

Contents

Part I General Sensor Characteristics

1	Introduction to Cell Phones and Wireless Technologies	3
1.1	Introduction	3
1.2	MS Obtaining Traffic Channels from BS	9
1.3	Multiplexing Schemes Used by a BS for Traffic Channels.	9
1.4	Orthogonal Frequency Division Multiplexing Access.	13
1.5	Directional Antenna and SDMA	13
1.6	Cellular Transmission.	14
1.6.1	Cellular Coverage Area for Traffic Channels	15
1.6.2	Signal Strength in Cellular Area	18
1.6.3	Roaming Support	19
1.7	Access to Control Channels	20
1.8	Different Wireless Technologies.	27
1.9	Access Points.	28
1.10	Sensor Networks	29
1.11	Conclusions	32
1.12	Questions	32
	References	34
2	Applications of Sensor Networks	35
2.1	Introduction	35
2.2	Applications of WSNs	37
2.2.1	Defense Applications of WSNs.	39
2.3	Civilian Applications	46
2.3.1	Weather Monitoring Applications	46
2.3.2	Precision Agriculture Applications	50
2.3.3	Echo System Monitoring Applications	52
2.3.4	Biomedical Applications	55
2.3.5	Other Applications	61
2.4	Conclusions	62

2.5	Questions	62
	References	62
3	Different Types of Transducers	65
3.1	Introduction	65
3.2	Types of Transducers	68
3.3	Temperature Transducers	72
3.4	Gas Transducers	73
3.5	Capacitive Transducers	75
3.5.1	Proximity Transducers	76
3.6	Fluid-Level Transducers	77
3.7	Humidity Transducers	78
3.7.1	Inductive Transducers	82
3.8	Magnetometer Transducers	85
3.9	Optical and Underwater Transducers	85
3.9.1	Underwater Acoustic Transducers	87
3.10	Strain and Biomedical Transducers	88
3.10.1	Pressure Transducers	88
3.11	Radiation Transducers	91
3.12	Transducers for Biomedical Applications	96
3.13	Conclusion	102
3.14	Questions	102
	References	103
4	Transducers' Range Modeling	105
4.1	Introduction	105
4.2	Modeling of a Transducers' Sensing Range	107
4.3	Modeling of Camera Transducers' (C-SN) Sensing Range	116
4.4	Conclusions	119
4.5	Questions	119
	References	120
5	Clock Synchronization and Localization	121
5.1	Introduction	121
5.2	Clock and Signal Propagation in a WSN	123
5.3	Localization of a SN	129
5.4	Conclusions	136
5.5	Questions	137
	References	138
6	Topology Discovery, Residual Energy, and Energy Harvesting	139
6.1	Introduction	139
6.2	Neighbor Determination and Hop Distance	141
6.3	MAC Protocols	142
6.4	Residual Energy Mapping	144
6.5	Routing with Energy Harvesting	147

6.6	Energy Harvesting by Fuel Cells and Healthcare Applications	149
6.7	Balanced Energy Consumption with Multiple Paths.	155
6.8	Conclusions	155
6.9	Questions	155
	References	156
7	TCP, Neighborhood Formation, Reliable Transport, and Simulators for WSNs	159
7.1	Introduction	159
7.2	Identifying Neighboring SNs	160
7.3	Delivering Packets to BS/Sink	165
7.4	Reliability of Delivered Packets	167
7.5	BS to SNs Reliability.	169
7.6	Congestion Control	171
7.7	Impact of Lower Layers on TCP	177
7.8	Conclusions	179
7.9	Questions	179
	References	179
8	Sensor Nodes (SNs), Camera Sensor Nodes (C-SNs), and Remote Sensor Nodes (RSNs).	181
8.1	Introduction to Sensor Nodes.	181
8.2	Camera Sensor Nodes (C-SNs)	183
8.3	Digital Images Using CCDs and CMOS Sensors.	186
8.4	Application of Camera Sensor Nodes (C-SNs).	188
8.5	Remote Sensor Node (R-SNs) Applications	190
8.6	Conclusions	193
8.7	Questions	193
	References	193
 Part II Random Topology		
9	Sensor Node Coverage and Connectivity for Random Deployment	197
9.1	Introduction	197
9.2	Coverage and Placement of SNs	199
9.3	Individual Sensor Coverage and Area Coverage by SNs	202
9.4	Energy-Hole Problem in a Randomly Deployed WSN.	204
9.5	Conclusions	207
9.6	Questions	207
	References	208
10	Medium Access and Routing	209
10.1	Introduction	209
10.2	Collision Avoidance in a WSN	209

10.3	Routing in a WSN	213
10.4	MAC Challenges for a WSN	219
10.5	S-MAC Protocols with Sleep–Awake Cycles	221
10.6	Conclusions	225
10.7	Questions	225
	References	226
11	Broadcasting, Data Aggregation, and Opportunistic	
	Forwarding	229
11.1	Introduction	229
11.2	Broadcasting	229
11.3	Lifetime of a WSN	236
11.4	Query Processing and Data Collection	243
11.5	Mobility as an Enabler in WSNs	245
11.6	Conclusions	247
11.7	Questions	248
	References	248
12	Clustering and Energy Consumption Minimization	251
12.1	Introduction	251
12.2	Clustering	251
12.3	Sensor Properties and Resource Constraints	255
12.4	Conclusions	264
12.5	Questions	264
	References	266
13	Intrusion Detection Using WSNs	267
13.1	Introduction	267
13.2	Intrusion Detection Schemes	271
13.3	Intrusion Detection Based on Hybrid Gaussian Deployment	279
13.4	Maintaining Anonymity	282
13.5	Base Station Location Anonymity	288
13.6	Conclusions	291
13.7	Questions	292
	References	292
Part III Regular Topology		
14	Coverage and Connectivity for Regular Deployments	297
14.1	Introduction	297
14.2	Mesh and Other Topologies	298
14.3	Rhombus and Irregular Topologies	308
14.4	More Complex Topologies	308
14.5	Topologies with K-Connectivity	308

14.6	Connected Coverage with Directional Antennas and C-SNs	312
14.7	Conclusions	318
14.8	Questions	326
	References	327
15	Routing and Performance of Regular WSNs	329
15.1	Introduction	329
15.2	Routing in Regular Topologies	329
15.3	Processing in Regular Topologies	335
15.4	Mobile Opportunistic Concept for Regular WSN Topologies	336
15.5	Conclusions	348
15.6	Questions	349
	References	351
16	Personal/Body Area Networks and Healthcare Applications	353
16.1	Introduction	353
16.2	Activities of Daily Living	356
16.3	Available Biomedical Transducers	361
16.4	Parkinson's Disease and Fatigue Level Detection	364
16.5	Communication Through Skin	366
16.6	Interference in WBANs	371
16.7	Data Reduction Schemes	375
16.8	Physiological Parameters for Identification Secured Communication	383
16.9	Conclusions	387
16.10	Questions	388
	References	388
 Part IV Security and Actuator Issues		
17	Authentication, Encryption, and Secured Communication	393
17.1	Introduction	393
17.2	Possible Attacks	393
17.3	Attacks in Routing Schemes	396
17.4	Encoding Schemes	399
17.5	Symmetric Matrix-Based Scheme	406
17.6	Matrix-Based Scheme (EPKEM)	407
17.7	Authenticated Key Agreement Based on Identity-Based Cryptography (IBC)	409
17.8	Conclusions	411
17.9	Questions	412
	References	412

18	Interaction with Actuators and WSN Test Beds	415
18.1	Introduction	415
18.2	A Generic WSN–Actuator Organization.	415
18.3	Actuators for a Vineyard	420
18.4	Mobile BS and Anchor Node Collecting Data from SNs.	421
18.5	Role of a System Actuator.	424
18.6	Conclusions	424
18.7	Questions	424
	References	425
 Part V Research Directions		
19	Deployed Large-Scale WSNs and Associated Design Steps	429
19.1	Introduction	429
19.2	Deployed WSNs	429
19.3	Forest Fire with Regularly Deployed SNs and Following Gaussian Distribution	431
19.4	Use of Controlled Deployment and Needle-Comb Approach to SNs	435
19.5	Conclusions	443
19.6	Questions	443
	References	444
20	Recent Advances	447
20.1	Introduction	447
20.2	Visual Sensor Networks.	447
20.3	WSNs in the Context of IoT, WoT, and SWoT.	451
20.4	Conclusions	454
20.5	Questions	459
	References	460
	Questions and Ideas for Design Projects	463
	Index	465



<http://www.springer.com/978-981-10-3037-6>

Embedded Sensor Systems

Agrawal, D.P.

2017, XLVII, 469 p. 438 illus., 208 illus. in color.,

Hardcover

ISBN: 978-981-10-3037-6