Surface acoustic wave (SAW) sensors provide versatility in that they can offer wireless, passive operation in numerous environments. Various SAW device embodiments may also be employed for retrieval of the sensed data. Single sensor systems typically use a single carrier frequency and a simple device embodiment since tagging is not required. However, it is necessary in a multi-sensor environment to both identify the sensor and retrieve the information. Overlapping sensor data signals in time and frequency present problems when attempting to collect the sensed data at the receiver. This dissertation defines a system simulation environment exclusive to SAW sensors. The major parameters associated with a multi-device system include the transmitter, the channel, and the receiver characteristics. These characteristics are studied for implementation into the simulation environment. A coupling of modes (COM) model for SAW devices is utilized as an accurate software representation of the various SAW devices. Measured device results are presented and compared with COM model predictions to verify performance of devices and system. Several coding techniques to alleviate code collisions and detection errors were investigated and evaluated. These specialized techniques apply the use of time, frequency, and spatial diversity to the devices. Utilizing these multiple access techniques a multi-device system is realized. An optimal system based on coding technique, frequency of operation, range, and related parameters is presented. Funding for much of this work was provided through STTR contracts from NASA Kennedy Space Center.