Index

3GPP/3GPP2 see Third-generation Partnership Project

access and core networks, 14–16, 18, 92
access network providers, 232–3, 248–50
access point name (APN), 51–2, 185–6
activity models, 149
ADC see analog-to-digital converter
advanced metering infrastructure (AMI), 14
ageing independently, 66
allocation and retention priority (ARP), 159, 184
alternative energy sources, 26
always-on systems, 44–6
Amazon Kindle™, 5, 34
AMI see advanced metering infrastructure
analog audio interface, 262
analog-to-digital converter (ADC) interface, 262
anonymity of data, 233
antenna interface, 261
API see application programming interfaces
APN see access point name
application architectures, 3–4
application enablement strategies, 95, 99
application execution environment, 263–4
application programming interfaces (API), 10, 16
application service providers (ASP) business of M2M, 29–30, 33
modules, 267–8
security, 233–4, 248–50
area networks, 13–14, 98
ARP see allocation and retention priority
ARPU see average revenue per user
ASP see application service providers
asset tracking, 24–5
assisted living, 24
asynchronous configuration, 119–20
asynchronous exchanges, 213–14
AT command interface, 268–9
authentication protocols, 245–7
authorization, 109
automated bootstrapping, 242–5
automated teller machines (ATM), 45, 76–7
average revenue per user (ARPU), 34–5, 91
ball grid array (BGA) interfaces, 257–8
barriers to adoption, 26–8
Beecham Report (2008), 30–1
billing management, 162
block transfer, 215–16
bootstrapping, 109–10, 132
automated, 242–5
identity-based encryption, 242–5
security, 234–9, 242–5, 248–50
broadcast discriminators, 198
building automation, 79–80, 90
business of M2M, 7, 23–35
drivers and barriers to adoption, 26–8
energy, 25–6
healthcare, 24
industry maturation, 5–12
market evolution, 35
market segments, 24–6, 297–8
market size projections, 30–31
metrics, 34–5
models, 32–4
security, 228–31
transportation, 25
value chain, 28–31
caching, 113–14, 117–18, 218–19
carrier portability, 28
CDR see charging data records
cell broadcast, 176–7
cellular certification, 269–71
certification
digital certificates, 236–9
industry maturation, 8
modules, 269–71
security, 278–9
terminal, 16–17
voluntary and mandatory, 16
charging data records (CDR), 154, 157
circuit-switched data (CSD), 38–9, 42–3, 49, 265
city automation systems, 72–3
CoAP see constrained application protocol
commercial networks, 28–9
communication networks, 2–3, 7, 23
communication scenarios, 143–5
communications service providers (CSP), 32–3
confidentiality, 233, 289–90
congestion
application-specific control, 185–6
basics, 179–80
control mechanisms, 181–2, 187
early M2M deployments, 46–8
extended access barring, 187
generic core network mobility management, 183–4
mobile networks, 151, 179–87
selective throttling, 184–5
connected consumer markets, 72–3
connection monitoring, 163–4
connectivity services, 264–5
constrained application protocol (CoAP), 122, 210–220
consumer-managed applications, 26
container resources, 137–9
context data, 156
core network nodes, 182–7
CoRE working group, 210–220
asynchronous exchanges, 213–14
 caching, 218–19
constraint application protocol, 210–220
HTTP mapping, 217–18
large block transfer, 215–16
message formats, 210–212
multicast, 216
periodic messages, 214–15
representational state transfer, 210, 217–20
resource discovery, 219–20
transport protocol, 212–16
corporate customer-led model, 34
cost reductions, 150, 152–9
criticality, 4
CRUD methods, 125–6
CSP see communications service providers
DAD see duplicate address detection
data collection and exchange, 38–9, 41–2
data communication patterns, 149–50
data connections, 146–50, 159–60
data models, 13
data-only services, 49
data revenues, 35
dedicated M2M chains, 49–50, 52
demand response, 26
device application registration, 135–7
device characteristics, 4–5
device configuration, 119–20
device-to-device scenarios, 143–4
device language message specification (DLMS), 17–18
Index

device management, 102, 106–8, 163, 266
device-to-server scenarios, 143–4
device triggering, 38–9, 41–2
digital certificates, 236–9
digital signatures, 236–7
DIO messages, 207–9
direct connectivity, 97
direction oriented directed acyclic graphs (DODAG), 207–9
disease management, 66
DLMS see device language message specification
DODAG see direction oriented directed acyclic graphs
drivers to adoption, 26–8
duplicate address detection (DAD), 193, 202
durability, 262
dynamic URL generation, 120–122

E.164 numbers, 165–8
early M2M deployments, 37–53
  common problems, 46–9
  context and challenges, 37–8, 297
  operational deployments, 38–46
  optimization, 49–53
  smart cards, 292
eBook readers, 146
eCall, 11–12
economic incentives, 10–11
eHealth see healthcare
  embedded devices, 4, 7
  embedded secure elements, 281–5, 293
  emergency-call support, 25
  encryption of data, 235
  end-user services, 1, 5
energy
  business of M2M, 25–6, 31
  early M2M deployments, 41–2
  mobile networks, 146
  use cases, 60–66, 72–3, 75–6
environmental factors, 274, 285–7
European Telecommunication Standards Institute (ETSI)
horizontal service platforms, 96
M2M concepts, 2–3, 12, 18–19
M2M services architectures, 95–140
  release 1 scenarios, 103–4
resource-based M2M communication and procedures, 124–39
REST architectural style, 110–124
security, 248–50
service capabilities, 97–103, 104–10, 125–39
smart cards, 280–283, 290, 293
  Tree Structure Model, 128–30
use cases, 57–9, 60–71, 92–3
  event handling, 115–17
  exclusivity of data, 233
  express mini cards, 258–9
  extended access barring, 187
fault management, 266–7
fax services, 265
fixed networks, 145–6
  fleet management, 25, 146, 231, 238
  form factors, 256–60
fourth generation (4G) traffic, 83, 86–90
fragmentation discriminators, 198
fragmentation of solutions, 7–8
fraud control, 164–5
functionality, 4
funding mechanisms, 11
FW Update, 266
gas tank level monitoring, 41–2
gateway GPRS support node (GGSN), 48, 51–2
gateway as network proxy, 98, 103
  gateway scenarios, 144–5, 173–4, 184–5
general-purpose input/output port (GPIO) interface, 261
generalization, 3–4
generic core network mobility management, 183–4
generic packet radio services (GPRS)
  early M2M deployments, 38, 41–2
  ETSI standards, 98
  use cases, 70
GGSN see gateway GPRS support node
global addresses, 202–5
global positioning systems (GPS), 40–1, 267
global regulations, 27
global traffic characterization, 83–90
GlobalPlatform, 291
goods-delivery mechanism, 1
government initiatives, 8, 10–12
GPIO see general-purpose input/output port
GPRS see generic packet radio services
GPS see global positioning systems
green technology, 27
group authentication, 245–7
group identifiers, 155
group-based subscriptions, 153–5
GSM networks
ETSI standards, 98
mobile networks, 147–8, 160–1, 172
use cases, 70
GSMA accreditation, 279
H2H see human-to-human
hardware interfaces, 260–262
header compression, 195–200
healthcare
business of M2M, 24, 31
early M2M deployments, 42–4
use cases, 66–70, 72–3, 77–8, 80, 90
high-level architectures
ETSI standards, 97–100
M2M concepts, 8–10
use cases, 70–74, 90–92
highly integrated modules, 259
hijacking through passive medium overhearing, 225–6, 235–6
Home grid, 17
home location registrar (HLR), 49–50
homecare, 24
horizontal service platforms, 9–10, 16, 96, 298
HSS signaling, 177
HTTP mapping, 217–18
human-to-human (H2H) traffic, 46–8, 159
human-to-machine interfaces, 5
humidity exposure, 274, 287
I²C see inter-integrated circuit bus
IBAKE see identity-based authenticated key exchange
IBE see identity-based encryption
ICCID see integrated circuit card identifiers
ICT see information and communication technologies
identifiers
early M2M deployments, 43–4, 48–9
mobile networks, 151, 155, 165–9
identity-based authenticated key exchange (IBAKE), 242–5
identity-based encryption (IBE), 242–5
idle mode, 184–5
IETF see Internet Engineering Task Force
IID see interface identification
IMEI see international mobile equipment identity
IMS see instant messaging service
IMSI see international mobile subscription identifiers
information and communication technologies (ICT), 3, 5
infotainment, 25
instant messaging service (IMS), 176
insurance markets, 25
integrated circuit card identifiers (ICCID), 168–9
integrity of data, 233, 235
interface identification (IID), 191–2, 197
interface procedures, 131–9
interference isolation, 68–70
inter-integrated circuit bus (I²C) interface, 262
international mobile equipment identity (IMEI), 168–9
international mobile subscription identifiers (IMSI), 50, 167–8, 186
Internet Engineering Task Force (IETF), 14, 17, 122
Internet protocol (IP), 189–220
business of M2M, 26–7
CoRE working group, 210–220
definitions, 189–90
header compression, 195–200
IPv6 basics, 190–192
6LoWPAN networks, 193–205
M2M concepts, 193–4
mobile networks, 170–4
neighbor discovery protocol, 192–3, 200–205
packet formats, 190–191
routing protocol for low-power and lossy networks, 205–10
security, 235–6
smart cards, 290–1
Internet of Things (IOT), 1, 5, 298
interoperability, 1, 3–4, 7–8
intrusiveness, 4
invisibility, 4
IOT see Internet of Things
IP see Internet protocol

key generation functions (KGF), 242–3, 245
Kindle™, 5, 34
KNX protocol, 17

large block transfer, 215–16
late personalization of subscription, 292
legacy cases, 104
lifetime expectancy, 5, 274, 286–7
limited functionality, 4
line grid array (LGA) interfaces, 257–8
link distance, 254–5
link-local (LL) addresses, 202
live video, 78, 80, 90, 146–50
logical device pairing, 284
logistics, 283–4
long term evolution (LTE), 159
lossy networks, 205–10
low-access priority, 182–3
6LoWPAN networks, 193–205
basics, 194–5
broadcast discriminators, 198
fragmentation discriminators, 198
framework, 195
global addresses, 202–5
header compression, 195–200
interface identification, 197
IPHC discriminators, 198–200
link-local addresses, 202
mesh discriminators, 197–8
neighbor discovery protocol, 200–205
low-power networks, 205–10
low-powered devices, 4
low-priority traffic, 184–5
LTE see long term evolution

M2M requirements see use cases
M2M service identity module (MSIM) application, 290
MAC see medium access control
management services, 265–7
mandatory regulatory certification, 16
market evolution, 35
market fragmentation, 27
market size projections, 30–31
mechanical constraints, 287
media synchronization, 146
mediated M2M relationship, 3, 4–5
medium access control (MAC) addresses, 191–2, 204, 223, 225
mesh discriminators, 197–8
middleware, 29–31
MIME types, 115–17, 124
mobile network operators (MNO)
certification, 270–271
eyear M2M deployments, 37–8, 41–2, 46, 48–9
optimization for M2M, 141–4, 152–6
mobile networks, 141–88
3GPP standardization, 151–2
activity models, 149
business of M2M, 23
communication scenarios, 143–5
context, 141–2, 150–151
context data and disconnection, 156
cost reductions, 150, 152–9
data communication patterns, 149–50
data connections for M2M applications, 146–50, 159–60
fixed networks, 145–6
industry maturation, 7
mobile networks (continued)
M2M concepts, 2–3, 142–50
network signaling, 157
numbering, identifiers and addressing, 151, 165–72
optimization for M2M, 150–187
overloading and congestion control, 151, 179–87
security, 165, 174–5
separate network for M2M, 159
trigger optimizations, 147–8, 151, 155, 172–8
user data and time-controlled features, 157–9
value-added services, 150, 159–65
mobile personal monitoring (MPM), 78
mobile station international subscriber directory number (MSISDN), 43–4, 48–9, 167–8
mobile subscriber identification number (MSIN), 168
mobile terminated SMS, 175
mobile virtual network operators (MVNO), 32–4, 222
modules, 253–71
access technology, 254–6
application execution environment, 263–4
application services, 267–8
AT command interface, 268–9
categorization for M2M, 253–60
certification, 16–17, 269–71
connectivity services, 264–5
definitions, 253
generation classification, 255–6
hardware interfaces, 260–262
link distance classification, 254–5
management services, 265–7
physical form factors, 256–60
SDK interface, 269
services, 263–8
software interfaces, 268–9
temperature and durability, 262
MPM see mobile personal monitoring
MSIM see M2M service identity module
MSIN see mobile subscriber identification number
MSISDN see mobile station international subscriber directory number
multicast, 216
mutliplane, 3
mutual authentication, 109, 233, 241–2, 248
MVNO see mobile virtual network operators
NAPT see network address and port translation
NAS signaling, 177
navigation applications, 25
neighbor discovery protocol (NDP), 192–3, 200–205
network address and port translation (NAPT), 170–171
network application registration 132–4
network architecture design, 71–4
network authentication, 234
network coverage, 27
network misalignment, 8
network operators
business models, 32–3, 35
early M2M deployments, 37–8
security, 235
see also mobile network operators
network-requested PDP context activation (NRPCA), 39, 177–8
network reselection, 186–7
network signaling, 157
objective functions, 209
off-peak resource usage, 157–9
open mobile alliance device management (OMA DM), 237–9
operator/company mismatch, 28
overloading
basics, 179–80
control mechanisms, 181–2, 187
early M2M deployments, 46–8
extended access barring, 187
low-access priority, 182–3
mobile networks, 151, 179–87
network reselection, 186–7

packet data protocol (PDP), 38–9, 44–5, 177–8
packet data serving nodes (PDSN), 225–6
packet exchanges, 224–6
packet formats, 190–191
packet-switched (PS) domain, 38, 44, 49, 264–5
PAP see priority action plans
passive medium overhearing, 225–6, 235–6
password-authenticated key (PAK) exchange, 241–5
PCI express mini cards, 258–9
PCM see pulse code modulation
PDP see packet data protocol
PDSN see packet data serving nodes
periodic messages, 214–15
personal emergency response systems (PERS), 77
personal fitness monitoring, 67
personalization of subscription, 292
physical form factors, 256–60
PIN numbers, 237–8
PKI see public key infrastructure
PLC see power-line communication
point of sale (PoS)
early M2M deployments, 46
mobile networks, 146
use cases, 76–7, 80–81, 90
policy initiatives, 8, 10–11
power interfaces, 260
power-line communication (PLC), 13–14
power supplies, 4
pre-provisioned symmetric keys, 241–2
prioritization, 159–62
priority action plans (PAP), 12
privacy, 8, 27, 273–5
proprietary modules, 259–60
proxy caching, 113–14, 117–18
PS see packet-switched
public key infrastructure (PKI), 236–9
pulse code modulation (PCM) interface, 262
pulse width modulation (PWM) interface, 262
quality of service (QoS), 159–62
radio-frequency identification (RFID), 5, 23, 30
radio network controller (RNC), 225–6
radio transmission activity, 70
RADIUS protocol, 44, 46, 84–6
Reachability, Addressing and Repository Capability, 101, 104–5
regular operation modes, 5
Remote Entity Management Capability, 102, 106–8
remote management, 289–94
remote monitoring devices (RMD), 69–70
remote patient monitoring (RPM), 24, 66, 69, 77
removable credentials, 224–5
removable smart cards, 281–3
removable UICCs, 284
representational state transfer (REST), 110–124
additional functionalities, 115–24
application to M2M, 110–112, 114–15
basics, 110, 113–14
caching, 218–19
CoRE working group, 210, 217–20
device configuration, 119–20
dynamic URL generation, 120–122
event handling, 115–17
HTTP mapping, 217–18
M2M concepts, 16
proxy caching, 113–14, 117–18
relationship with other standards, 122–4
resource discovery, 219–20
sensors, 110–120
resource-based M2M communication and procedures, 124–39
definitions, 126
interface procedures, 131–9
resource-based M2M communication and procedures (continued)
resource structures, 126–30
resource types, 127–8
smart metering, 132–9
Tree Structure Model, 128–30
resource discovery, 219–20
resource structures, 126–30
REST see representational state transfer
retail, 31, 45, 76–7
return on investment (ROI), 26–7, 35
RFID see radio-frequency identification
RNC see radio network controller
routing protocol for low-power and lossy networks (RPL), 205–10
basics, 205–7
metrics and rank calculation, 209–10
neighbors and parents, 207–9
objective functions, 209
topology, 207–10
RPM see remote patient monitoring
SCADA see supervisory control and data acquisition
scalability, 117–18, 234
SDK interface, 269
second generation (2G) traffic, 83–6
secure element distribution and logistics, 283–4
secure UICC-host channels, 284–5
security, 221–51
access network providers, 232–3, 248–50
application service providers, 233–4, 248–50
bootstrapping, 234–9, 242–5, 248–50
business of M2M, 27, 31, 228–31
certification, 278–9
comparative assessment of methods, 277
customer/device user requirements, 228–32
detection and prevention solutions, 235–47
early M2M deployments, 44–5
embedded secure elements, 281–5, 293
environmental factors, 274, 285–7
grounds for hardware-based security systems, 275–6
groups of M2M devices, 245–7
hijacking through passive medium overhearing, 225–6, 235–6
identity-based encryption, 242–5
independent secure elements, 276–81
industry maturation, 8
logical device pairing, 284
M2M concepts, 222–6
mobile networks, 165, 174–5
modules, 267
pre-provisioned symmetric keys, 241–2
public key solutions, 236–9
remote management, 289–90, 291–4
requirements for M2M, 228–35
sample attacks, 223–6
secure element distribution and logistics, 283–4
secure UICC-host channels, 284–5
service restriction, 285
standardization, 247–50
theft of removable credentials, 224–5
toolkit commands, 287–9
trust relationships in M2M, 227–8, 276–9
use cases, 76, 80–81, 90, 222–3
Security Capability, 102, 108–10
selective throttling, 184–5
self-diagnostics, 266–7
sensors, 110–120
serial peripheral interface (SPI), 262
service capabilities (SC), 8, 97–110, 125–39
service layers, 9–10, 16
service providers see application service providers; communications service providers
service restriction, 285
shock conditions, 287
short messaging service (SMS)
early M2M deployments, 38–9, 41–2, 49
mobile networks, 175
modules, 264
use cases, 66
signatures, 236–7
SIM cards, 146, 165
simple object access protocol (SOAP), 123–4
advantages, 279–81, 293
certification, 278–9
comparative assessment of methods, 277
early M2M deployments, 292
embedded secure elements, 281–5, 293
environmental factors, 274, 285–7
future evolutions, 290–291
grounds for hardware-based security systems, 275–6
independent secure elements, 276–8, 291–4
open issues, 294
remote management, 289–94
removable, 281–3
secure element distribution and logistics, 283–4
secure UICC-host channels, 284–5
security and privacy, 273–5
service restriction, 285
specific properties for M2M, 281–90
standardization, 293
toolkit commands, 287–9
trust relationships in M2M, 276–9
smart metering
business of M2M, 25
container resources, 137–9
deployment scenarios, 62–6
device application registration, 135–7
ETSI standards, 132–9
M2M concepts, 2
network application registration, 132–5
security, 228–9
traffic modeling and characterization, 79–83, 90
use cases, 60–66, 72–3, 75–6, 79–83, 90
smart telemetry, 41–2, 75–6, 80–81, 90
SMS see short messaging service
SOAP see simple object access protocol
software interfaces, 268–9
solder-down modules, 257–8
SPI see serial peripheral interface
subscription management, 162, 292–4
supervisory control and data acquisition (SCADA), 23
surveillance
early M2M deployments, 44–5
mobile networks, 146–50
use cases, 76, 80–81
system applications, 30–31
system integrators, 29
TAC see type allocation code
TCP see transport protocol
technological challenges, 28
telecom industry certification, 270
telephone numbers, 165–8
temperature range of operation, 262, 274, 287
terminals, 16–17, 253
see also modules
testing and certification see certification
theft prevention, 25
theft of removable credentials, 224–5
third generation (3G) traffic, 83, 86–7
third party applications, 289–90
Third-generation Partnership Project (3GPP)
mobile networks, 151–2, 173–4
security, 249
smart cards, 281
standards, 12, 14–15, 18–19
use cases, 57–8
throttling, 184–5
time-controlled features, 157–9
toll payment, 25
toolkit commands, 287–9
traffic identification, 50, 52
traffic modeling and characterization, 71–4, 79–90
transport protocol (TCP), 212–16
transportation
devolution, 25, 31
early deployments, 40–41
mobile networks, 146
use cases, 72–3, 74–5, 80–81, 90
Tree Structure Model, 128–30
triggers
basics, 147–8, 172–5
cell broadcast, 176–7
group-based, 155
IMS messages, 176
mobile terminated SMS, 175
network-requested PDP context
activation, 177–8
NSS and NAS signaling, 177
optimization, 151, 155, 172–8
trust relationships in M2M, 227–8, 276–9
type allocation code (TAC), 168–9
UMTS networks, 147–8, 160–161, 172
universal asynchronous
receiver/transmitter (UART)
interface, 260–261
universal integrated circuit card (UICC)
interface
environmental constraints, 285–7
environmental factors, 285–7
future evolutions, 290–291
modules, 261
remote management, 289–90
removable UICC with logical device
pairing, 284
secure UICC-host channels, 284–5
service restriction, 285
smart cards, 279–83, 284–91
theft of removable credentials e, 224–5
toolkit commands, 287–9
universal serial bus (USB) interface, 260
unknown devices, 278–9
use cases, 9
definitions, 58
deployment scenarios, 62–6
development methodology, 59–60
ETSI standards, 57–71, 92–3
healthcare, 66–70, 72–3, 77–8, 80, 90
high-level architectures, 70–74, 90–92
market segment applicability, 70–73
security, 222–3
smart metering, 60–66, 72–3, 75–6, 79–83, 90
template, 59–60
traffic modeling and characterization,
71–4, 79–90
user data, 157–9
value chain, 28–31
value-added services
billing and subscription management, 162
business of M2M, 31
connection monitoring, 163–4
device management, 163
fraud control, 164–5
mobile networks, 150, 159–65
QoS and priority, 159–62
security, 165
variety, 3–4
vehicle maintenance, 25
vehicle-tracking, 40–41
vending machines, 77, 80–81, 90, 146
vibration conditions, 287
voice services, 228, 230, 265
voluntary certification, 16
wakeup services, 264
wired access technology, 254
wireless access technology, 254–6
wireless IP networks, 26–8
wireless networks, 71–4
wireless sensor networks (WSN), 193
Yankee Group, 95
ZigBee alliance, 17, 23, 28, 194
Zwave, 23, 28