# List of Figures

1.1 Area of research problem .............................................. 12

2.1 Sleep scheduling schemes: (a) Always ON, (b) Rotational, (c) Greedy, (d) Event triggered wakeup .................................................. 23

2.2 Power consumption and idle periods of a processor (a) without DVFS, (b) with DVFS ................................................................. 26

2.3 DMS concept ................................................................. 28

3.1 Basic blocks of a sensor node ........................................... 36

3.2 ON period divided in to slots ........................................... 37

3.3 Wireless sensor node having DVFS and DMS without coordination .... 38

3.4 Coordinated power management concept as given in [138] .......... 39

3.5 Concept of CAP management on Wireless Sensor Node ............ 41

4.1 Tandem queue model of Wireless Sensor Node ..................... 44

4.2 Sensor node model with DVFS and DMS ............................. 51

4.3 Input and output buffer lengths during time slots 1 to 100 .......... 53

4.4 Input and output buffer lengths during time slots 170 to 270 ....... 53
4.5 Coordinating DVFS and DMS ................. 54
4.6 Buffer overflow probabilities during catastrophe ........ 58
4.7 Buffer overflow probabilities during normal period ........ 59
4.8 Average idle time probabilities .................. 59
4.9 Comparison between fixed service rate and variable service rate sensor node in normal time period ................. 61
4.10 Comparison between fixed service rate and variable service rate sensor node in catastrophe period ................. 61
4.11 Various threshold policies ...................... 64
4.12 Comparison of a sensor node using fixed threshold policy and adaptive threshold policy ....................... 65
5.1 Late arrival system .................................. 68
5.2 Coordinated Rate Adaptive model of Wireless Sensor Node ............. 68
5.3 Flowchart for a two service rate capability sensor node ................. 70
5.4 Markov chain model of a rate adaptive wireless sensor node .......... 72
6.1 Components of GSPN ............................... 83
6.2 Wireless Sensor Node with fixed service rate ................. 84
6.3 Wireless Sensor Node with only DVFS .................. 88
6.4 Wireless Sensor Node with only DMS .................. 89
6.5 Wireless Sensor Node with coordinated DVFS and DMS ............. 90
6.6 Wireless Sensor Node with fixed battery capacity and fixed service rate 91
<table>
<thead>
<tr>
<th>Figure</th>
<th>Description</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>6.7</td>
<td>Wireless Sensor Node with fixed battery capacity and multiple service rates</td>
<td>91</td>
</tr>
<tr>
<td>6.8</td>
<td>Performance of a sensor node with only DVFS and only DMS</td>
<td>98</td>
</tr>
<tr>
<td>6.9</td>
<td>Performance of a sensor node with fixed service rate</td>
<td>100</td>
</tr>
<tr>
<td>6.10</td>
<td>Performance of a sensor node with multiple service rates</td>
<td>101</td>
</tr>
<tr>
<td>6.11</td>
<td>Comparison between fixed service rate and multiple service rates</td>
<td>102</td>
</tr>
<tr>
<td>6.12</td>
<td>Comparison between fixed service rate and multiple service rates for (a) buffer overflow prob. and (b) lifetime</td>
<td>102</td>
</tr>
<tr>
<td>7.1</td>
<td>Current consumption of microcontroller in ATmega128RFA1 [162]</td>
<td>104</td>
</tr>
<tr>
<td>7.2</td>
<td>Clock frequency switching from 8 MHz to 1 MHz</td>
<td>105</td>
</tr>
<tr>
<td>7.3</td>
<td>Clock frequency switching from 1 MHz to 8 MHz</td>
<td>106</td>
</tr>
<tr>
<td>7.4</td>
<td>Current consumption of radio transceiver in ATmega128RFA1 [162]</td>
<td>111</td>
</tr>
</tbody>
</table>