

CHAPTER THREE

SYSTEM DESIGN

3.1 System Description

In this chapter the proposed architecture and its implementation will be described in details in addition to the circuit that handles the signal flow and the interconnection between organizations. For a better understanding, it should be noted that software architecture refers to the idle design of the system.

The system takes two organizations as an example to be explored in real application field. The design is an easy way to interconnect between both organizations regardless of different technology or frequency bands.

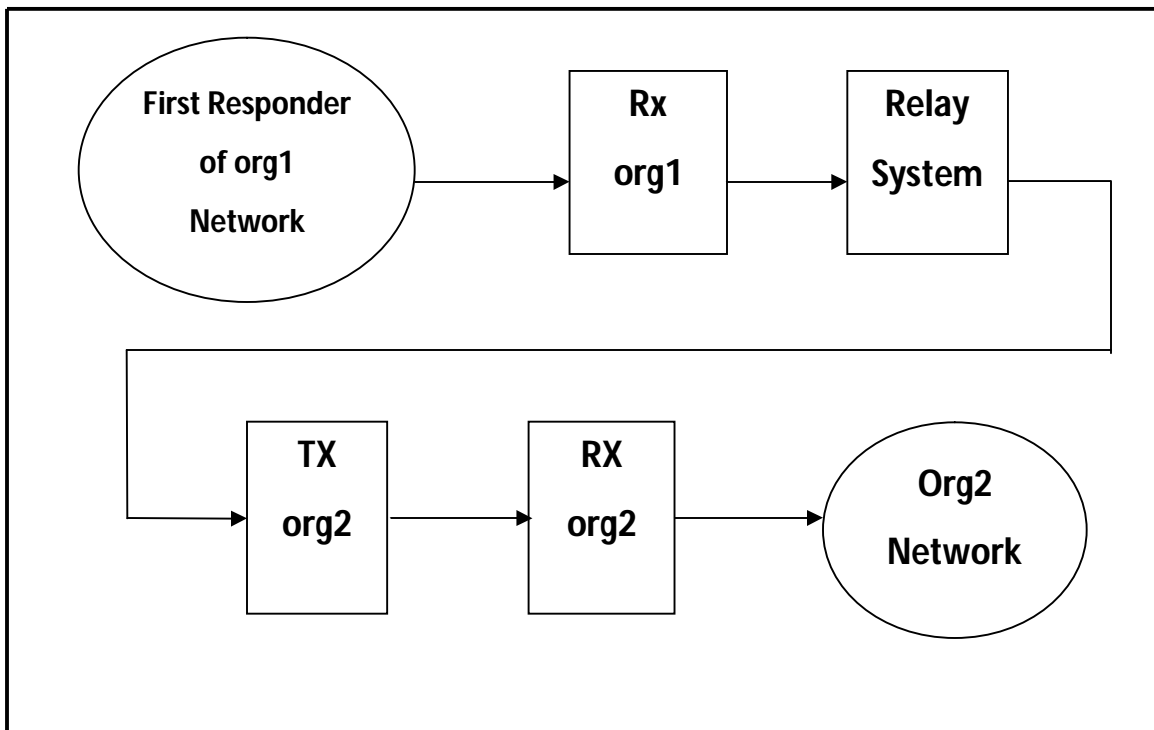


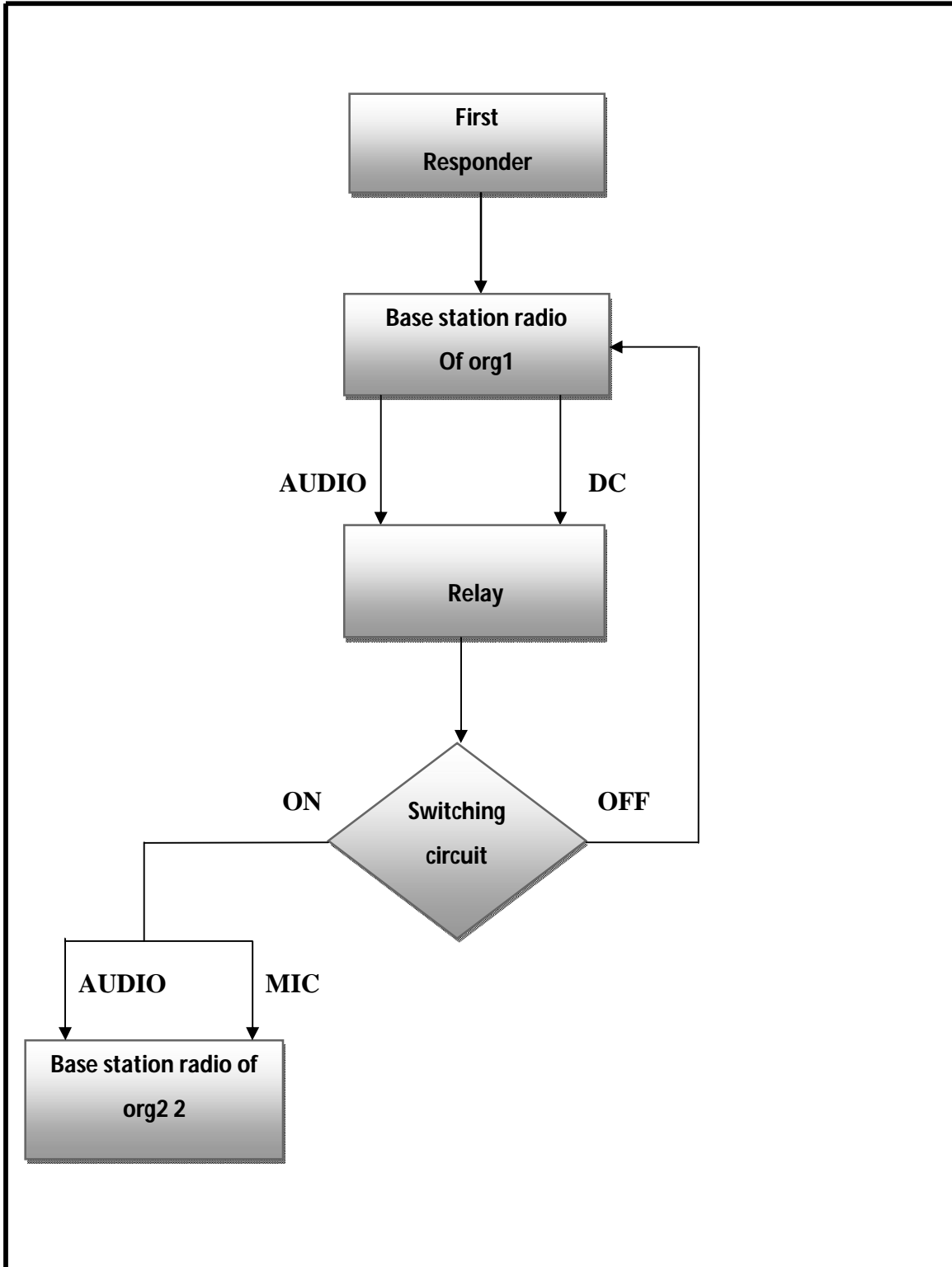
Figure 3.1: Block Diagram

The above block diagram shows how the interconnection between two different organizations with different infrastructure is done. The first responder could be a (police officer, fireman, traffic policeman and even an ER operator) etc. (org 1) and (org2) are public safety organizations such as police department, military, coastal police, fire department. The relay control is a relay system to interconnect the two organizations together.

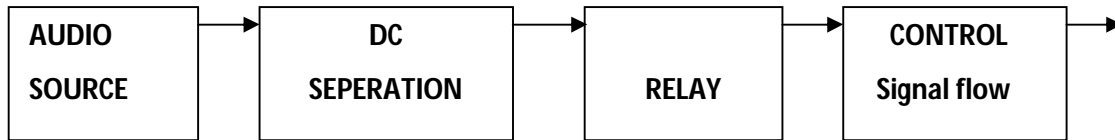
When any first responder from organization 1 wants to convey a message in an emergency situation the push-to-talk button of a transceiver device is pressed to convey an information, this information will be received by the RX radio of organization 1 which will also at the same time triggers the transmitter of organization2 so that all members within organization 2 can receive. This process will be done by a relaying circuit which will extract the audio portion in the RX radio of organization 1 and relay it to the TX radio in organization2; in this case the two organizations will seem as if they are in one network (interconnection).

The below flow chart illustrates the signal flow starting from the first responder of organization 1 through the relay and to switching circuit to the radio of organization 2.

Flow chart:



3.2 System Implantation



3.2.1 Audio source

The Audio source is the first responder who needs interconnection with another organization.

3.2.2 DC Separation

Audio signal contains a dc voltage; the separation of the DC voltage is done to make use of DC for controlling the signal flow.

The Capacitor is a passive two-terminal electrical component used to temporarily separate the DC for the audio signal. The forms of practical capacitors vary widely, but most contain at least two electrical conductors (plates) separated by a dielectric. The conductors can be thin films, foils or sintered beads of metal or conductive electrolyte.

Capacitor used in the design is made of ceramic, and has capacitance value of 1 microfarad.

3.2.3 Relay

A relay is an electrically operated switch uses an electromagnet to mechanically operate a switch. The Relay is used to control the circuit by a separate low-power signal, or where several circuits must be controlled by one signal. In this design the relay relays the signal coming from the first responder and re-transmitted it on another network where interconnection is needed.

Relays require one pulse of coil power to move their contacts in one direction, and another, redirected pulse to move them back. Repeated pulses from the same input have no effect.

Relay has coil nominal voltage of 12v and coil resistance of 412ohm.

3.2.4 Control of Signal Flow

The Audio signal is applied to the relay, therefore the relay is controlled to pass signal or not.

A transistor is a semiconductor device used to control the signal coming from the relay. It is composed of semiconductor material. A voltage or current applied to one pair of the transistor's terminals controls the current through another pair of terminals. Because the controlled (output) power can be higher than the controlling (input) power.

Because a transistor's collector current is proportionally switch. Limited by its base current, it can be used as a sort of current-controlled, which then controls the signal flow from relay.

The Transistor is a NPN type biased by the separated dc voltage from the audio signal with the value of 5volt.

Transistor base current is controlled by variable resistance with a value of 1kohm.

3.2.5 Control of Organization 2 MIC

When the signal passes the relay, the MIC of organization 2 must be ON.

The MIC is controlled by using the NPN transistor, where the press to talk pin of the MIC of organization 2 is connected to the transistor collector, so when the transistor is ON the PTT(press -to -talk)is grounded, this means that the MIC is on.

The Transistor is biased with separated dc voltage from audio which has value of 5 volt and base resistance of 1kohm. And the LED is used to indicate that the MIC is ON.

3.2.6 Modulation and Filterization of the Audio Signal

Modulation of the transmitted audio signal is done by the radio device itself (Motorola radios).

The Design uses frequency modulation where frequency is varied in accordance to the instantaneous amplitude of the modulating signal.

Frequency modulation is chosen for the design for its several advantages that offers:

- **Resilient to noise:** One of the main advantages of frequency modulation that has been utilized by the broadcasting industry is the reduction in noise. As most noise is amplitude based, this can be removed by running the signal through a limiter so that only frequency variations appear. This is provided that the signal level is sufficiently high to allow the signal to be limited.
- **Resilient to signal strength variations:** In the same way that amplitude noise can be removed, so too can any signal variations. This means that one of the advantages of frequency modulation is that it does not suffer audio amplitude variations as the signal level varies, and it makes FM ideal for use in mobile applications where signal levels constantly vary. This is provided that the signal level is sufficiently high to allow the signal to be limited.
- **Does not require linear amplifiers in the transmitter:**
As only frequency changes are required to be carried, an amplifiers in the transmitter do not need to be linear.

- Enables greater efficiency than many other modes:

The use of non-linear amplifiers, e.g. class C, etc means that transmitter efficiency levels will be higher - linear amplifiers are inherently inefficient

3.2.7 Audio Signal Filterization at the Receiver

At the receiver (organization two) audio is needed to be filtered according to its transmitted frequency.

The process is done by radio device filter which enabling the required frequencies to be passed through the circuit, while rejecting those that are not needed radio device uses the band pass filter.