

INDEX

A

Angular broadening 2-46
Angular width of source
 relation to scintillation 2-45
Antenna gain 1-1, 10-12
 discrimination against
 multipath 9-61
 off-axis 8-27 to 8-29
Antimultipath techniques
 antenna' discrimination 9-61
 adaptive equalizers 6-31, 6-32
 diversity 6-31
 pilot tones 6-34, 6-35
 spread spectrum 6-31,
 6-35 to 6-39
Attenuation
 clouds 5-6 to 5-10
 dust 5-15 to 5-17
 gases 3-19 to 3-22
 ionosphere 2-53 to 2-56
 rain 4-1 to 4-41
 vegetation 5-19
Attenuation, rain 4-1 to 4-41
 models 4-21 to 4-41 (see
 also Models of rain atten.)
Attenuation constant
 clouds 5-6 to 5-10
 dust 5-15 to 5-17
 ionosphere 2-53 to 2-56
 oxygen 3-19, 3-20
 rain 4-1, 4-2, 4-8 to 4-13
 water vapor 3-20, 3-22
Attenuation constant, rain
 empirical relations 4-9, 4-10,
 4-12 to 4-14
 extinction 4-1
 models 4-21 to 4-41
 plots 4-8, 4-11

B

Bending, ray 3-10 to 3-13, 9-23,
 9-24
Bit error rate (BER) 10-2, 10-3
Bistatic scatter from rain, 4-50
 to 4-53, 8-20 to 8-25, 8-30
 to 8-32

C

Characteristic waves 2-1, 2-2,
 2-5, 2-6, 2-12
Clouds '5-1, '5-2, 5-6 to 5-14,
 7-12, 7-13, 9-54 to 9-57
 attenuation 5-6 to 5-10, 9-54
 excess range delay 5-12, 5-13
 noise 5-10, 5-11, 9-57
Coding 10-2, 10-3
Complex dielectric constant
 dust 5-15
 relation to complex index 4-5
 water 4-5, 5-7, 5-10
Complex index of refraction
 clouds 5-6, 5-7
 rain 4-6, 4-7, 4-9
 vegetation 5-18
 water 4-2
Coordination area 8-1 to 8-3
 great circle paths 8-9 to 8-19
 scatter by rain 8-20 to 8-24
Coverage area of satellite 1-3,
 10-30 to 10-32
Curvature, ray 3-6, 3-7, 3-11

D

Defocusing 3-10, 8-14, 8-15,
 9-28, 9-29
Depolarization 1-7, 4-42 to
 4-50, 9-46 to 9-54

Depolarization (cont.)

Chu theory 4-45 to 4-49

D 4-43 to 4-47

differential constant 4-48

and attenuation 4-47, 4-49

XPD 4-42, 4-43

Difference range versus int.

Doppler 2-20 to 2-22

Diffuse scatter 6-20, 6-21

Digital systems 6-35, 10-2,
10-3, 10-22 to 10-26

Diversity 10-7, 10-8

DRVID 2-20 to 2-22

Ducting 3-14, 3-15, 8-16 to
8-19

Dust and sand storms 5-14 to
5-17, 9-55

E

Earth radius, effective 3-7 to
3-9

Elevation-angle error 3-9,
3-10, 9-23, 9-24

Excess range delay

clouds 5-12, 5-13

ionosphere 2-17 to 2-19
9-8, 9-10, 9-15, 9-16

rain 5-13

clear troposphere 3-22 to
3-29, 9-23, 9-30 to 9-32

Excess time delay

ionosphere 2-18, 2-26,
2-27, 9-7, 9-10, 9-15,
9-16

troposphere 9-30

F

Faraday rotation 2-12 to 2-16,
2-28, 9-7, 9-9, 9-15

Flat-earth plots 3-8 to 3-11

Footprint, satellite 10-31, 10-32

Free-space loss 1-2, 8-12, 8-13

Frequency allocations 1-8 to 1-15

Fresnel zones 2-38, 2-43, 2-66,
2-67, 6-3 to 6-5

G

Gaseous attenuation, α_o, α_w, A_a
3-19 to 3-22, 9-30

Geostationary satellite

azimuth angle 1-5

distance 1-4, 1-5, 10-12

elevation angle 1-4, 1-5, 10-12

Global positioning system (GPS)

C/A code 6-60

carrier phase 6-61, 6-62

differential GPS 6-62, 6-63

ionospheric delay 6-61

P code 6-59, 6-60

pseudorange 6-59, 6-62

TOPEX satellite 6-62, 6-63

tropospheric delay 6-61

Ground waves 6-1, 6-2

I

Index of refraction

circular polarization 2-2, 2-5

extraordinary wave 2-6

ordinary wave 2-5, 2-6

quasilongitudinal (QL) 2-11

role in propagation 2-6, 2-7

troposphere 3-1 (see also

Refractivity)

Interference 8-1 to 8-33

aircraft 8-33

earth-station siting 8-32

ducting 8-2, 8-3, 8-16 to 8-19

procedures for analysis 8-26 to
8-31

scatter by rain 8-20 to 8-25

Interference (cont.)

signal-to-interference ratio
8-3 to 8-8

Ionosphere 1-19 to 1-22

absorption 2-53 to 2-56

am-oral 2-30, 2-31

D region 1-19, 1-21

disturbances 2-29 and 2-34

E region 1-21

equatorial 2-29

F region 1-21, 1-22

polar cap 2-33, 2-54 to 2-56

SID's and storms 2-31, 2-32

spread F 2-33

TID's 2-32, 2-33

Ionospheric effects (see

Ionospheric propagation)

Ionospheric propagation 2-1 to

2-67, 9-1 to 9-18

absorption 2-53 to 2-56

bandwidth coherence 2-22

Doppler frequency 2-20 to

2-22, 9-16, 9-17

excess range delay 2-17 to

2-19, 9-15, 9-16

excess time delay 2-18,

2-26, 2-27, 9-15, 9-16

Faraday rotation 2-12 to

2-16, 2-28, 9-15

left circular polarization 2-1,

2-2, 2-5, 2-11

phase advance 2-19, 9-16

QL approximation 2-11

reflection 2-7, 2-8

refraction 2-9, 2-10

right circular polarization

2-1, 2-2, 2-5, 2-11

scintillation 2-35 to 2-53,

9-18 to 9-21

L

Land-mobile satellite systems

1-15, 6-40 to 6-49, 9-55 to

9-61, 10-17 to 10-21

balloon measurements 6-42

data summaries 6-43 to 6-45

diffuse scatter 6-41, 6-42,

6-46, 6-47

Doppler shift 6-42, 6-46, 6-47

shadowing by trees 6-41, 6-42,

6-47, 6-48

specular reflection 6-41

Laser ranging 3-29, 3-30

Laws and Parsons distribution

4-2 to 4-4

Link power budget 1-1 to 1-3,

10-9, 10-10, 10-13 to 10-26

Losses and loss factors

clouds 5-6 to 5-10

defocusing 3-10

diffraction 6-4 to 6-7, 8-14,

8-16, 8-17

ducts 8-16 to 8-18

dust 5-15 to 5-17

free space, L_{FS} 1-2, 8-12,

8-13

ionospheric 2-53 to 2-56 .

L_b 8-10, 8-12 to 8-14

L_t 8-10, 8-20 to 8-23

rain 4-1 to 4-41

vegetation 5-19, 6-42, 6-47

M

Magnetic field, Earth's 1-22,

2-2 to 2-5, 9-4 to 9-6

dipole model 2-3 to 2-5,

9-4, 9-5, 9-72 to 9-76

Marshall and Palmer distr.

4-2, 4-3

- Maximum usable frequency 2-i O
- Mesosphere 1-18
- Mie theory 4-1 to 4-5
- Mobile systems
 - aeronautical mobile 6-54 to 6-58
 - global positioning system 6-59 to 6-63
 - land mobile 1-15, 6-40 to 6-49, 9-55 to 9-61, 10-17 to 10-21
 - maritime 6-50 to 6-53
- Models of rain attenuation 4-21 to 4-41
 - CCIR 4-34 to 4-41, 9-34, 9-37 to 9-46
 - Dutton-Dougherty 4-27
 - global 4-29 to 4-33, 9-35, 9-36
 - piecewise uniform 4-28
 - radar 4-39
 - Rice-Holmberg 4-26
 - SAM 4-33
 - two-component 4-33, 4-60, 4-61
 - (also see Rain models, features of)
- Multipath fading
 - antimultipath techniques 6-30 to 6-39
 - specular reflection 6-8 to 6-13, 6-28, 6-29
 - tropospheric 3-12, 3-17, 3-18
- N**
- N units 3-1 to 3-8, 9-27, 9-28
- Natural regions of Earth 1-23
- Noise effect on C/X 7-8, 7-11, 9-63, 9-64
- Noise figure 7-1, 7-2
 - relation to noise temperature 7-2
- Noise sources or types
 - atmospheric thermal noise 7-6 to 7-10, 7-15, 9-63, 9-64
 - clouds 5-7 to 5-10, 7-13
 - cosmic noise 7-6
 - extraterrestrial 7-14 to 7-28
 - lightning 7-6
 - microwave background 7-17, 7-27
- Moon 7-22
- sea surface 7-32
- synchrotrons radiation 7-19, 7-20
- terrestrial 7-29 to 7-34
- thermal 7-6 to 7-10
- Noise temperature
 - antenna 7-3
 - attenuator 7-2, 7-3
 - brightness temperature, T_b 7-7, 7-8, 7-10, 7-11, 9-62, 9-63
 - receiver 7-1, 7-2
 - relation to noise figure 7-2
 - series combination 7-4
 - system 7-4 to 7-6, 9-61
- O**
- Obstacle gain 6-6, 6-7
- Obstructions on path
 - knife-edge 6-4 to 6-7
 - smooth earth 6-4, 6-6
- P**
- Plasmasphere 1-22
- Probability density functions
 - 6-21 to 6-25
 - lognormal 6-24

Probability density functions
(cont.)

Rayleigh 6-23

Rician 6-25

Pulsars 7-28

Q

QL approximation 2-11

Quasars 7-28

R

Radio noise (see Noise sources
and Noise temperature)

Rain

attenuation 4-1 to 441

depolarization 4-42 to 4-50
9-46 to 9-54

rain rate regions 4-21 to
4-26, 4-39 to 441

rain rate values 4-30, 4-32,
4-38

spatial distribution 4-18 to
4-20

scatter from 4-50 to 4-53

Raindrops

shape 4-1, 4-2

size distribution 4-2 to 4-4

terminal velocity 4-5

Rainfall data 4-15, 4-17

Rain models, features of

height extent 4-18, 4-19,
4-35

path reduction factor, 4-18,
4-20, 4-35

percentage of time rates are
exceeded 4-32, 4-35 to
4-38, 9-38 to 9-40

rain rate regions 4-21 to
4-26, 4-39

rain rate values 4-30, 4-32,
4-38, 9-34

relation of rain rate to ,
attenuation constant, 4-9,
4-10, 4-12 to 4-14, 9-37,
9-41, 9-44

spatial distribution 4-18 to
4-20, 9-41 to 9-43

step-by-step procedure
9-34 to 9-44

Range delay (see Excess range
delay)

Rayleigh theory 4-5, 5-3 to 5-7

Reflection coefficients

average ground 6-16

Brewster angle 6-15

circular Polarization 6-17,
6-70 to 6-72

divergence factor 6-55

horizontal polarization
6-14, 6-15

ice caps 6-56

smooth sea 6-53

surface roughness factor
6-18, 6-19

vertical polarization
6-14, 6-15

Refractivity, of troposphere

3-1 to 3-8, 9-27 to 9-29

RF link relations 1-1 to 1-3, 4-
10-9, 10-10, 10-13 to
10-30

s

Saturation water vapor pressure
3-2, 9-27

Scintillation

indices 2-37, 2-53

interplanetary 2-45, 2-46

ionospheric 2-35 to 2-53,
9-18 to 9-21

- Scintillation (cont.)
 microwave 2-47, 2-49
 phase 2-41 to 2-43
 tropospheric 3-17, 3-18, 9-25, 9-26
- Signal-to-noise ratio 1-2, 1-3
 10-1, 10-2, 10-9, 10-10
 allocation of 10-5, 10-6
 analog systems 10-5
 composite or overall 10-6
 digital systems 10-2
 examples of calculations 10-13 to 10-26
 relation to E_b/N_0 10-2
- Single sideband systems 6-34, 10-33 to 10-37
- Solar power satellite 8-26
- Specific attenuation (see Attenuation constant)
- Spectral broadening 2-46
- Specular reflection 6-8 to 6-17
 and diffuse scatter 6-21
 modification by roughness 6-17 to 6-20
- Spread-spectrum systems 6-35 to 6-39, 10-37 to 10-41
- Stratosphere 1-18
- Surface roughness 6-17 to 6-20
- Synchrotron radiation 7-19, 7-20 “
- System noise temperature, 1-2, 7-4 to 7-6, 9-61, 10-10, “ 10-11
- T
- TDRSS (see Tracking and data relay system)
- TEC 2-16 to 2-28, 9-13 to 9-18
 effects of 2-17 to 2-24, 2-26 to 2-28, 9-7 to 9-13
 oblique path 9-13, 9-14
 plasmasphere 2-22, 2-23
- Temperature inversions 1-18, 3-4.3-6.3-27
- Time delay (see Excess time del.)
- TOPEX 6-62, 6-63
- Total electron content (see TEC)
- Tracking and data relay system 10-40* 10-41
- Tropospheric propagation 3-1 to 3-30, 9-22 to 9-32
 bending, ray 3-10, 3-12, 3-13
 ducting 3-14, 3-15
 elevation-angle error 3-9, 3-10, 3-13
 excess range delay 3-22 to 3-29
 fading 3-12, 3-17, 3-18
 flat-earth plots 3-8 to 3-11
 gaseous attenuation 3-19 to 3-22
- N units 3-1 to 3-8
 ray paths 3-11
 refractivity 3-1 to 3-8
 scintillation 3-17, 3-18
- Turbulence, atmospheric 3-15 to 3-17
 Bragg scatter 3-16
 C_n^2 coefficient 3-16
 range of scale sizes 3-15
 troposcatter 3-16, 3-17, 8-2
- V
- Velocity of light, to nine decimal places with no uncertainty 3-23

Very small aperture terminal (VSAT)
10-40, 10-42
potential interference due to broad
beam alleviated by use of spread
spectrum 10-40

W

Water on radome 4-54, 10-24
Water vapor pressure 3-1 to 3-3, 9-27
excess range delay ΔR_w 3-25
excess range delay AR_2 3-25, 3-27
highest known value 3-3, 3-27, 9-28
saturation water vapor pressure 3-2
Water vapor radiometers 3-25 to 3-27,
6-63
application to GPS and TOPEX 6-63
correction for excess range delay AR_2
3-25
radiative transfer theory 3-25, 3-26
statistical retrieval technique 3-26,
3-27