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A Review Paper on Low Efficient Wireless Communication Network Design

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***Abstract:*-Technological advances in wireless communication paved way to the development of tiny low-cost, low-power and multi-functional sensor nodes in the wireless sensor networks. Wireless Networks have become popular due to the concept of "3 any"- any person, anywhere and anytime. The design of sensor network is influenced by factors like scalability, energy consumption, environment etc. and depends on the application. Of the three activities: sensing, processing and communication, most of the energy is spent on communication purposes. Energy conservation is thus a dominant factor in wireless sensor networks. Routing strategy selection is very important for proper delivery of packets. Ongoing research aims in extending network lifetime by designing protocols that requires less energy during communication. An energy harvesting wireless sensor networks is a solution against the drainage of energy in battery powered networks since renewal of energy is too expensive. Energy harvesting make use of nodes that are able to harvest energy from the environment. This paper provides a survey on energy efficient routing in wireless sensor networks and introduces the concept of energy harvesting in wireless sensor networks.**

INRODUCTION

The Energy-efficient in wireless communication network design is an important and a challenging problem. It is important because the mobile units operate on batteries with the limited energy supply. It is challenging because there are the many different issues that must be dealt with designing a low-energy wireless communication system (e.g.,in amplifier design, coding, in modulation design, resource allocation, and the routing strategies), and these issues are coupled with the one another. Furthermore, the design and the operation of the each component of wireless communication system presents the trade-off between the performance and the energy consumption. The key observation is that the constraining energy of the nodes in the wireless network imposes a coupling among the design components that can't be ignored in performing the system optimization.

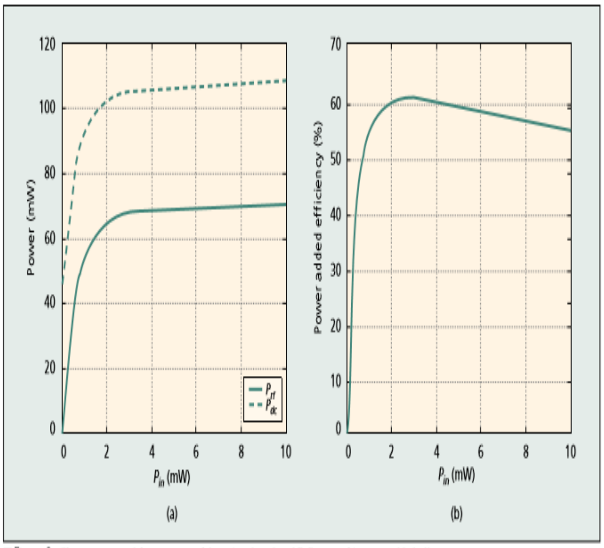
A DESIGN EXAMPLE: MODELS FOR SYSTEM DECOMPOSITION

We apply our integrated design methodology for the particular network design problem, namely, the situational awareness problem inthe wireless mobile networks. In situational awareness problem a number of the mobile nodes desire to keeps the track of location of each other over some time duration. The nodes operate with the batteries and thus have a finite energy constraint. The transmission of the information by a node requires a certain amount of the energy as does the processing of theany received signal. The goal is to minimize the mean absolute error of the position estimates. There is a plethora of the parameters that could be considered for the optimization. We focus on a thesmall set of parameters to illustrate the design and the simulation methodology. In addition, we describe the system decomposition and justify our choice of the coupling parameters among the different layers. We proceed to describe the each layer in a bottom-up manner.

THE DEVICE LAYER

At the device layer, we assume that the each node has an omni-directional dipole antenna and small power amplifier. Because the power amplifier is major source of the energy consumption and our global objective is to achieve the high-precision situational awareness (i.e., the low estimation errors) for every node under an energy constraint, it is important to understand role of amplifier power added efficiency in overall optimization problem. Let P_{IN}be the input power, P_{RF}be the radiated power, and be P_{DC} the consumed DC power. The power added efficiency is defined as

$$\text{Power added efficiency} = (P_{RF-} P_{IN)}/ P_{DC}$$



. Figure 3. Characteristics of the power amplifier: a) radiated and DC power; b) power added efficiency.

The characteristics of power amplifier [7] shown in Fig. 3 and are tabulated for use at the processing layer. From Fig. 3 we see that the input/output relation of power amplifier is fairly linear when input power is small. However, amplifier operates at the very low efficiency. When input power is large, the amplifier operates at the higher efficiency, but with the large input-output nonlinearity. This nonlinearity generates the in-band and out-of-band signals known as intermodulation signals, which adversely affect the performance of processing layer, which in turn indirectly affects the design of network layer protocols.

THE PROCESSING LAYER

The basic block diagram representation of the processing layer is shown in the Fig. 4. A block of theinformation is presented to a channel encoder. The channel encoder adds redundancy to protect against the channel errors. The output of channel encoder is interleaved, modulated, and the spread -in bandwidth. The resulting signal is amplified by the power amplifier (PA) and the transmitted. At the receiver, inverse operations are needed to accurately recover the block of the information. While each of these operation consumes power inorder to process the data or the signal, we focus on energy being consumed bythe power amplifier, demodulator, and the channel decoder. We focus on these elements, since they consume much more energy than the other elements in system. Thus, we focus on performanceenergy trade-off of the demodulator and the decoder**.**

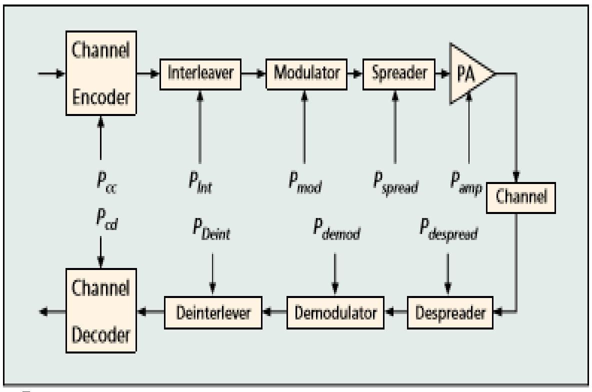


Figure 4. *A processing layer block diagram.*

NETWORK LAYER

Here we consider a network of the nine nodes. All nodes move according to the specific mobility model. In the situational awareness problem, the each node attempts to keep the track of positions of all the other nodes. This is accomplished by the communication and estimation. All nodes share their respective position of information according to a specific communication protocol..

Mobility Models —Herewe describes the two mobility models that we use in the various optimization problems we consider. In theboth mobility models, the each node in network moves to the new location at the end of every Tm s. In the examples we considerT_m= 1.

In mobility model 1, we consider a region ofsize 6 km × 6 km and a group ofthe nine nodes initially deployed in the area as shown in Fig. 6a. All nodes travel towards the same destination which is located at G = (6000, 6000) m. Each node travels at the average speed ofv, where v = 1m/s (not drawn to scale in Fig. 6a). At each step, each node's motion is subjected to a random disturbance in the x and y coordinates. In mobility model 2, all the nodes are initially deployed in the region of size 1332 × 1332 m and move within the region as shown in Fig. 6b. The mobility of the each node is characterized by the twostate discrete-time Markov chain as shown in the Fig. 7, where the two states are labeled in the stay and move. In each of these states, the each node's motion is subjected to the random disturbance in the x and they coordinates.

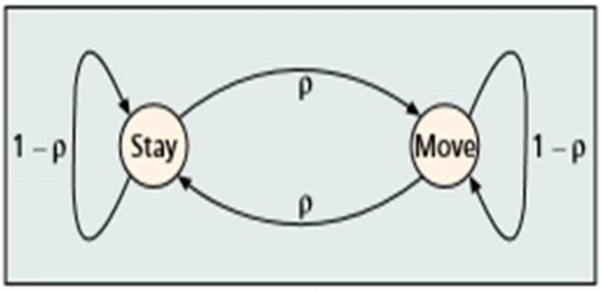


Figure 7. *The Markov chain for mobility model 2, ρ = 0.05.*

Propagation Model — The transmitted signal from the each node experiences propagation loss and the fading. In the results that follow, we assume the twopath propagation model. The Table 1 shows the variables and their typical values that are needed to explain the model. The two path propagation model consists of the direct path and thepath reflected off the ground with 180˚ phase change at reflection point from the transmitter to receiver.

Variable	Meaning	Value	Unit
λ_c	Carrier wavelength	10	m
h_t	Height of transmitter antenna	1	m
h_r	Height of receiver antenna	1	m
G_t	Gain of transmitter antenna	1	–
G_r	Gain of receiver antenna	1	–
d	Propagation distance	(0, 9000)	m
P_t	Transmitted power	$[10^{-7}, 1]$	W
P_r	Received power	(Eq. 5)	W

Table 1. *Variables used in wireless system modeling.*

Communication Protocols — In this describesthe medium access control strategy as well as the routing protocols. We consider two communication protocols: a single-hop transmissionprotocol (which may be considered a single-hop routing protocol) and a multihop routing protocol. For both communication protocols, the omni-directionality of the antenna at each node makes the potential connections among thenodes point-to-multipoint, that is, if the node sends out a packet, the electromagnetic wave will propagate inall the directions and may be received by the many other nodes. Therefore, in the design of the wireless communication protocols, the communication occurs in thebroadcast medium, which is very different from the traditional wired networks, where the connections are most commonly from point-to-point. This omni-directionality property of antenna can be exploited in situational awareness scenario under the consideration.

Single-Hop Transmission Protocol — In single-hop transmission protocol, each node transmits its position information packets in every T s, where T is the design parameter. The MAC is time-division multiple access (TDMA), where each node is assigned for transmission slot of the duration T/N, where N = 9 in case, as shown in the Fig. 8. The slot duration is much larger than the packet duration. In the given slot, each packet transmission is followed with the probability q, by the re-transmission, and so forth, until the slot ends. The re-transmission probability q is considered by the design parameter.1 Since the each node operates on battery with the limited capacity, we constrain energy used for the each packet transmission or re-transmission to be upper bounded by the Ect, which we consider the design parameter.

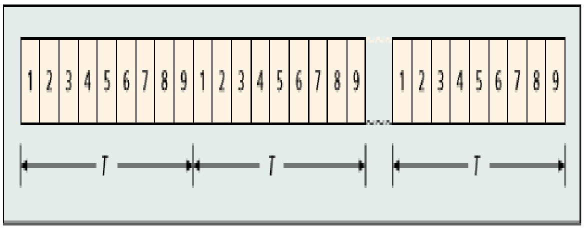


Figure 8. *TDMA for single-hop transmission protocol.*

CONCLUSION

We propose an integrated design methodology that can be applied to the optimization of the situational awareness problem in ad hoc mobile wireless networks. We gives evidence of why the integrated design methodology performs the other design methodologies that do not account for the exploit coupling among layers. This evidence is supported bythe simulation experiments. Since the optimization and the simulation at the processing and device layer are done by offline mode, the complexity and scalability of the integrated design are almost the same as those of the network layer design. Therefore,the integrated design can be applied to any network layer design as long as such network layer design is feasible. In the future research, it would be one of interest to classify the other cases where an integrated design approach leads to the large performance gains over the traditional approaches.

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