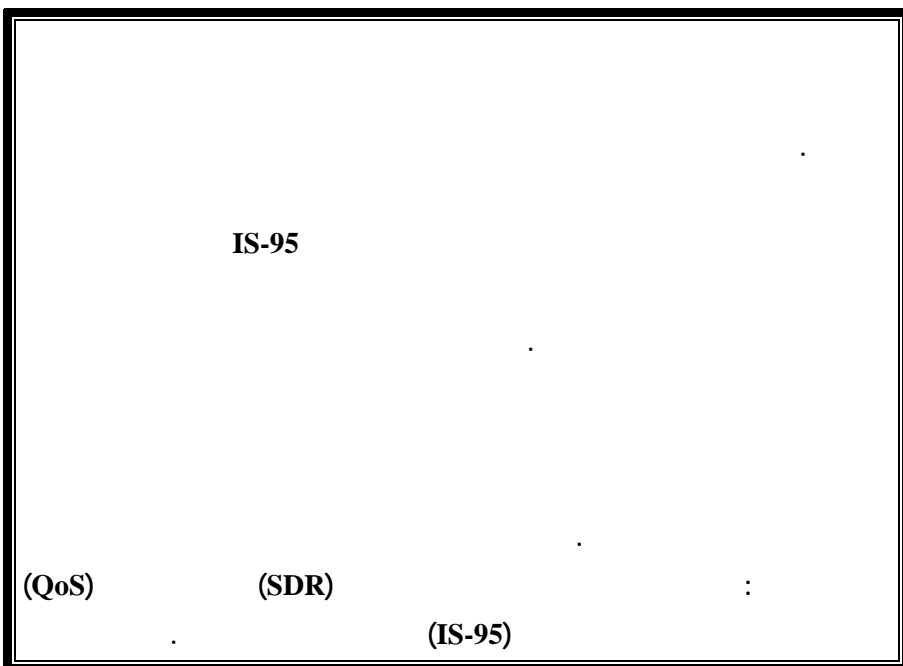
2



1

2

3



-1

quality of services )

(QoS

(standards)

( )

(ubiquitous)

(flexible)

[1]

Software )

(Defined Radio SDR

---

.(software reconfigurability)

.[2,3]

:

.

(user

defined quality of service)

(GSM, IS-95, WCDMA...)

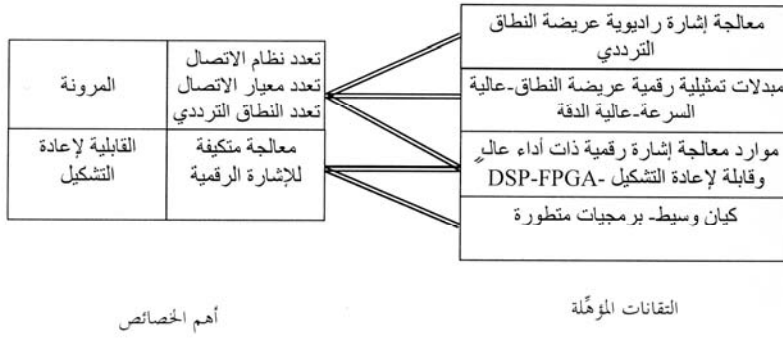
(frequency band)

.[4,5]

- -

[6] /2010/

(1)



:(1)

(trade-off)

(diversity)

«(code division multiple access CDMA)

(path diversity)

.(system capacity)

(rake receiver)

---

) IS-95

CDMA

:

(

.(Software Reconfigurability)

**IS-95**

**-2**

(Interim Standard IS-95)

Global System for Mobile Communications )

70%

(GSM

20%

10% )

IS-95

(

GSM

(time division multiple access TDMA)

IS-95

) GSM

CDMA

CDMA

( 40%

(

)

( ) IS-95

GSM

GSM

.IS-95

3G

IS-95

WCDMA

[1].

direct )

IS-95

(sequence DS-SSSS) DS-SSSS

(spread spectrum)

(users)

(1.25 MHz)

(chip rate) 1.228 Mcps

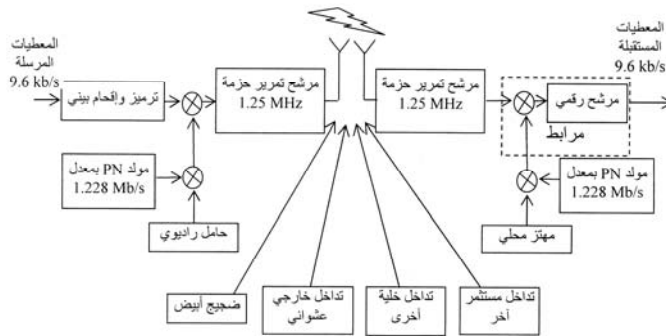
(PN sequence)

(orthogonal)

(spreading)

(despreading)

(2)



IS-95

(2):

Code Excited Linear Prediction CELP

voice )

(9.6-4.8-2.4-1.2 kbps)

(activity VA

19.2 kbps

(convolutional)

1.2288 Mcps

(19.2\*64=1228.8) 64

QPSK

BPSK

(soft hand-off)

(1)

|  |        |
|--|--------|
| Rx: 869-894<br>Tx: 824-849<br>Rx: 1930-1990<br>Tx: 1850-1910<br>Rx: 2110-2170<br>Tx: 1920-1980 | (MHz)  |
| CDMA/FDMA  |        |
| 15...50  |        |
| 1.25   | (MHz)  |
| QPSK/BPSK  |        |
| 1.2288 Mcps  | ( )    |
| 20   |        |
| 9.6...1.2  | (kb/s) |
| 1/2-1/3-k=9  |        |
| 19.2...2.4   | (kb/s) |
| 20   | (ms)   |
| 0.6  | (W)    |
| موجود  |        |
| 6  | (dB)   |
| 3/4 fingers  |        |

IS-95

:(1)



) :

(...

( )

...( ) ( 2%)  
(operator)

IS-

95

.(2)

voice activity )

.(detection VAD

near-far )

DS-CDMA

(problem

)

.(IS-95 800 Hz



( )  
)

.(

[1,7]

2.5G IS-95

(IS-95B ) 2.5G

IS-95

IS-95 )

2.5G IS-95B (14.4 kbps

144 IS-95C 64 kbps

IS-95 (Qualcomm) .kbps

[6] 2.4 Mbps

[8]

: (QoS)

(interoperability)

-1-2

-(BER)

-2-2

:

BER=10<sup>-3</sup>

( )

(fading)

**IS-95**

**-3**

(diversity)

CDMA

( correlation )

---

)  
 (chip) (

(frequency selective fading)

fast )

(fading

:[9]

$T_c$  -1-3

) (channel coherence time)  $T_0$

.(

$T_c$  -2-3

) (maximum excess delay)  $T_m$

- -

.(

$T_m < T_c < T_0$  :

[1,10]

( )

PN

CDMA

-4

(fingers )

( ) (symbol)

(3)

:[1]

$$s(t) = \sum_{k=0}^K \sum_{n=-\infty}^{+\infty} b_k(n) c_k(t - nT_s) c_s(t)$$

(1)

$s(t)$   
 $bk(n)$   
 $T_s$   $k$   
 $ck(t)$   
 $cs(t)$   
 $L$

$$h(t) = \sum_{l=0}^{L-1} \gamma_l(t) \delta(t - lT_c) \quad (2)$$

$\gamma_l(t)$  :

$$r(t) = s(t) * h(t) + \eta(t) \quad (3)$$

$\eta(t)$  :

Additive White Gaussian ) (Noise AWGN

$$r(t) = \sum_{l=0}^{L-1} \sum_{n=-\infty}^{+\infty} \sum_{k=0}^K [b_k(n)c_k(t - nT_s - lT_c)c_s(t - lT_c)]\gamma_l(t) + \eta(t) \quad (4)$$

( [1,12] )

:[1, 10, 11]  
: -1-4

( correlator)

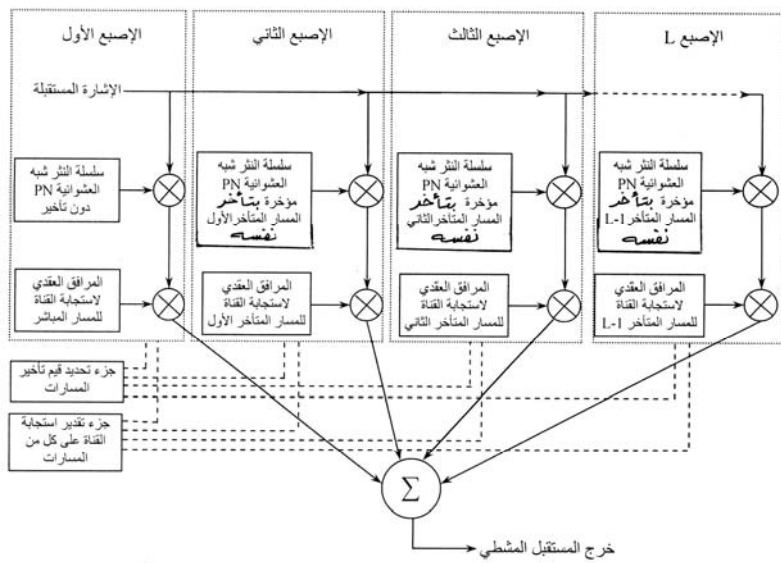
( threshold)

(tracking والملاحقة acquisition )

)  
 .(IS-95 20 ms) (

[11]

.(chip rate)



L : (3)

-2-4

.( )

---

( )

(  
:  
-3-4

( )

IS-95  
(training sequence)

)  
(  
:  
-4-4

IS-95  
(maximal ratio coherent combining)  
.[1, 10, 11]  
-5  
-1-5

( /2-2/ /1/ ) QoS



[5,8]

:  
 (spreading gain) (quantization levels)

IS-95 (chip rate) BER  
 [12]

10 dB  
 6 4  $10^{-2}$   $5 \cdot 10^{-2}$  BER

( )

(computation load)  
 [12] ( )  
 (spreading gain)

IS-95  
 )

(/2/

[12]

- -

BPSK )

: L Eb/No (IS-95

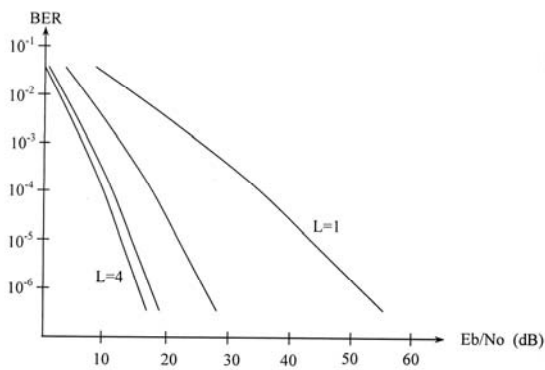
$$P_e = \left( \frac{1}{4Eb/No} \right)^L \binom{2L-1}{L} \quad (5)$$

BER Eb/No (4)

Eb/No BER  
Eb/No (2)

IS-95 .BER

[1, 13]



L=4 L=1 BER Eb/No :(4)

$E_b/N_0 = 17 \text{ dB}$

BER =  $10^{-3}$       !  $10^{-6}$        $10^{-2}$       BER  
 )      50%      BER =  $10^{-6}$

$E_b/N_0 = 15 \text{ dB}$       (

|          | BER       |           |           |           |           |
|----------|-----------|-----------|-----------|-----------|-----------|
|          | $10^{-2}$ | $10^{-3}$ | $10^{-4}$ | $10^{-5}$ | $10^{-6}$ |
| <b>1</b> | 17        | 27        | 37        | 46        | 54        |
| <b>2</b> | 9         | 15        | 19        | 22        | 25        |
| <b>3</b> | 5         | 10        | 13        | 15.5      | 17        |
| <b>4</b> | 3.5       | 8         | 11        | 13.5      | 15        |
| <b>5</b> | 2.5       | 6         | 9         | 11.5      | 13        |
| <b>6</b> | 1.5       | 5         | 8         | 10.5      | 12        |
| <b>7</b> | 1         | 4         | 7         | 9.5       | 11        |
| <b>8</b> | 1         | 4         | 6         | 8.5       | 10        |

$E_b/N_0$  : (2)

BER

$E_b/N_0 = 10 \text{ dB}$        $10^{-6}$        $10^{-5}$   
 .[10]      12

BER

---

2  $\mu$ s 1  $\mu$ s  
.[10] 20  $\mu$ s

5  $\mu$ s

(IS-95 0.8  $\mu$ s)  
234

(3x108/1.28x106)

IS- )

[10] 95

.( 2

1 )

(

:

\_\_\_\_\_

:

IS-95  
 (IS-95 )  
 .delay BER  
 :  
 (IS-95  $10^{-4}$ ) BER  
 (3)

|   |                |
|---|----------------|
|   |                |
|   | <b>50 ms</b>   |
|   | <b>100 ms</b>  |
|   | <b>150 ms</b>  |
| - | <b>250 ms</b>  |
|   | <b>400 ms</b>  |
|   | <b>600+ ms</b> |

:(3)

---

(20ms)

IS-95

[1]

:

:

(background)

(streaming)

(interactive)

( )

:

)

(

[6]

)

:(

:

[7]

5 )

:

)

(3 4

- 1
- 2
- 3
- 4
- 5
- 6

.(IS-95 )



:  
: -1

: -2

: -3

: -4

)

[14] (Cognitive Communications)  
.(



(20 ms)

Eb/No (4)

( )

| 4    | 3    | 2  | 1  |     |  |
|------|------|----|----|-----|--|
| -    | -    | -  | +9 | /1/ |  |
| -    | -    | -  | 0  |     |  |
| +2.5 | +2.5 | +3 | +9 | /2/ |  |
|      |      |    |    | /3/ |  |
| +2.5 | -    | -  | -  | /4/ |  |
| 0    | -    | -  | -  |     |  |

Eb/No (dB) : (4)

/1/ (4)

(/1/ ) /2/

/3/

/2/ /4/

(/4/ )

/3/



)

/3/ /2/

(

-

-

**-2-5**

(/4/

)

-

-

.(correlator)

-

-

(Estimator)

)

.(/4/

)

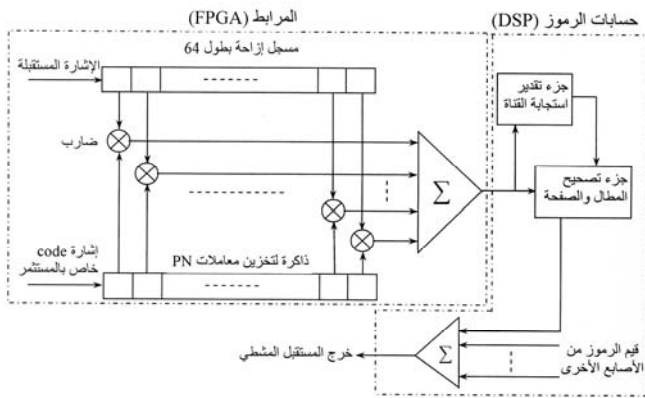
.(

)

(

)  
 (  
 .(Field Programmable Gate Array FPGA)  
 )  
 .(Digital Signal Processor DSP) (  
 (FPGAs DSPs )  
 .[5]

(5)



:(5)

-3-5

-1-3-5

(6)

:( )

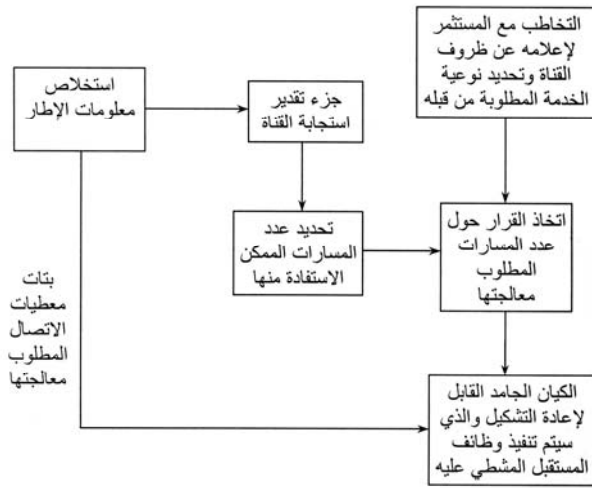
-1

-2

( ) :  
(/1-5/ )

-3

-4



:(6)

-2-3-5

:  
MATLAB :

(DSP+FPGA)  
.[5] ( )

C :

.( ) DSP+FPGA

:  
( )  
)

.(/1-5/

64

x 64 :

-1 +1

---

64

x 64 :

( )

( )

64

9

-2-3-5

(5)

( )

(/4/ )

(discrete uniform distribution)

(5)

.50%

| 4 | 3    | 2    | 1    |     |     |
|---|------|------|------|-----|-----|
| - | -    | -    | -75% |     | /1/ |
| - | -    | -    | -75% |     |     |
|   | -25% | -50% | -75% | /2/ |     |
|   | -25% | -50% | -75% | /3/ |     |
|   | -    | -    | -    |     | /4/ |
|   | -    | -    | -    |     |     |

:(5)

)

(

50%

( )

-6

( )



75% 25%



---

|                |  |           |
|----------------|--|-----------|
| <b>SDR</b>     | <b>Software Defined Radio</b>                        |           |
| <b>IS-95</b>   | <b>Interim Standard 95</b>                           | <b>95</b> |
| <b>CDMA</b>    | <b>Code Division Multiple Access</b>                 |           |
| <b>QoS</b>     | <b>Quality of Service</b>                            |           |
| <b>GSM</b>     | <b>Global System for Mobile Communications</b>       |           |
| <b>WCDMA</b>   | <b>Wideband Code Division Multiple Access</b>        |           |
| <b>TDMA</b>    | <b>Time Division Multiple Access</b>                 |           |
| <b>PN</b>      | <b>Pseudo Noise</b>                                  |           |
| <b>CELP</b>    | <b>Code Excited Linear Prediction</b>                |           |
| <b>BPSK</b>    | <b>Binary Phase Shift Keying</b>                     |           |
| <b>QPSK</b>    | <b>Quaternary Phase Shift Keying</b>                 |           |
| <b>DS-CDMA</b> | <b>Direct Sequence-Code Division Multiple Access</b> |           |
| <b>BER</b>     | <b>Bit Error Rate</b>                                |           |
| <b>FPGA</b>    | <b>Field Programmable Gate Array</b>                 |           |
| <b>DSP</b>     | <b>Digital Signal Processor</b>                      |           |

- 
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