IV. ILLUSTRATIVE APPLICATION FOR MMSNs

Fig. 2 is an illustrative application of enabling location-aware mobile multimedia services for healthcare. In this application, Tom is an old person and needs care. He owns a smart house, where three RFID readers are deployed at the proximity of the three entrances to his house. A certain number of sensor nodes are deployed in his house to detect environmental parameters. In addition, there is a mobile multimedia sensor node, which is equipped with camera, as shown in Fig. 2. To save energy, mobile node is powered off if no tasks are detected.

Once Tom enters his house through one of the entrances, his ID information stored in his tag will be transmitted to the nearby RFID reader. With the awareness of Tom’s ID, the mobile node is activated. The system will periodically collect the three RSSI (received signal strength indication) values from the three RFID readers (i.e., RFID reader 1, RFID reader 1, and RFID reader 3 in Fig. 2) to estimate the location of Tom. Assume the result of RFID-locating is living room, the mobile node will move to living room to take video for Tom. Due to his requirements for patient care, every details of his activities in specific rooms (i.e., living room and study room) need to be video recorded. The video streaming is forwarded to the local video server through the access point. These video images are time-stamped and stored in a directory associated with Tom’s profile. When Tom moves from living room to study room, the result of RFID-locating will be changed to study room, and thus the mobile node will follow Tom to study room.

In this system, the vital signals of Tom are collected by body sensors. These body signals are subsequently updated into the database through sensor node(s) and/or access point. Any abnormalities that do not require immediate treatment may be logged into the database, and registered by Tom’s RFID tag for future reference. Based on these body signals, a diagnosis might indicate more complicated multimedia information is needed to further ensure the accuracy of the diagnosis. On the other hand, the resolution of the camera in the mobile node can be adaptively adjusted by the severity of diagnosis result according to the contextual information (e.g. Tom’s profile, behaviors, body signals, and environmental parameters, etc.). It might be possible for the doctor to remotely diagnose Tom immediately through the real-time video communications through the mobile node, as well as the physiological data information retrieved by a wireless body area network hosted by Tom. It’s critical for the mobile node to approach to the object in a timely and energy-efficient fashion.

V. MOBILE MULTIMEDIA GEOGRAPHIC ROUTING

Since our design goal is to effectively support the multimedia service in MMSNs, we consider the performance in terms of both delay and energy. First, the delay guaranteeing is treated as the goal with top priority for the QoS provisioning. Then, the energy consumption should be minimized to enlarge the life time of sensors. This motivates to exploit the energy-delay tradeoffs for the design of mobile multimedia geographic routing (MGR) scheme.

A. Analysis of Delay-Energy Tradeoffs

1) Analysis of One-Hop Delay: In this section, we analyze the latency between two neighboring nodes, which is the summation over the queuing, processing, propagation, and transmission delays:

- **Queuing delay**: For the sake of simplicity, we assume a stable packet rate in our network. Then, queuing delay is considered to be a constant for each hop, which is denoted by \( T_q \).
- **Processing delay**: With respect to processing delay, we assume that each node incurs similar delay to process and forward one packet with constant length. The processing delay is denoted by \( T_p \).