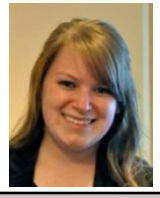
Acknowledgments

- Wayne Burleson, Advisor
- Dan Holcomb, Advisor
- Lt. Thrasher, UMass Police Department
- Officer Sullivan, UMass Police Department
- Suzan Young, UMPD IT Coordinator

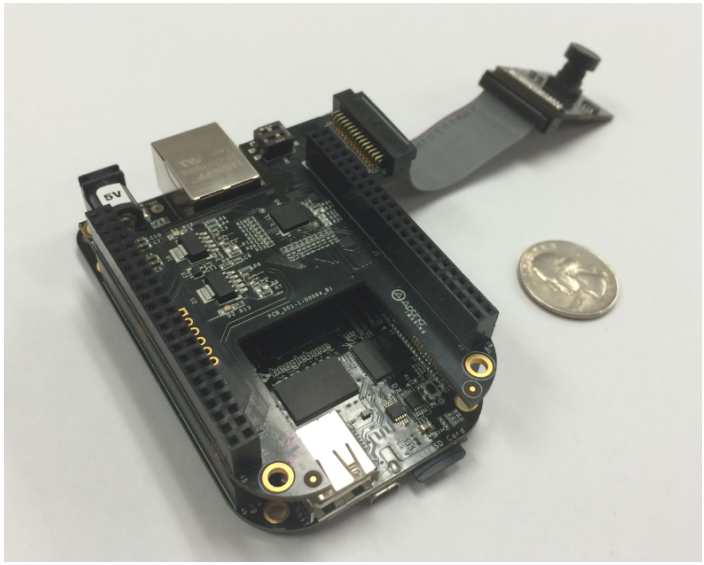


Agenda

- F.I.R.E System Requirements
- Use and Threat Models
- Block Diagrams
  - Previous
  - Updated
- MDR Deliverables
  - Proposed
  - Current
- Deliverables
  - Microphone Unit
  - Sensor Evaluation Module
  - PCB Preliminary Design
  - Camera Unit

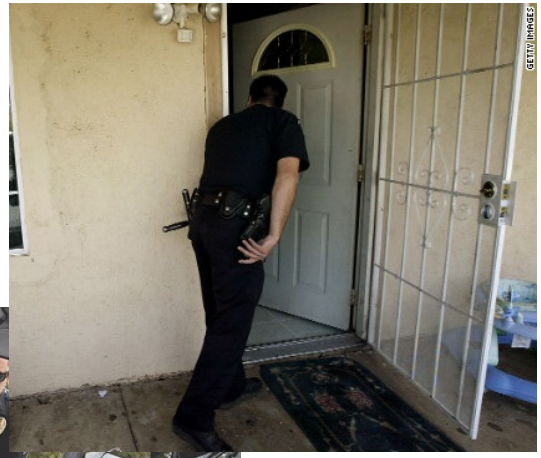
F.I.R.E System Requirements

- Chest-mounted video camera connected to box on officer's belt
- Sensor activated when officer removes weapon from duty belt
- Small, reliable, easy to use, emphasized by UMPD



Use Models

- Entering building
  - Camera automatically activated if officer draws weapon
  - Camera activated manually if situation potentially dangerous
- Traffic stop
  - Camera activated manually if situation potentially dangerous
  - Camera automatically activated if officer draws handcuffs
- Officer caught unaware (Ferguson)
  - No time to manually activate, camera automatically activated if officer draws weapon
  - Pre-record feature will detect why weapon was drawn



Threat Model

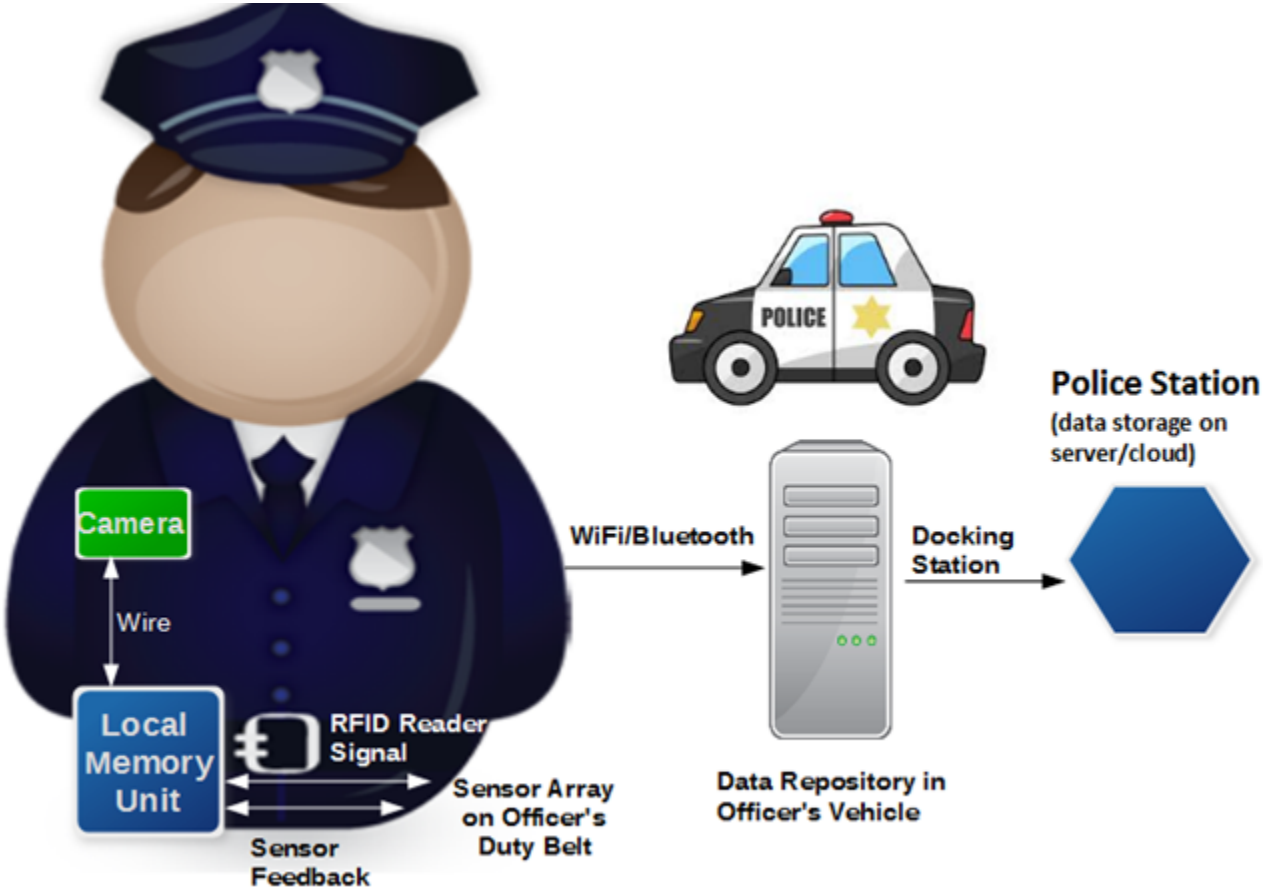
Controlled:

- Officer attempts to access the data
  - Data is encrypted - only accessible when downloaded to computer
- Officer doesn't want/forgets to turn the camera on
  - Sensor array will activate it anyway
- Hacker attempts to steal data from servers
  - Data is encrypted
- Tampered data loaded onto server
  - Data signed with key contained in camera

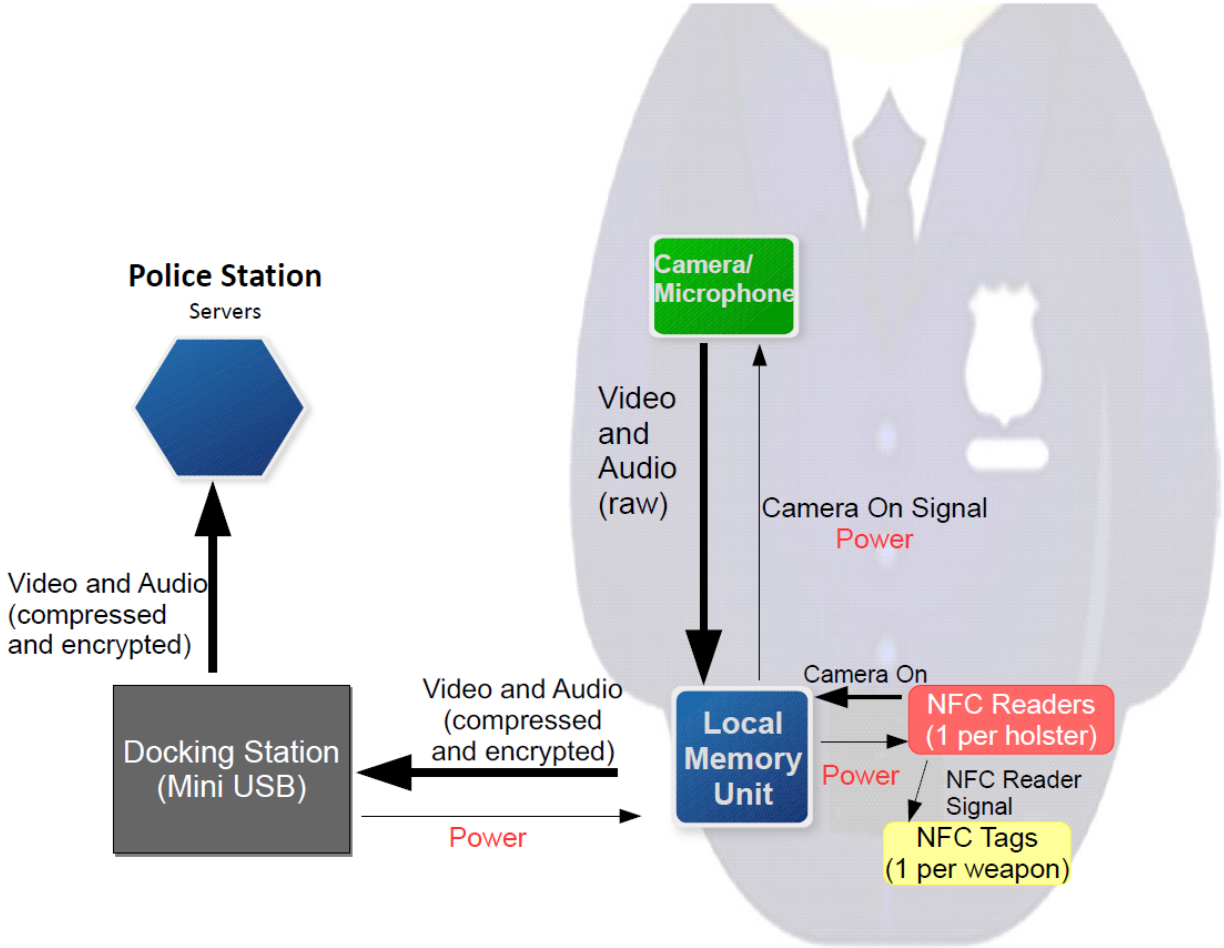
Uncontrolled:

- Local Memory Unit was 'lost'/ stolen (either by officer or attacker)
- Officer covered the camera

Previous Block Diagram



Updated Block Diagram



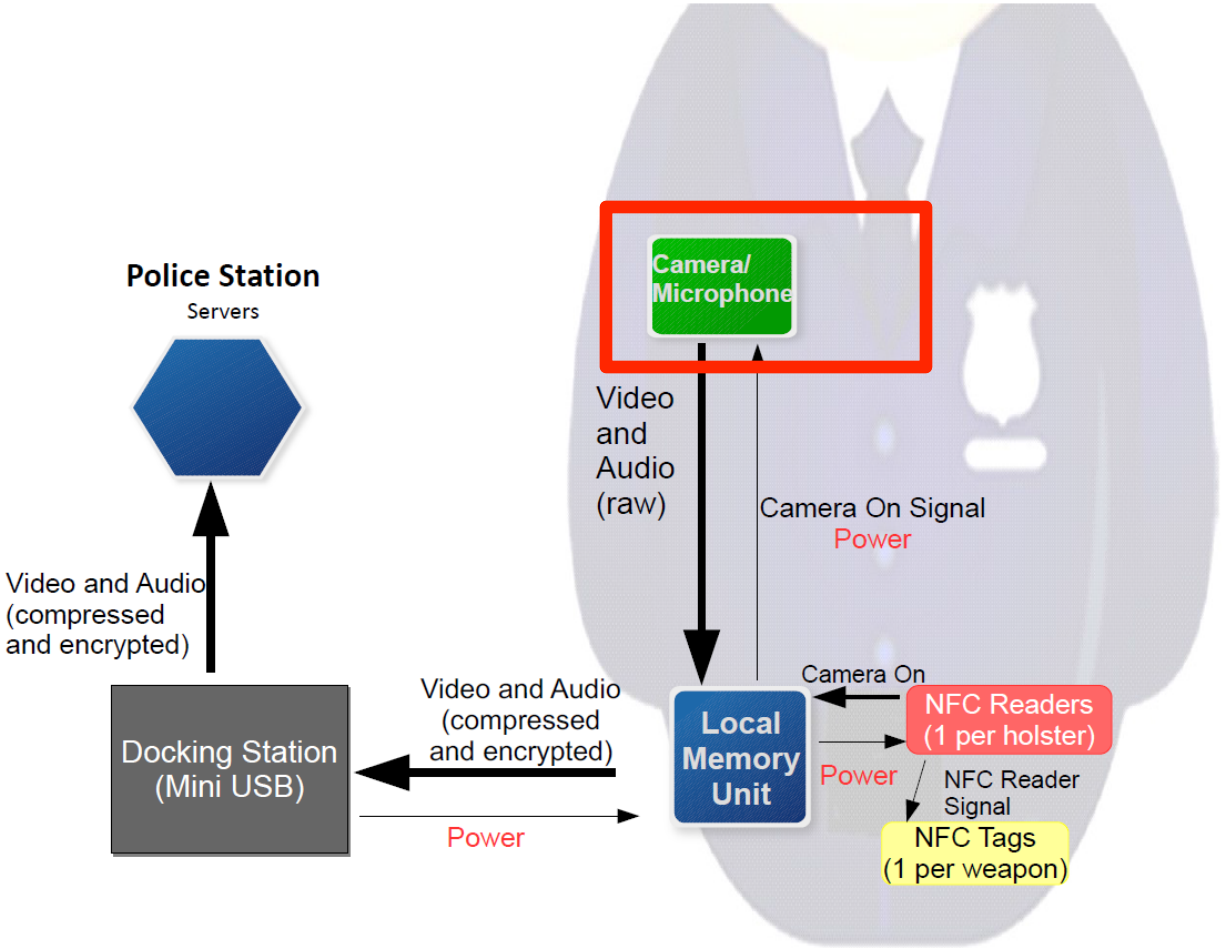
Previous MDR Deliverables

- Prototype for RFID sensor array on officer duty belt
- Components of local memory unit connected via breadboard
- Camera unit functional and mounting option decided upon
- Software at the police station prototype

Updated MDR Deliverables

- Microphone record and playback demonstration
- Activation Sensors evaluation module demonstration
- Camera record and compression demonstration
- Preliminary PCB design and list of Local Memory Unit components for custom PCB

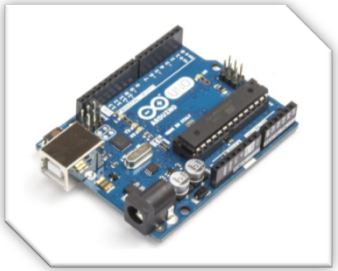
Block Diagram



Microphone Unit components

- Microphone Preamp System
- ISD 4002/Arduino Subsystem
- Postamp Speaker subsystem

ISD 4002 Record-Playback Device

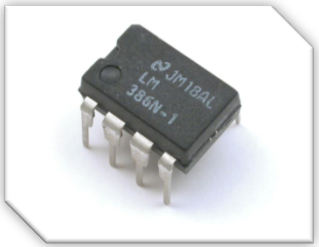


Arduino Uno microcontroller

PUI Electret Microphone

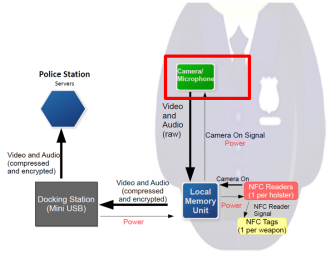
TL074CN JFET quad op-amp

8 ohm mini speaker

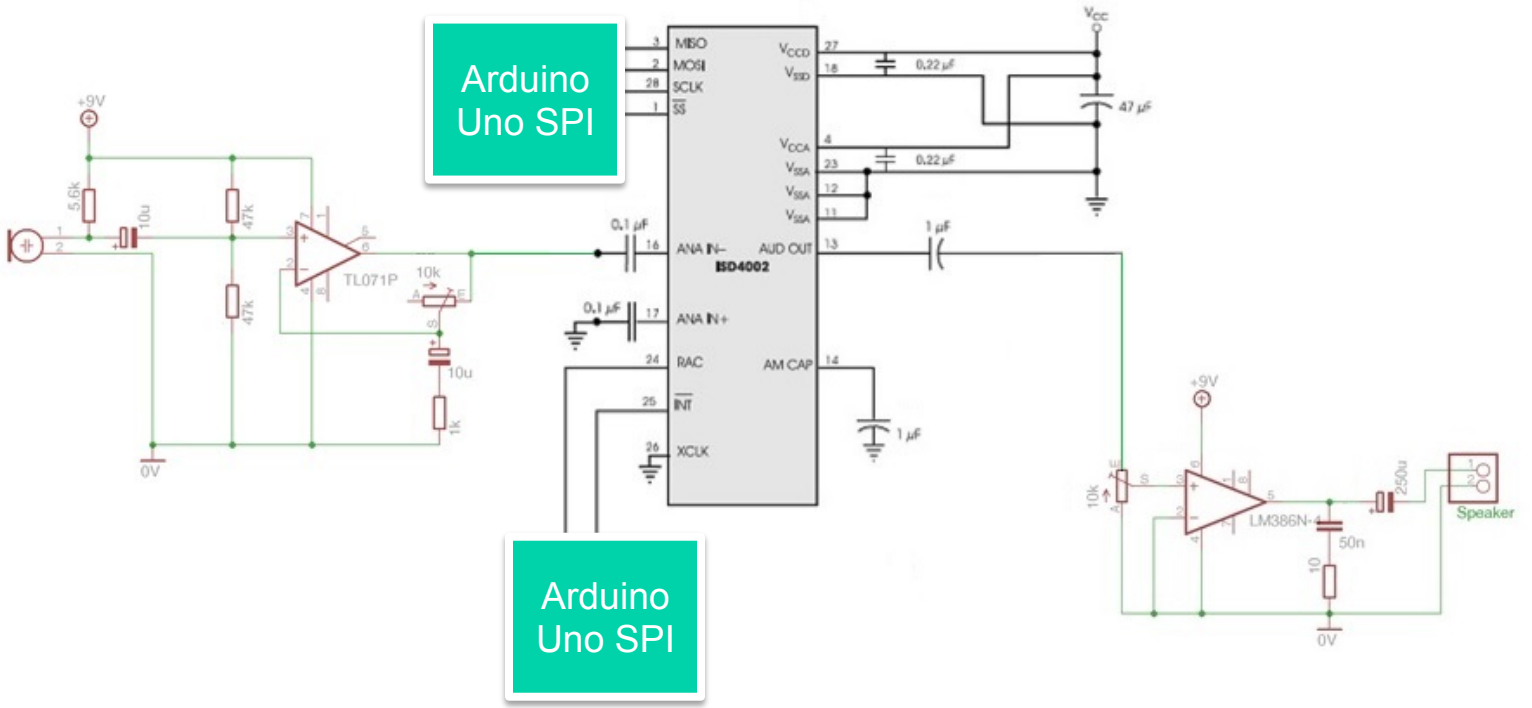


LM386 audio power amp

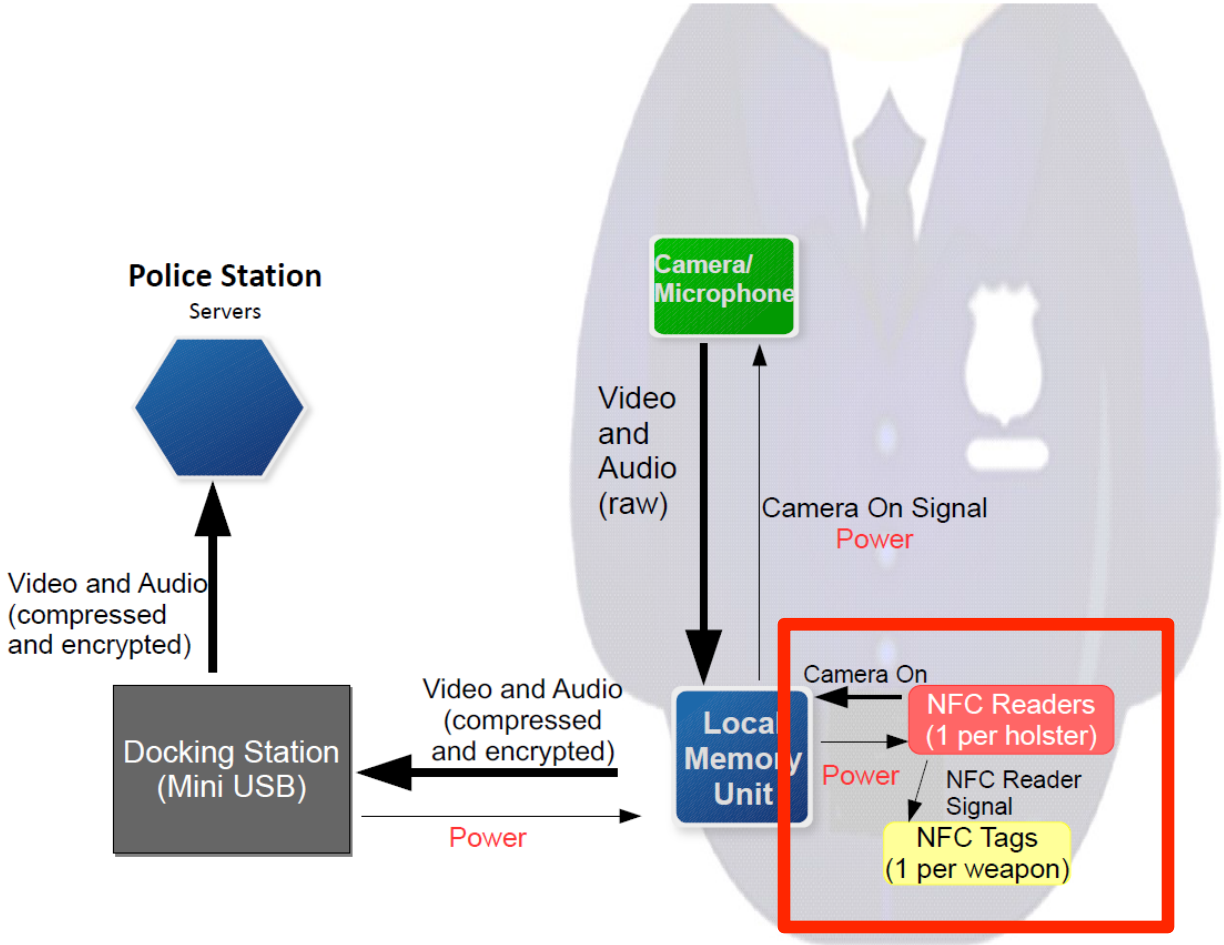
Team Member: Andrew Kelley (EE)



Microphone Unit schematic



Block Diagram



Sensor Evaluation Module

- NFC Reader 13.56 MHz
- Determine functionalities of TRF7970A transponder using provided GUI to create custom software

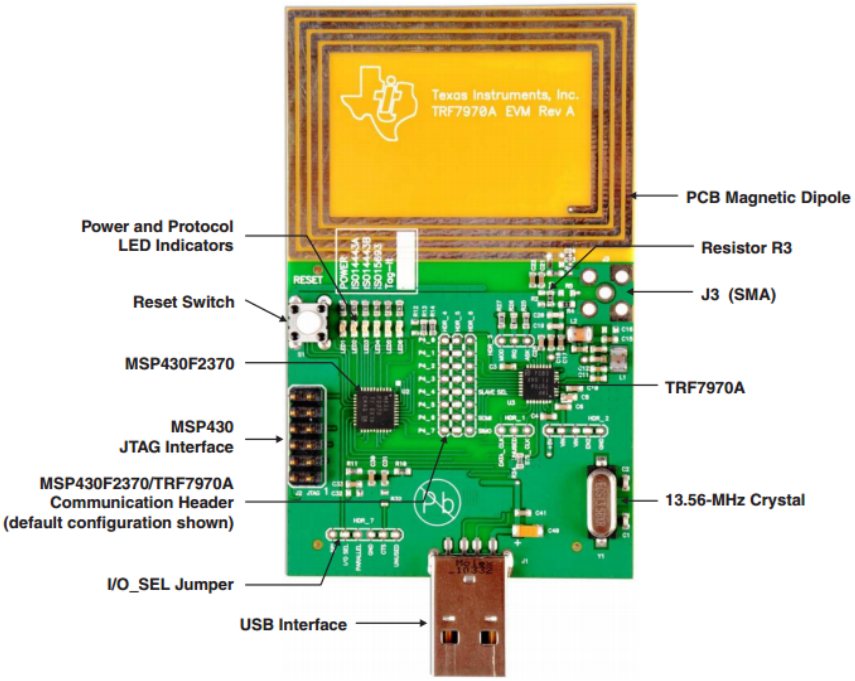
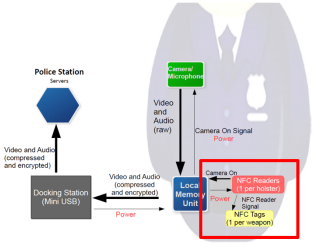


Figure 1. TRF7970A EVM (Top Side)



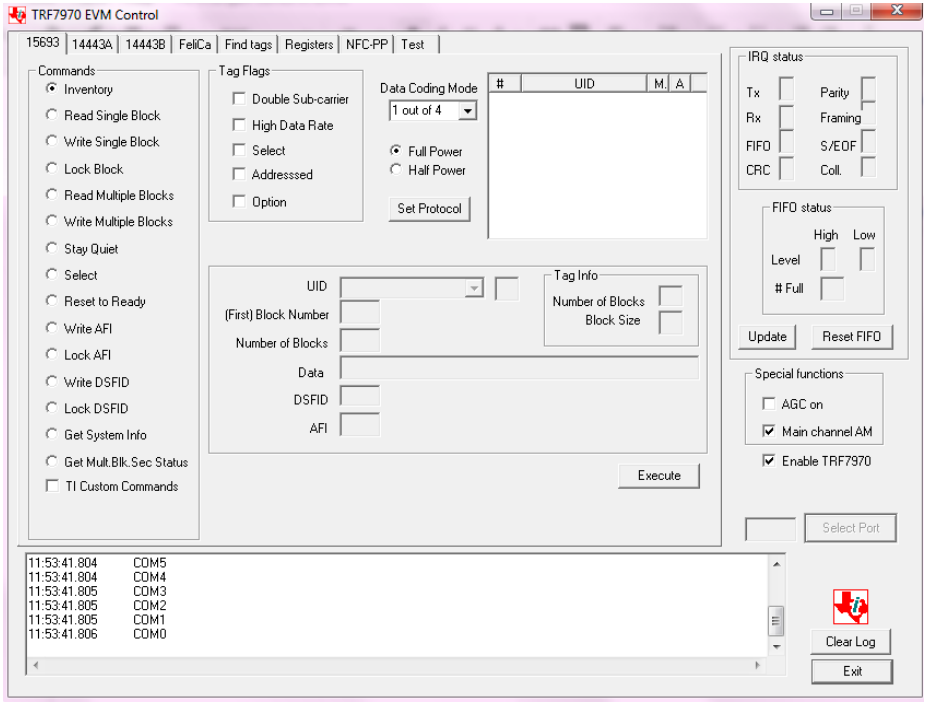
Evaluation Module GUI

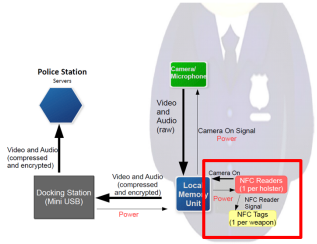
Required Commands:

- Inventory (Code: 0x01)
- Stay Quiet (Code: 0x02)
- Select (Code: 0x25)

Optional Commands:

- Read Single Block (Code 0x20)
- Write Single Block (Code 0x21)





Low Power NFC Reader

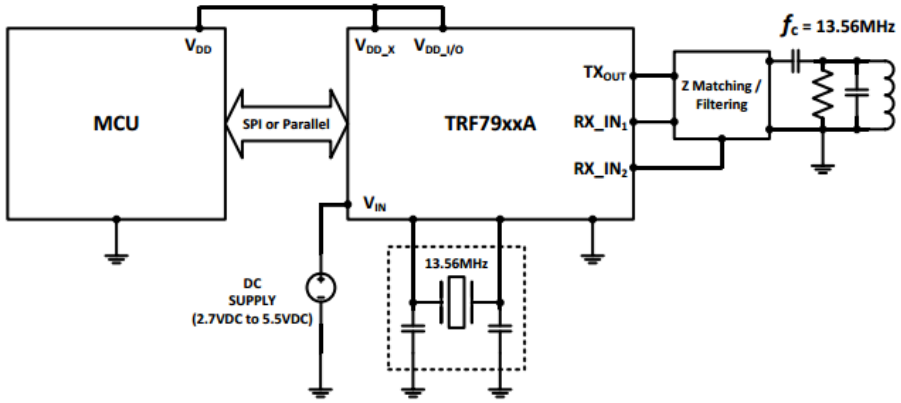


Figure 5. TRF79xxA Based RSSI Approach

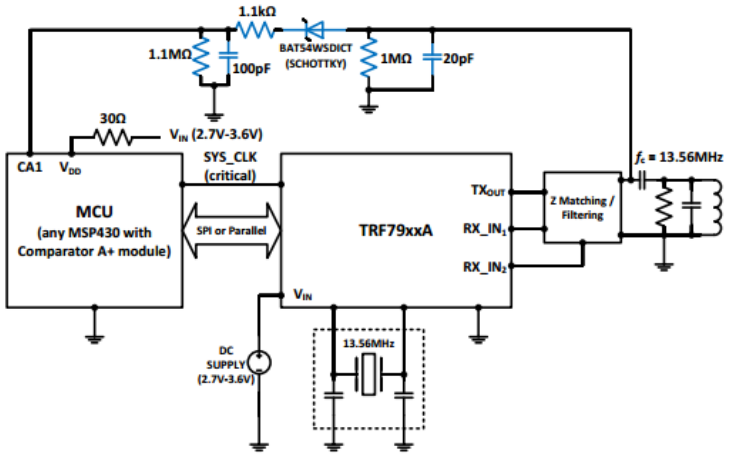
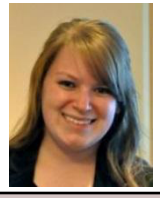
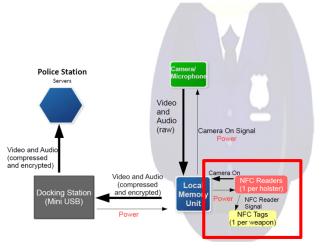


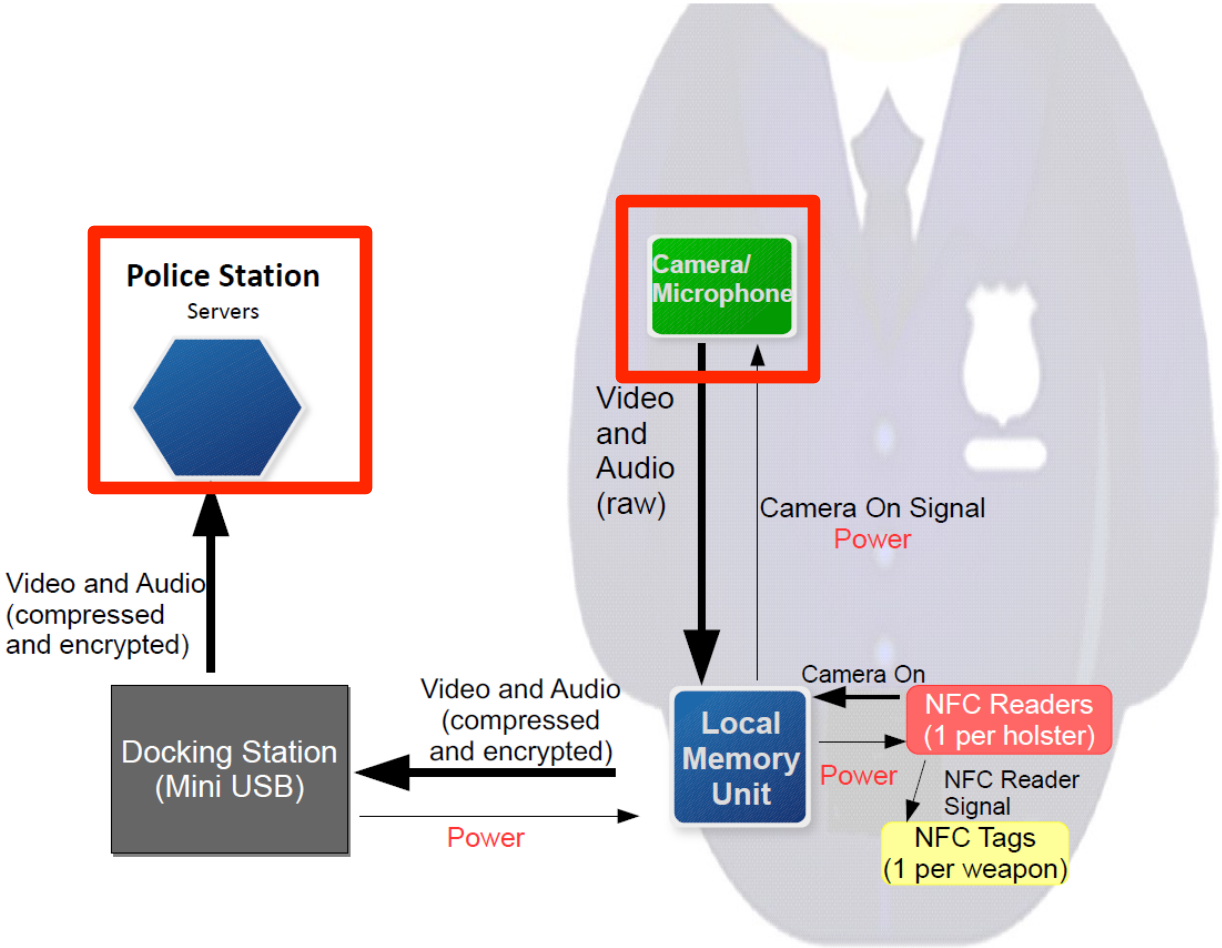
Figure 6. ULP Card Presence Detection and NFC/RFID Reader Circuit

- Samples then measures the time it takes for signal to decay
- Unable to implement yet because of incorrect cable to download firmware





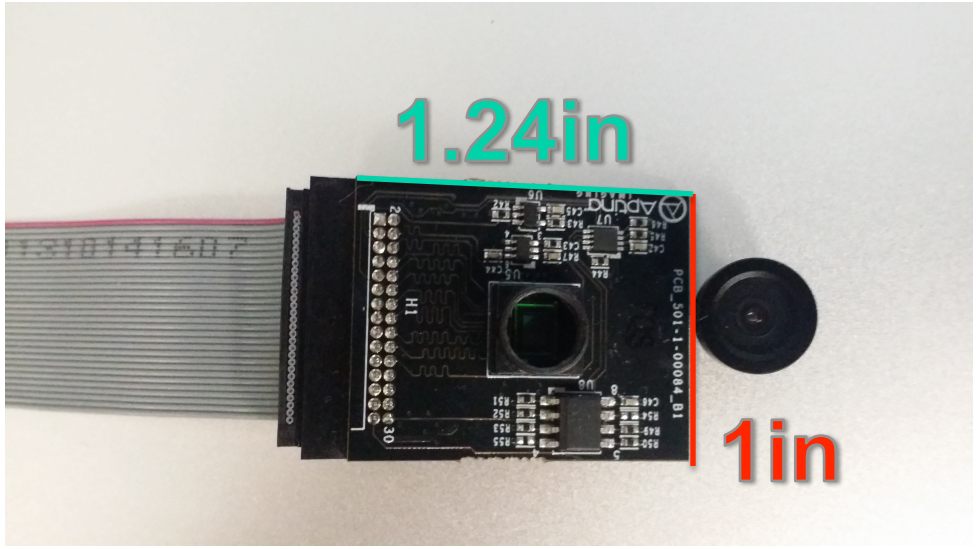
Block Diagram



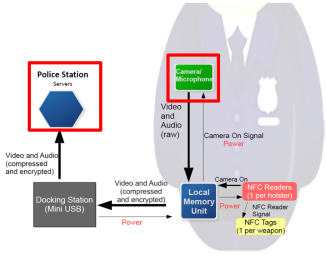
Camera Unit

BeagleBone Black

- Camera Cape
- 1.26MP Camera Sensor
- Ultra-low-power



- Outputs data in YUV4:2:2 format
- Capable of 1280x720 at 30 fps (adjustable)



Camera Data Processing

RAW from Camera

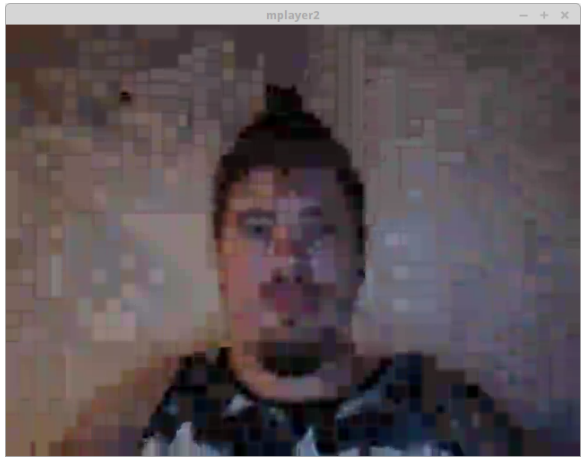
Data Rate
14.648 MB/s

Beaglebone Black
H.264 Encoding

After encoding

Quality Level	Data Rate
0 (best)	4.6523 MB/s
25	.05775 MB/s
51 (worst)	.003052 MB/s

Quality 51

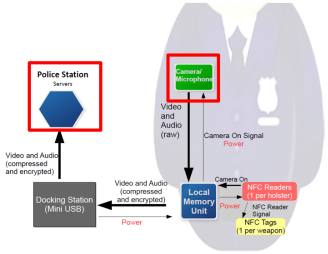


Quality 25

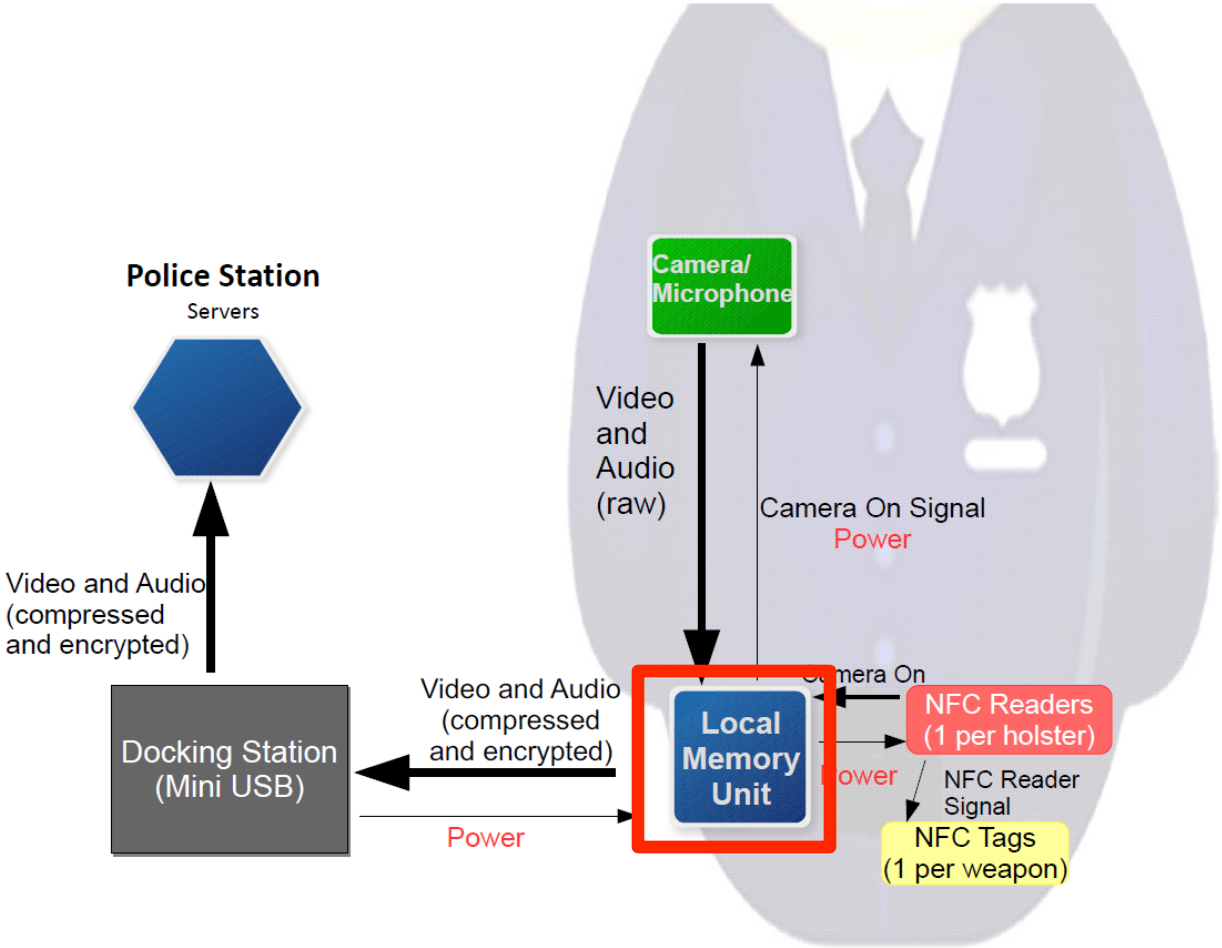
Quality 0

End Point Storage / Software

- Police frowned upon cloud storage
- Will be creating an end point interface
  - Manage software / permissions on device
  - Ability to catalogue and tag videos



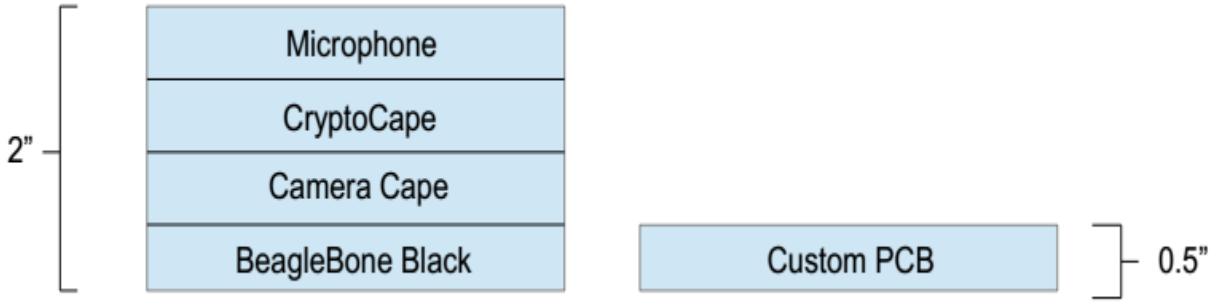
Block Diagram

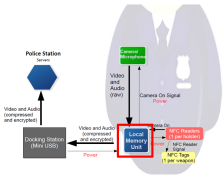


Custom PCB justification

- BeagleBone Black impractical both in terms of size and features
- Custom design allows for a smaller Local Memory Unit
- Power supply will be integrated (no built in solution for BeagleBone Black)

Height of BBB (with all desired features) vs. Height of PCB





Local Memory Unit Specifics

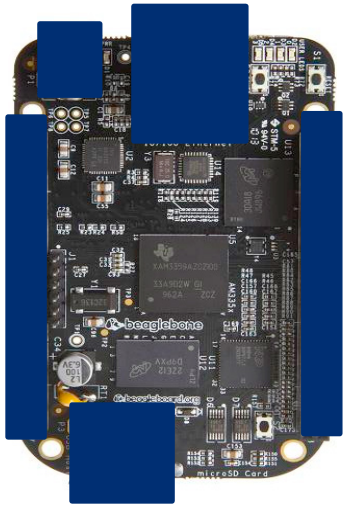
- ✓ AM335x 1GHz ARM Cortex-A8 processor
- ✓ Mini HDMI Port
- ✓ MicroSDHC Port
- ✓ USB PC interface
- × Encryption hardware
  - Atmel At24C32D
  - AES Algorithm with 128 – bit keys
- × Battery
  - TPS65217CRSLT power management IC
  - 3.7V LiPo battery
- × Microphone
  - ISD 4002 Record-Playback Device
- – USB host
- – DC Power Connector
- – Cape Support
- – Ethernet Port

Key

✓ **On BBB**

× **Not on BBB**

– **On BBB but Unneeded**



Demonstrations and Questions