

1. Record Nr.	UNINA9910136795203321
Autore	Pahl John A.
Titolo	Interference analysis : modelling radio systems for spectrum management // John A. Pahl
Pubbl/distr/stampa	Chichester, UK ; ; Hoboken, NJ : , : Wiley, , 2016 [Piscataway, New Jersey] : , : IEEE Xplore, , [2016]
ISBN	1-119-06529-1 1-119-06532-1 1-119-06531-3
Descrizione fisica	1 online resource (750 p.)
Disciplina	621.382/24
Soggetti	Radio - Interference - Mathematical models Radio - Transmitters and transmission - Mathematical models Electromagnetic waves - Transmission - Mathematical models Radio frequency allocation - Management
Lingua di pubblicazione	Inglese
Formato	Materiale a stampa
Livello bibliografico	Monografia
Note generali	Description based upon print version of record.
Nota di bibliografia	Includes bibliographical references and index.
Nota di contenuto	-- Foreword xiii -- Preface xv -- 1 Introduction 1 -- 1.1 Motivations and Target Audience 2 -- 1.2 Book Structure 2 -- 1.3 Chapter Structure and Additional Resources 3 -- 1.4 Case Study: How to Observe Interference 3 -- 2 Motivations 6 -- 2.1 Why Undertake Interference Analysis? 6 -- 2.2 Drivers of Change 7 -- 2.3 The Regulatory Framework 8 -- 2.4 International Regulations 10 -- 2.4.1 History and Structure 10 -- 2.4.2 The Radiocommunication Sector 13 -- 2.4.3 Radio Regulations 15 -- 2.4.4 World Radiocommunication Conference 23 -- 2.4.5 Study Groups and Working Parties 24 -- 2.4.6 Recommendations and Reports 25 -- 2.5 Updating the Radio Regulations and Recommendations 27 -- 2.6 Meetings and Presenting Results 29 -- 2.7 National Regulators 34 -- 2.8 Regional and Industry Organisations 35 -- 2.9 Frequency Assignment and Planning 37 -- 2.10 Coordination 40 -- 2.11 Types of Interference Analysis 42 -- 2.12 Further Reading and Next Steps 42 -- 3 Fundamental Concepts 43 -- 3.1 Radiocommunication Systems 43 -- 3.2 Radio Waves and Decibels 46 -- 3.3 The Power Calculation 49 -- 3.4 Carrier Types and

Modulation 52 -- 3.4.1 Overview 52 -- 3.4.2 Analogue Modulation 53 -- 3.4.3 Digital Modulation 55 -- 3.4.4 Frequency Hopping and OFDM 60 -- 3.4.5 Digital Modulation Selection 62 -- 3.4.6 Pulse Modulation and UWB 64 -- 3.4.7 Filtering 64 -- 3.5 Multiple Access Methods 66 -- 3.5.1 Overview 66 -- 3.5.2 Collision Sensing Multiple Access 68 -- 3.5.3 Frequency Division Multiple Access 69 -- 3.5.4 Time Division Multiple Access 70 -- 3.5.5 Code Division Multiple Access 71 -- 3.5.6 Orthogonal Frequency Division Multiple Access 75 -- 3.6 Noise Temperature and Reference Points 75 -- 3.7 Antennas 82 -- 3.7.1 Basic Concepts 82 -- 3.7.2 Beams and Beamwidths 85 -- 3.7.3 Common Gain Pattern Types 85 -- 3.7.4 Isotropic Gain Pattern 88 -- 3.7.5 Parabolic Dish Antennas 88 -- 3.7.6 Elliptical Patterns 92 -- 3.7.7 Phased Array Antennas 95 -- 3.7.8 Azimuth Dependent Antennas 96 -- 3.7.9 Elevation Dependent Antennas 98. 3.7.10 Azimuth and Elevation Slices 99 -- 3.7.11 3D Gain Tables 100 -- 3.7.12 Antenna Pointing Methods 101 -- 3.8 Geometry and Dynamics 101 -- 3.8.1 Geometric Frameworks 101 -- 3.8.2 Flat Earth Vectors 103 -- 3.8.3 Earth Spherical Coordinates 105 -- 3.8.4 ECI Vector Coordinates 110 -- 3.8.5 Ellipsoidal Earth and Orbit Models 120 -- 3.8.6 Delay and Doppler 121 -- 3.9 Calculation of Angles 122 -- 3.9.1 Azimuth and Elevation 122 -- 3.9.2 Terrestrial 123 -- 3.9.3 Satellite 123 -- 3.9.4 Angles in the Antenna Frame 124 -- 3.9.5 Off-Axis Angle from ECI Vectors 125 -- 3.9.6 Theta Phi Coordinates 127 -- 3.10 Statistics and Distributions 128 -- 3.11 Link Budgets and Metrics 133 -- 3.12 Spectrum Efficiency and Requirements 138 -- 3.13 Worked Example 140 -- 3.14 Further Reading and Next Steps 142 -- 4 Propagation Models 144 -- 4.1 Overview 145 -- 4.2 The Propagation Environment 148 -- 4.2.1 Effective Earth Radius 148 -- 4.2.2 Geoclimatic and Meteorological Parameters 150 -- 4.2.3 Radio Climatic Zones 150 -- 4.2.4 Terrain and Surface Databases 152 -- 4.2.5 Land Use Databases 155 -- 4.2.6 Signal Variation and Fast Fading 156 -- 4.3 Terrestrial Propagation Models 160 -- 4.3.1 P.525: Free Space Path Loss 160 -- 4.3.2 P.526: Diffraction 161 -- 4.3.3 P.530: Multipath and Rain Fade 165 -- 4.3.4 P.452: Interference Prediction 169 -- 4.3.5 P.1546: Point-to-Area Prediction 173 -- 4.3.6 P.1812: Point-to-Area Prediction 177 -- 4.3.7 P.2001: Wide-Range Propagation Model 179 -- 4.3.8 Hata/COST 231 Median Loss Model 182 -- 4.3.9 Appendix 7 184 -- 4.3.10 Generic Models 188 -- 4.3.11 Other Propagation Models 192 -- 4.3.12 Comparing Terrestrial Propagation Models 193 -- 4.4 Earth to Space Propagation Models 199 -- 4.4.1 P.676: Gaseous Attenuation 199 -- 4.4.2 P.618: Rain Loss and Noise Rise 201 -- 4.5 Aeronautical Propagation Models 205 -- 4.6 Additional Attenuations 205 -- 4.7 Radio Path Geometry 208 -- 4.8 Percentages of Time and Correlation 209 -- 4.9 Selection of Propagation Model 214 -- 4.10 Further Reading and Next Steps 216. 5 The Interference Calculation 217 -- 5.1 Bandwidths and Domains 218 -- 5.2 Bandwidth Adjustment Factor 221 -- 5.3 Spectrum Masks, Ratios and Guard Bands 224 -- 5.3.1 Transmit Mask and Calculated Bandwidth 224 -- 5.3.2 Standards and Spectrum Emission Masks 228 -- 5.3.3 The Mask Integration Adjustment Factor 232 -- 5.3.4 Frequency-Dependent Rejection and Net Filter Discrimination Terminology 239 -- 5.3.5 Adjacent Channel Leakage Ratio, ACS and Adjacent Channel Interference Ratio 242 -- 5.3.6 Spurious Emissions and dBc 245 -- 5.3.7 Intermodulation 246 -- 5.3.8 Block Edge Masks and Guard Bands 250 -- 5.4 Polarisation 254 -- 5.5 Adaptive Systems: Frequency, Power and Modulation 258 -- 5.5.1 Dynamic Frequency Selection 258 -- 5.5.2 Automatic Power Control 259 -- 5.5.3 Adaptive Coding and Modulation 262 -- 5.6 End-to-End Performance 263 -- 5.7

Modelling Deployment and Traffic 266 -- 5.7.1 Deployment Range 266 -- 5.7.2 Activity Models and Erlangs 269 -- 5.7.3 Traffic Type 272 -- 5.7.4 Deployment Models 273 -- 5.7.5 Aggregation Techniques 275 -- 5.8 Link Design and Margin 276 -- 5.9 Interference Apportionment and Thresholds 281 -- 5.9.1 Interference Margin 281 -- 5.9.2 Interference Apportionment 284 -- 5.9.3 Short-Term and Long-Term Thresholds 286 -- 5.9.4 Thresholds and Bandwidths 289 -- 5.10 Types of Interference Thresholds 292 -- 5.10.1 C/I and W/U Ratios 293 -- 5.10.2 FDP 297 -- 5.10.3 C/(N + I) and BER 301 -- 5.10.4 Unavailability 303 -- 5.10.5 Coverage, Range and Capacity 304 -- 5.10.6 Observation Duration and Locations 307 -- 5.10.7 Radar and Aeronautical Thresholds 307 -- 5.10.8 Channel Sharing Ratio 308 -- 5.10.9 Field Strength, PFD and EPFD 309 -- 5.10.10 Margin over Threshold 312 -- 5.11 Interference Mitigation 314 -- 5.11.1 Transmit Power and Bandwidth 315 -- 5.11.2 Antenna Gain Patterns 316 -- 5.11.3 Antenna Pointing 318 -- 5.11.4 Locations, Zones and Separation Distance 318 -- 5.11.5 Deployment Likelihood 320 -- 5.11.6 Noise, Feed Loss and Interference Margin 320. 5.11.7 Receiver Processing 321 -- 5.11.8 Time and Traffic 321 -- 5.11.9 Polarisation 322 -- 5.11.10 Antenna Height 323 -- 5.11.11 Operate Indoors 323 -- 5.11.12 Improved Filtering and Guard Bands 323 -- 5.11.13 Site Shielding 325 -- 5.11.14 Spectrum Sensing and Geodatabases 325 -- 5.11.15 Wanted System Modifications 325 -- 5.11.16 Modelling Methodology 326 -- 5.12 Further Reading and Next Steps 327 -- 6 Interference Analysis Methodologies 328 -- 6.1 Methodologies and Studies 329 -- 6.2 Example Scenarios 331 -- 6.2.1 IMT Sharing with Satellite ES 331 -- 6.2.2 Sharing Between Non-GSO MSS and FS 334 -- 6.3 Static Analysis 338 -- 6.4 Input Variation Analysis 344 -- 6.5 Area and Boundary Analysis 347 -- 6.5.1 Area Analysis 347 -- 6.5.2 Boundary Analysis 351 -- 6.6 Minimum Coupling Loss and Required Separation Distance 353 -- 6.7 Analytic Analysis 357 -- 6.8 Dynamic Analysis 363 -- 6.9 Monte Carlo Analysis 373 -- 6.9.1 Methodology 373 -- 6.9.2 Variation of Inputs 378 -- 6.9.3 Output Statistics and U Parameter Variation 380 -- 6.9.4 Example Monte Carlo Analysis 382 -- 6.9.5 LTE Downlink Link Budget 384 -- 6.9.6 Statistical Significance 385 -- 6.9.7 Deployment Analysis 392 -- 6.9.8 Conclusions 394 -- 6.10 Area and Two-Stage Monte Carlo 395 -- 6.11 Probabilistic Analysis 401 -- 6.12 Selection of Methodology 402 -- 6.13 Study Projects and Working Methods 404 -- 6.14 Further Reading and Next Steps 407 -- 7 Specific Algorithms and Services 408 -- 7.1 Fixed Service Planning 409 -- 7.1.1 Overview 409 -- 7.1.2 Link Planning 410 -- 7.1.3 Interference Thresholds 412 -- 7.1.4 High versus Low Site 415 -- 7.1.5 Channel Selection 416 -- 7.2 Private Mobile Radio 417 -- 7.2.1 Overview 417 -- 7.2.2 Coverage Calculation 418 -- 7.2.3 PSA and Uplink Calculations 422 -- 7.2.4 Thresholds and Propagation Model 422 -- 7.2.5 Compatibility Checks 424 -- 7.2.6 Channel Sharing Ratio 427 -- 7.2.7 Sharing with Other Services 430 -- 7.3 Broadcasting 431 -- 7.3.1 Threshold Calculation 431 -- 7.3.2 Coverage Prediction 434. 7.3.3 Statistical Power Summation 437 -- 7.3.4 Single-Frequency Networks 442 -- 7.4 Earth Station Coordination 443 -- 7.5 GSO Satellite Coordination 450 -- 7.5.1 Regulatory Background 450 -- 7.5.2 Coordination Triggers 454 -- 7.5.3 Detailed Coordination 457 -- 7.5.4 Coordination and Regulatory Constraints 464 -- 7.5.5 Gain Patterns 465 -- 7.6 EPFD and Rec. ITU-R S.1503 467 -- 7.6.1 Background 467 -- 7.6.2 Exclusion Zones and the Angle 471 -- 7.6.3 EPFD Validation Methodology 475 -- 7.6.4 EPFD Calculation 479 -- 7.7 The Radar Equation 483 -- 7.8 N-Systems Methodology 488 --

7.9 Generic Radio Modelling Tool 494 -- 7.10 White Space Devices 501
-- 7.10.1 Background and Services 501 -- 7.10.2 FCC Methodology
504 -- 7.10.3 Ofcom Methodology 506 -- 7.10.4 Comparison of
Approaches 511 -- 7.11 Final Thoughts 514 -- References 515 --
Acronyms, Abbreviations and Symbols 522 -- Index 530.
