

# Index

## A

AB-detect vs. GAB-detect, 120–121

Adaptive approach

B-detect vs. AB-detect, 116–117

parameter tuning and optimisation,  
113–116

protocol description, 112–113

## B

Backlog Markov chain, 17–18

Baseline approach

parameter tuning and optimisation,  
109–111

protocol description, 109

B-detect vs. AB-detect, 116–117

Bloom filter-based missing tag detection

protocol (BMTD), 4

actual reliability, 99–102

design rational and protocol, 83

expected detection time, 91–94, 100, 102

missing tag detection, 84

parameter setting, 94

unexpected tag deactivation, 83–84

vs RUN, 99–102

worst-case execution time, 90–91

## C

Code Division Multiple Access (CDMA), 8

Cumulative sum control chart (CUSUM), 44

## D

*de facto* standard, 2

## E

Error-prone channel, 70

extended Kalman filter (EKF), 47–48

## F

Frame Slotted Aloha (FSA)

Backlog Markov chain, 17–18

CDMA, 8

context and motivation, 7–8

contributions, 8–9

FSA-MPR

numerical results, 32–35

packet success probability, 13

results, 16–17

stability, 9–10, 27–28

system behavior, 29–31

FSA-SPR

Backlog Markov chain, 17–18

numerical results, 32–35

packet success probability, 12–13

results, 15–16

stability analysis, 19–24

system behavior, 24–26

Kalman filter-based estimator, 32

Lemma 2.3 proof, 35–37

Lemma 2.6 proof, 37–40

Lemma 2.7 proof, 40–41

MIMO, 8

M2M networks, 7

notations, 14

packet success probability, 12–13

performance analysis, 11

physical layer, 10–11

Poisson distribution, 31

Frame Slotted Aloha (FSA) (*cont.*)

- random access model, 11
- results, 13–17
- RFID systems, 7
- stability, 9
- traffic model, 11–12

## FSA stability, 2–3

**G**

## Group wise approach

- AB-detect vs. GAB-detect, 120–121
- parameter tuning and optimisation, 118–120
- protocol description, 117–118

**L**

## Listen-before-talk mechanism, 81

**M**

## Machine-to-Machine (M2M) networks, 7

## Missing tag detection

- bloom filter, 81

## BMTD

- actual reliability, 99–102
  - design rational and protocol, 83
  - expected detection time, 91–94, 100, 102
  - missing tag detection, 84
  - parameter setting, 94
  - unexpected tag deactivation, 83–84
  - vs RUN, 99–102
  - worst-case execution time, 90–91
- deterministic protocol, 78, 80
- enforcing detection reliability, 97
- estimation error, 96
- estimation protocol, 79
- fast detection, 95–96
- identification protocol, 79
- listen-before-talk mechanism, 81
- motivation, 77–78
- multi-reader case, 97
- probabilistic protocol, 78, 80
- problem formulation, 81–82
- system model, 81
- tuning parameters
- expected detection time, 91–94
  - parameter setting, 94
  - phase 1, 85–87
  - phase 2, 87–89
  - worst-case execution time, 90–91
- unexpected tags, 77, 78
- Worst- $M$  and Expected- $M$ , 98–99

## Multi-group multi-region systems, missing tags

## adaptive approach

- B-detect vs. AB-detect, 116–117
- parameter tuning and optimisation, 113–116
- protocol description, 112–113

## baseline approach

- parameter tuning and optimisation, 109–111
- protocol description, 109

## bloom filter, 106

## design rational, 108

## groups of tags, 105

## group wise approach

- AB-detect vs. GAB-detect, 120–121
- parameter tuning and optimisation, 118–120
- protocol description, 117–118

## interrogation regions, 105

## notations, 107

## performance evaluation

- asymmetric scenario, 124–125
- impact of nonidentical  $M_g$ , 125–126
- symmetric scenario, 123–124

## problem formulation, 107

## simulation settings, 123

## system model, 106–107

## tag population, 121–122

## unknown and unexpected tags, 122

## Multipacket reception (MPR), FSA

- numerical results, 32–35
- packet success probability, 13
- results, 16–17
- stability, 9–10, 27–28
- system behavior, 29–31

## Multiple-Input and Multiple-Output (MIMO), 8

**P**

## Packet success probability

- MPR technology, 13
- SPR technology, 12–13

**R**

## Radio frequency identification (RFID) technology

- BMTD, 4
- compatibility and implementability, 132
- de facto* standard, 2
- energy efficiency, 130–131
- Internet of Things (IoT), 129

- overview, 1–2
- security and privacy, 132
- tag counting, 3
- tag monitoring, 4
- unique serial number (ID), 1

**S**

- Single packet reception (SPR), FSA
  - Backlog Markov chain, 17–18
  - numerical results, 32–35
  - packet success probability, 12–13
  - results, 15–16
  - stability analysis, 19–24
  - system behavior, 24–26

**T**

- Tag counting, 3
- Tag monitoring, 4
- Tag population estimation
  - algorithm, 50–55
  - boundedness of stochastic process, 48–49

- context and motivation, 43–44
- contributions, 44
- CUSUM test, 55–57
- dynamic case, 65–69
- dynamic RFID systems, 45–46
- error-prone channel, 70
- extended Kalman filter, 47–48
- measurement model, 51–52, 54
- multi-reader case, 70
- notations, 46
- numerical analysis
  - algorithm performance, 72–74
  - algorithm verification, 71–72
- static case, 58–65
- static RFID systems, 45
- system dynamics, 51–52, 54
- system model, 50
- unique serial number (ID), 43

**U**

- Unique serial number (ID), 1, 43