Improved Application of Wireless Sensor Network in Fighting Bushfires

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I. ABSRACT

The spread of housing into forests has substantially increased the risks to lives and properties imposed by wildfire [1]. In February 2009, the Victorian bushfire in Australia claimed 173 lives. It destroyed and damaged 9723 properties [2]. Recently in the U.S., the California bush fires destroyed 50 homes and 10 commercial buildings and claimed the lives of two firefighters [3].

Wireless Sensor Networks (WSNs) can be efficiently used for monitoring wild fire[4, 5]. Existing protocols do not change their state when a crucial event occurs in the network domain. These protocols cannot adopt themselves to new conditions of the network environment which can dramatically change the network layout as well as the area that is being monitored. For example, a wildfire damages nodes of a WSN established in forest or bush area. In this case, the topology of the network during and after fire event is different from the initial topology of the network before the fire.

In this research a new adaptive protocol with real time management capabilities is introduced for WSNs. This protocol provides network with the ability to change its transmission rules and types of transmitted data as the environmental condition changes. The proposed protocol is inspired by the fact that fire destroys most of the nodes that are captured or close to be captured. Therefore, the new protocol utilizes the energy of the nodes closer to the fire for tasks with higher priorities. Such tasks can be monitoring the fire more accurately or sensing the fire related measures only. This is basically a new state that all nodes are switched to. Under the new state, other nodes are adopted for reporting the fire event. This means that they intelligently switched off their normal activities and concentrate on reporting the emergency event or fire.

MATLAB was used to simulate the network, energy consumption, latency and efficiency of transmitted data. It was shown that the proposed State Aware Protocol (SAP) can improve performance and latency of the network when a wildfire occurs.

Figure 1 shows an example which includes three nodes in a 100m×100m area that is covered by 100 nodes. If fire happens in the network, existing protocols would not change their transmission procedure and node 2 has to send its data through 23 hops to reach node 1 and consequently the Fusion Center (FC). Node 3 needs to pass 16 hops to reach FC. Furthermore, types of the data transmitted using these protocols remain unchanged. SAP makes fire routs 1 and 2 as shown in fig 1. Now node 2 can communicate with node 1 through only 1 hop and node 3 through 13 hops which is equivalent to reduction in number of hops and hence the delay of the data transmission. Finally, types of the transmitted data have increased.

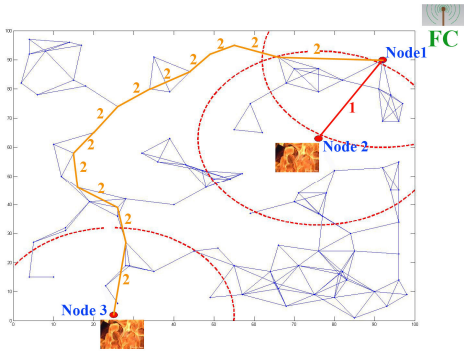

Fig 1. Three sample nodes and their new route to FC after fire occurs in the network

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