Design flow of Implementation of Transceiver System for UHF/VHF in Rayleigh Fading

G V V Sharma*

CONTENTS

1. EQUALIZER

$$\hat{x}_m[v] = \mathcal{F}(u_m[v]) = \frac{1}{\sqrt{2}}\{sgn(Re\{u_m[v]\}) + j.sgn(Im\{u_m[v]\})\}$$

with the signum function $sgn\{a\} = \pm 1$ for $\mathbb{R} \ni a \gtrless 0$.

$$\mathbf{w}_{m,i}[v] = \mathbf{w}_{m,i}^{(CM)}[v] + \mathbf{w}_{m,i}^{(DD)}[v]$$

CM Algorithm – Concurrent Constant ModulusAlgorithm
DD Algorithm – Decision Directed Algorithm

where $\mathbf{w}_{m,i}^{(CM)}[v]$ will be updated by a CM algorithm
$\mathbf{w}_{m,i}^{(DD)}[v]$ is adjusted in DD mode, with $m \in \{1, 2, ...40\}$ being the subcarrier index

$$v_m[v] = \sum_{i=0}^{2} \mathbf{w}_{m,i}^H[v]\mathbf{y}_{m,i}[v]$$

where $\mathbf{y}_{m,i}[v]$ is a tap-delay-line vector containing a data window of the polyphase signal $\mathbf{y}_{m,i}[v]$ in Fig.8,such that

$$\mathbf{y}_{m,i}[v] = \begin{pmatrix} y_{m,i}[v] \\ y_{m,i}[v-1] \\ . \\ . \\ . \\ y_{m,i}[v - L_{m,i} + 1] \end{pmatrix}$$

If we neglect carrier frequency and phase offsets, then the subcarrier output is given by

$$\hat{x}_m[v] = \mathcal{F}(u_m[v])$$

$$\mathbf{w}_{m,i}^{(CM)}[v + 1] = \mathbf{w}_{m,i}^{(CM)}[v] + \Delta\mathbf{w}_{m,i}^{(CM)}[v]\mathbf{y}_{m,i}[v]$$

$$\Delta\mathbf{w}_{m,i}^{(CM)}[v] = \mu_{CM}(1 - |v_m[v]^2)v_m^*[v]\mathbf{y}_{m,i}[v]$$

$$v_m^{(CM)}[v] = \sum_{i=0}^{2}(\mathbf{w}_{m,i}^{(CM)}[v] + \Delta\mathbf{w}_{m,i}^{(CM)}[v])^H\mathbf{y}_{m,i}[v]$$

*The authors are with the Department of Electrical Engineering, Indian Institute of Technology, Hyderabad 502285 India e-mail: gadepall@iith.ac.in.

$$\mathbf{w}_{m,i}^{(DD)}[v + 1] =$$

$$\mathbf{w}_{m,i}^{(DD)}[v] + \mu_{DD}.\delta(\hat{x}_m[v] - \mathcal{F}(u_m[v])).(\mathcal{F}(u_m[v]) - v_m[v])^*\mathbf{y}_{m,i}[v]$$

where,

$$\delta(a) = \begin{cases} 1 & a = 0 \\ 0 & a \neq 0 \end{cases}$$