

Index

Table of Contents

Table of Contents.....	i
List of Figures.....	v
Executive summary.....	1
1 Introduction.....	3
1.1 The global trend of urbanisation	3
1.1.1 Regional differences in urbanisation.....	4
1.2 Smart cities and connected public spaces	6
1.2.1 Smart city architecture	7
1.2.2 The management of public spaces.....	8
1.3 IoT network technologies	10
1.3.1 Network architectures	10
1.3.2 Unlicensed and licensed frequency bands.....	11
1.3.3 The role of wired and wireless networks for connected public spaces.....	13
1.4 Wireless IoT communication technologies	14
1.4.1 3GPP cellular technologies	14
1.4.1 3GPP-based LPWA	17
1.4.2 Non 3GPP-based LPWA.....	20
1.4.3 RF and IEEE 802.15.4	23
2 Smart street lighting.....	27
2.1 The transition to LED and adaptive lighting	27
2.2 Smart street lighting	29
2.2.1 Smart street lighting infrastructure	31
2.3 Market analysis	35
2.3.1 Market forecasts	36
2.3.2 Industry analysis.....	39
2.3.3 The new era of competition within smart street lighting	44
2.4 Company profiles	45
2.4.1 Acuity Brands	46

2.4.2	CIMCON Lighting	47
2.4.3	DimOnOff.....	48
2.4.4	Flashnet (Engie)	49
2.4.5	GE Current, a Daintree Company	51
2.4.6	Itron	52
2.4.7	LED Roadway Lighting	53
2.4.8	Lucy Zodion.....	55
2.4.9	Reverberi Enetec	57
2.4.10	Rongwen Energy Technology Group	58
2.4.11	Schréder.....	59
2.4.12	Sensus (Xylem)	60
2.4.13	Signify.....	61
2.4.14	SSE.....	64
2.4.15	Telematics Wireless (ST Engineering)	65
2.4.16	Telensa.....	66
2.4.17	Chinese domestic vendors.....	69
3	Smart parking	71
3.1	Urban traffic and parking.....	71
3.1.1	Passenger cars in use by region.....	72
3.1.2	Traffic congestion and parking inefficiencies.....	74
3.1.3	Types of parking and asset ownership	75
3.2	Smart parking	76
3.2.1	Smart parking infrastructure.....	78
3.3	Parking space occupancy monitoring.....	79
3.3.1	Global occupancy level monitoring	80
3.3.2	Single space occupancy detection	80
3.4	Market analysis	84
3.4.1	Market forecasts	85
3.4.2	Industry analysis.....	87
3.4.3	The foreshadowing threat from camera-based solutions	90
3.5	Company profiles	91
3.5.1	CivicSmart	91

3.5.2	CommuniThings	92
3.5.3	Fangle Technology	93
3.5.4	Frogparking	94
3.5.5	Fybr	95
3.5.6	Nedap	96
3.5.7	Nwave Technologies	97
3.5.8	Onesitu (Circet)	98
3.5.9	PNI	99
3.5.10	Smart Parking	100
3.5.11	SmartGrains	102
3.5.12	Streetline (Kapsch Group)	103
3.5.13	Urbiotica	104
3.5.14	Worldsensing	106
4	Smart waste collection	109
4.1	Global waste generation and management	109
4.2	Smart waste sensors	112
4.2.1	Smart waste collection infrastructure	113
4.3	Market analysis	116
4.3.1	Market forecasts	116
4.3.2	Industry analysis	119
4.3.3	LPWA to improve the business case for smart waste sensors	122
4.4	Company profiles	123
4.4.1	BH Technologies	123
4.4.2	Bigbelly	124
4.4.3	Compology	126
4.4.4	Dingtek Technology	127
4.4.5	Ecube Labs	128
4.4.6	Enevo	129
4.4.7	Evreka	130
4.4.8	FarSite Communications	131
4.4.9	Nordsense	132
4.4.10	OnePlus Systems	133



4.4.11	SAYME.....	134
4.4.12	Sensoneo	135
4.4.13	SigrenEa (SUEZ)	136
4.4.14	Waste Vision.....	137
5	Smart city surveillance.....	139
5.1	Issues of public safety	139
5.1.1	Criminal activities and terrorist threats	140
5.2	Smart city surveillance.....	142
5.2.1	Fixed video surveillance infrastructure.....	142
5.2.2	Body-worn cameras (BWCs) for law enforcement.....	147
5.2.3	Gunshot detection and localisation systems	148
5.3	Market analysis	150
5.3.1	Market forecasts	151
5.3.2	Industry analysis.....	152
5.3.3	Western vendors turn to new strategies to mitigate Chinese AI advantage	156
5.4	Company profiles	157
5.4.1	Axis Communications (Canon)	158
5.4.2	Dahua Technology	159
5.4.3	Hanwha Techwin.....	160
5.4.4	Hikvision	162
5.4.5	Honeywell.....	163
5.4.6	Infinova	164
5.4.7	Motorola Solutions	164
5.4.8	Panasonic i-PRO Sensing Solutions	166
5.4.9	Tiandy Technologies	167
5.4.10	Uniview Technologies	168
5.4.11	Axon	168
5.4.12	WCCTV	170
5.4.13	ShotSpotter	170
	Glossary	173

Index

List of Figures

Figure 1.1: Urban population, % of total (World 1960–2018)	3
Figure 1.2: Number of major cities worldwide	4
Figure 1.3: Countries with the largest number of major cities (World 2018)	5
Figure 1.4: Connected public spaces.....	8
Figure 1.5: Unlicensed and reserved radio frequencies available for wireless IoT	12
Figure 1.6: Comparison of LTE MTC enhancements in 3GPP Release 14	15
Figure 1.7: LTE-M network availability (Q4-2018).....	18
Figure 1.8: NB-IoT network availability (Q4-2018)	19
Figure 1.9: Public LoRaWAN network operators (World Q4-2018)	21
Figure 1.10: Sigfox network operators by country (Q1-2019)	22
Figure 2.1: Dimmable luminaire with external LCU	32
Figure 2.2: Members of the TALQ Consortium.....	34
Figure 2.3: Smart street lighting LCU shipments and installed base (World 2018–2023).....	37
Figure 2.4: Installed base by communications technology (World 2018–2023)	38
Figure 2.5: Top-12 smart street lighting LCU vendors (World Q3-2019).....	41
Figure 2.6: Vendor market shares (World Q3-2019).....	43
Figure 2.7: CIMCON Lighting NearSky 360.....	48
Figure 2.8: Flashnet inteliLIGHT Zhaga and NEMA socket LCUs	50
Figure 2.9: LED Roadway Lighting Tool-less Sensor Platform.....	54
Figure 2.10: The new Lucy Zodion Ki. Node One LCU	56
Figure 2.11: Signify CityTouch NEMA socket LCU.....	63
Figure 3.1: Car parc by region (World 2009–2017)	72
Figure 3.2: Passenger car density per 1,000 inhabitants (EU28 2017)	73
Figure 3.3: Driving time spent in congestion per capita (World excluding Asia 2018)	74
Figure 3.4: Time and costs associated with the search for parking (US 2017).....	75
Figure 3.5: In-ground and surface-mount parking occupancy detection sensors	82
Figure 3.6: Smart ground parking sensor comparison	83
Figure 3.7: Smart parking sensor shipments and installed base (World 2018–2023)	85

Figure 3.8: Installed base by communication technology (World 2018–2023)	86
Figure 3.9: Top-10 smart ground parking sensor vendors (World Q3-2019).....	88
Figure 3.10: Vendor market shares (World Q3-2019).....	89
Figure 3.11: Fybr Parking Sensor III & Parking Genius guidance & payment app	95
Figure 3.12: Nedap SENSIT surface- and flush-mount sensors.....	97
Figure 3.13: PNI PlacePod in-ground and surface-mount sensors.....	100
Figure 3.14: SmartGrains surface-mount sensor.....	103
Figure 4.1: Global waste generation and collection statistics	110
Figure 4.2: Examples of smart waste sensors	114
Figure 4.3: Ecube Labs waste management software CleanCityNetworks	115
Figure 4.4: Smart waste sensor shipments and installed base (World 2018–2023)	117
Figure 4.5: Smart waste sensors by communications technology (World 2018–2023)	118
Figure 4.6: Top-11 smart waste sensor technology vendors (World Q3-2019)	120
Figure 4.7: Vendor market shares (World Q3-2019).....	121
Figure 4.8: Bigbelly's SC5.5 and HC5 smart bins	125
Figure 4.9: Compology's camera sensor	126
Figure 4.10: CleanFLEX fill-level sensor and CleanCUBE smart bins	128
Figure 4.11: Enevo's smart fill-level sensor	130
Figure 4.12: FarSite Communications netBin nPod sensor	132
Figure 4.13: Sensoneo route planning dashboard.....	135
Figure 5.1: Crime rates per 100,000 inhabitants (US & EU 2017	140
Figure 5.2: Number of deaths from terrorism (World 1995–2018)	141
Figure 5.3: Common network surveillance camera types	145
Figure 5.4: Body-worn camera with integrated cellular connectivity.....	148
Figure 5.5: Urban gunshot detection sensor system	149
Figure 5.6: Smart city surveillance equipment value forecast (World 2018–2023)	152
Figure 5.7: Smart city surveillance vendor data (World FY2018)	153
Figure 5.8: Mergers and acquisitions among video surveillance vendors	155
Figure 5.9: Dahua multi-sensor panoramic/PTZ + AI bullet network cameras.....	159
Figure 5.10: Wisenet SSM video management software.....	161
Figure 5.11: Avigilon H4 Multisensor camera with self-learning video analytics.....	165
Figure 5.12: Axon Body 3	169