

# CONTENTS

	Page
FIGURES . . . . .	vi
TABLES . . . . .	viii
ABSTRACT . . . . .	1
1. INTRODUCTION . . . . .	1
2. MEASUREMENT SYSTEM . . . . .	3
2.1 Transmitter . . . . .	3
2.2 Receiver . . . . .	3
3. MEASUREMENT PROCEDURE . . . . .	9
4. MEASUREMENT LOCATIONS . . . . .	13
5. DATA ANALYSIS METHODS AND RESULTS . . . . .	17
5.1 Delay Statistics . . . . .	18
5.2 Effects of Spatial Diversity . . . . .	26
5.3 Multipath Power Statistics . . . . .	28
5.4 Number of Paths, Path Arrival Time, and Path Power Statistics . . . . .	33
5.5 Correlation Bandwidth . . . . .	42
6. SUMMARY AND CONCLUSIONS . . . . .	47
7. REFERENCES . . . . .	49

## FIGURES

	Page
Figure 2.1. Photograph of the measurement system transmitter van . . . . .	4
Figure 2.2. Photograph of the measurement system receiver van . . . . .	5
Figure 2.3. Block diagram of the measurement system transmitter . . . . .	6
Figure 2.4. Block diagram of the measurement system receiver . . . . .	7
Figure 3.1. Example calibration power delay profile . . . . .	10
Figure 4.1. Measurement routes in the flat rural cell . . . . .	14
Figure 4.2. Measurement routes in the hilly rural cell . . . . .	15
Figure 4.3. Measurement routes in the urban high-rise cell . . . . .	16
Figure 5.1. Histograms of maximum delay (a), mean delay (b), and RMS delay spread (c) for the flat rural cell using a threshold 20 dB below the peak in each APDP . . . . .	20
Figure 5.2. Histograms of maximum delay (a), mean delay (b), and RMS delay spread (c) for the hilly rural cell using a threshold 20 dB below the peak in each APDP . . . . .	21
Figure 5.3. Histograms of maximum delay (a), mean delay (b), and RMS delay spread (c) for the urban high-rise cell using a threshold 20 dB below the peak in each APDP . . . . .	22
Figure 5.4. Cumulative distributions of maximum delay (a), mean delay (b), and RMS delay spread (c) for the flat rural cell using a threshold 20 dB below the peak in each APDP . . . . .	23
Figure 5.5. Cumulative distributions of maximum delay (a), mean delay (b), and RMS delay spread (c) for the hilly rural cell using a threshold 20 dB below the peak in each APDP . . . . .	24
Figure 5.6. Cumulative distributions of maximum delay (a), mean delay (b), and RMS delay spread (c) for the urban high-rise cell using a threshold 20 dB below the peak in each APDP . . . . .	25
Figure 5.7. Effects of spatial diversity in the flat rural (a), hilly rural (b), and urban high-rise (c) cells . . . . .	27

**FIGURES (cont'd)**

	Page
Figure 5.8. Average and standard deviation of power (a), peak power (b), and threshold statistics (c) for the flat rural cell . . . . .	30
Figure 5.9. Average and standard deviation of power (a), peak power (b), and threshold statistics (c) for the hilly rural cell . . . . .	31
Figure 5.10. Average and standard deviation of power (a), peak power (b), and threshold statistics (c) for the urban high-rise cell . . . . .	32
Figure 5.11. Cumulative distributions of the number of significant paths for different thresholds for the flat rural (a), hilly rural (b), and urban high-rise (c) cells . . . . .	34
Figure 5.12. Histograms (a-b) and cumulative distributions (c) of correlation bandwidth for the flat rural cell . . . . .	44
Figure 5.13. Histograms (a-b) and cumulative distributions (c) of correlation bandwidth for the hilly rural cell . . . . .	45
Figure 5.14. Histograms (a-b) and cumulative distributions (c) of correlation bandwidth for the urban high-rise cell . . . . .	46

## TABLES

	Page
Table 5.1. Mean ( $\mu$ ) and Standard Deviation ( $\sigma$ ) of Path Arrival Time (in $\mu\text{s}$ ) and Path Power (in dB) Using a -20 dB Threshold for Each Individual Path for APDPs Having a Total of n Paths in the Flat Rural Cell . . . . .	36
Table 5.2. Mean ( $\mu$ ) and Standard Deviation ( $\sigma$ ) of Path Arrival Time (in $\mu\text{s}$ ) and Path Power (in dB) Using a -20 dB Threshold for Each Individual Path for APDPs Having a Total of n Paths in the Hilly Rural Cell . . . . .	37
Table 5.3. Mean ( $\mu$ ) and Standard Deviation ( $\sigma$ ) of Path Arrival Time (in $\mu\text{s}$ ) and Path Power (in dB) Using a -20 dB Threshold for Each Individual Path for APDPs Having a Total of n Paths in the Urban High-Rise Cell . . . . .	38
Table 5.4. Mean ( $\mu$ ) and Standard Deviation ( $\sigma$ ) of Path Arrival Time (in $\mu\text{s}$ ) and Path Power (in dB) Using a -10 dB Threshold for Each Individual Path for APDPs Having a Total of n Paths in the Flat Rural Cell . . . . .	39
Table 5.5. Mean ( $\mu$ ) and Standard Deviation ( $\sigma$ ) of Path Arrival Time (in $\mu\text{s}$ ) and Path Power (in dB) Using a -10 dB Threshold for Each Individual Path for APDPs Having a Total of n Paths in the Hilly Rural Cell . . . . .	40
Table 5.6. Mean ( $\mu$ ) and Standard Deviation ( $\sigma$ ) of Path Arrival Time (in $\mu\text{s}$ ) and Path Power (in dB) Using a -10 dB Threshold for Each Individual Path for APDPs Having a Total of n Paths in the Urban High-Rise Cell . . . . .	41