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ALC Rooftop Sensor System

by Timothy Gregory

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14. ABSTRACT

The Battlefield Information Processing Branch (RDRL-CII-B) built an experimental sensor network at the US Army Adelphi Laboratory Center (ALC) campus. Some components of this sensor network are installed on the roof of the ALC buildings. This technical note describes the rooftop sensor system components.

15. SUBJECT TERMS

sensor network, rooftop sensor system, Adelphi Laboratory Center, ALC, weather stations

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1. Introduction

The original US Army Adelphi Laboratory Center (ALC) rooftop sensor system consisted of Sony Ball cameras mounted on the roof of the ALC buildings. As the Sony cameras failed, they were replaced with Axis network cameras.

As the US Army Research Laboratory's (ARL's) work in sensors grew, some additions and improvements were made to the rooftop components. This document describes the current rooftop system. Images are included in the document to help identify the equipment on the roof. Figure 1 shows the location of the equipment on the ALC buildings.

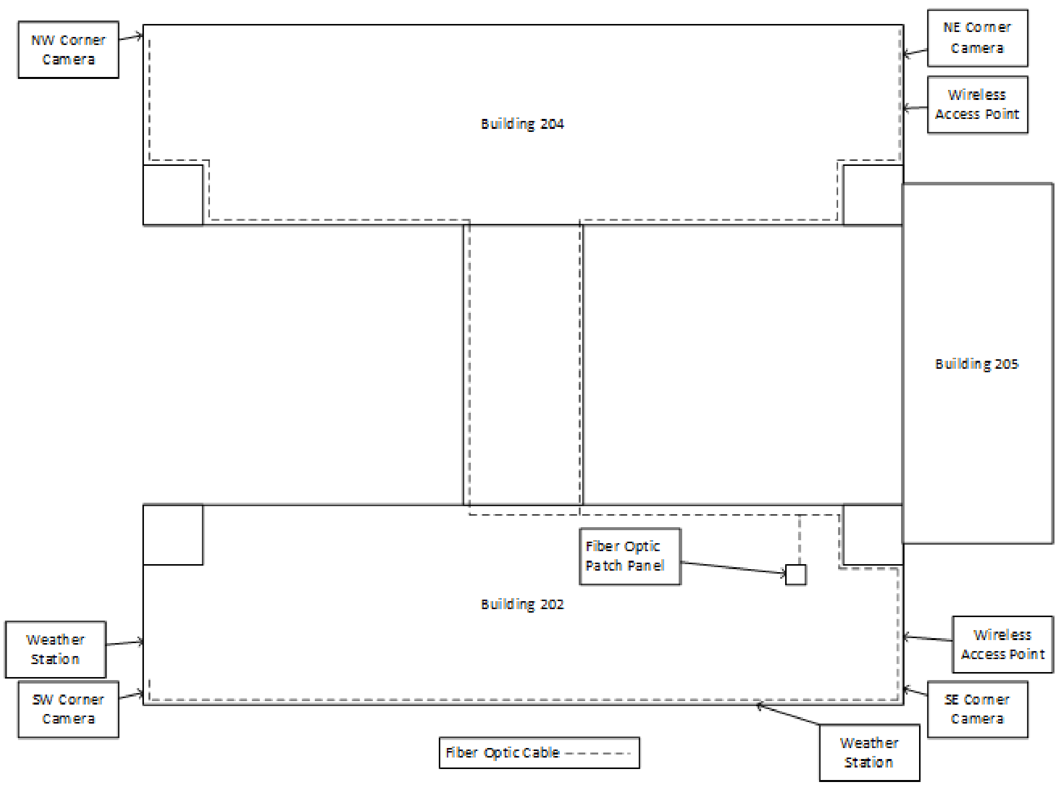

Fig. 1 Rooftop sensor layout

2. Improvements to the Rooftop Sensor System

In 2015, several improvements were made to the rooftop sensor system. Below is a summary of the improvements that were installed.

- Larger enclosures to house the current and future equipment.
- Device servers.

- Weather stations (temperature, wind, humidity, GPS) added.
- Network cameras.
- Wireless links to sensor sites on the ALC campus.
- Ethernet switch–8 port.
- Cable feed-through.
- Wireless access points.

2.1 Larger Enclosures

The original Pelican cases installed at the southeast (SE) and southwest (SW) corners have been replaced with larger Pelican cases. This will allow for additional equipment to be installed in the future. Figure 2 shows a new sensor box installed on the roof. Figure 3 shows the interior of the new sensor box. The new boxes are Pelican model #1610. The northeast (NE) and northwest (NW) corners still have the original Pelican case #1520. Figure 4 shows the view of the interior of the original sensor box.

Fig. 2 Sensor box installation

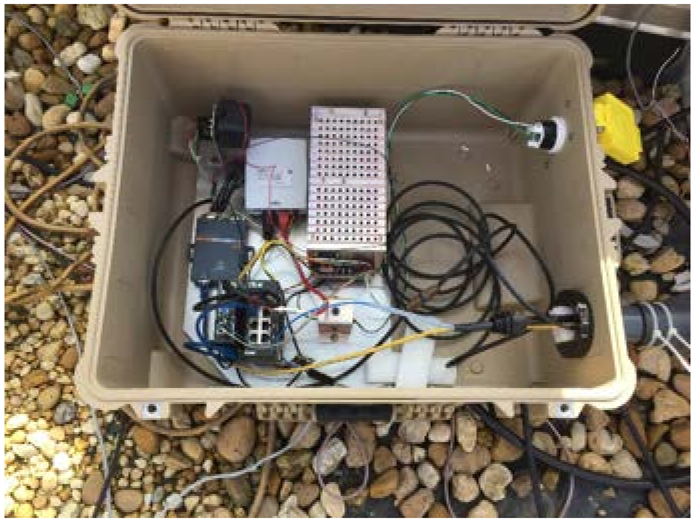

Fig. 3 Interior view of the new sensor box

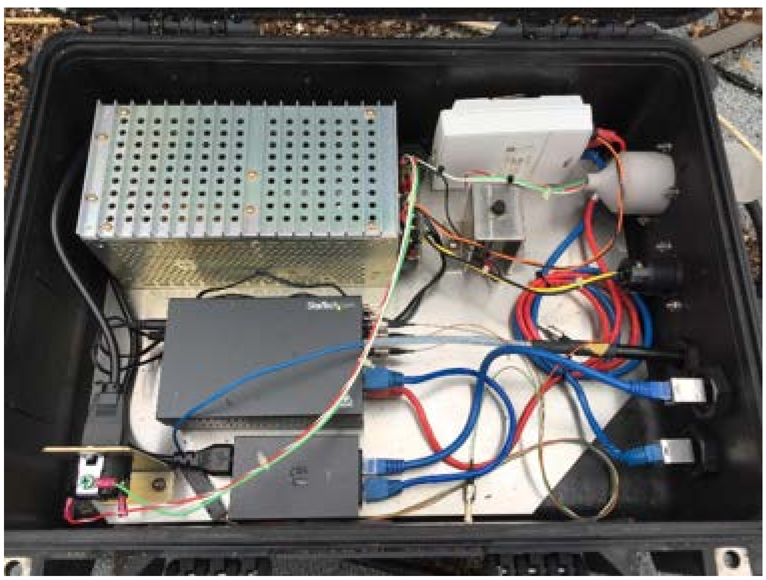

Fig. 4 Interior of original sensor box

2.2 Network Cameras

The cameras on the NE, SE, and SW corners of the building are AXIS P5534-E. The AXIS P5534-E provides HDTV 720p in compliance with the SMPTE 296M standard of 1280 × 720 pixel resolution, full frame rate, HDTV color fidelity, and a 16:9 format. The day and night camera can deliver multiple H.264 and Motion JPEG streams simultaneously. The NW corner of the building has an AXIS P5522-E. The Battlefield Information Processing Branch's cameras are mounted on aluminum C-channel as shown in Fig. 5.

Fig. 5 Camera installation

2.3 Device Server

A LANTRONIX UDS2100 device server is installed in the SE and SW locations. The UDS2100 device server allows controlling and managing any piece of equipment with a serial port. This will support the weather station described below. Contact the author of this document for the necessary information to access the NMEA data streams.

2.4 Weather Stations

Airmar LB150WX weather stations have been installed on the SE and SW corners of Building 202. The weather station installed at the SW corner location is shown in Fig. 6. These weather stations provide an NMEA data stream containing the weather parameters. The serial output from these stations is available through the device servers.

Fig. 6 Weather station

2.5 Ethernet Switches

An 8-port Ethernet switch is installed in the SE and SW locations. The Ethernet switches will allow adding additional equipment that requires a network connection.

2.6 Cable Feed-Through

A cable feed-through was added to facilitate passing cables into the enclosure. This will allow adding additional equipment and capabilities to the sensor network. The feed-through must be sealed to keep water and insects from entering the enclosure.

2.7 Wireless Access Points

Wireless access points have been installed on the NE and SE corners of the building. These provide a network connection to the sensor systems that are on the ALC campus. An Ubiquiti Rocket M900 access point with a high-gain Yagi antenna is installed on the NE corner of the roof (Fig. 7). The SE corner has an Ubiquiti NanoStation LOCO M900 mounted (Fig. 8).

Fig. 7 Ubiquiti Rocket M900 with Yagi antenna on the NE corner of building 204

Fig. 8 Ubiquiti NanoStation Loco M900 on the SE corner of building 202

3. Connection to the ALC Sensor Network

The rooftop systems are connected to the rest of the ALC sensor network through fiber optic cables. The fiber optic cables from each corner of the building lead to a patch panel mounted on one of the “dog houses” on the roof of building 202 (see Fig. 9). The interior view of the patch panel is shown in Fig. 10. For reference, the image has been annotated with the destination of the fiber pairs. From the dog house, the fiber optic cable runs to room 4F025 where media converters perform conversion to Ethernet and finally connect to the rest of the sensor network.

Fig. 9 Fiber optic patch panel

Fig. 10 Interior of fiber patch panel

4. Subscribing to Weather Station Data

Software developers can subscribe to the output of the weather stations through the device servers. Figure 11 contains sample Java source code to capture the NMEA strings from the weather stations. Contact the author for details such as the IP address of the device.

```
package LB150WX;

import java.io.BufferedReader;
import java.io.IOException;
import java.io.InputStreamReader;
import java.net.InetSocketAddress;
import java.net.Socket;
import java.net.SocketAddress;
import java.util.UUID;

public class datareader {
	// TO DO: replace xxx.xxx.xx.xx with the correct IP address
	static String deviceserverIP = "xxx.xxx.xx.xx";
	static int port = 10001;

	public static void main(String[] args) {
		try {
			SocketAddress sa = new InetSocketAddress(deviceserverIP,port);
			Socket sock = new Socket();
			sock.connect(sa);
			BufferedReader br = new BufferedReader(new InputStreamReader(sock.getInputStream()));
			while (true)
			{
				String nmeamsg = br.readLine();
				// Process the NMEA string here.
				System.out.println(nmeamsg);
				if (nmeamsg.toUpperCase().contains("$WIMDA"))
				{
					String[] parts = nmeamsg.split(",");
					System.out.println("Temperature="+parts[5]);
				}
			}
		} catch (IOException e) {
			e.printStackTrace();
		}
	}
}
```

Fig. 11 Java sample code to capture NMEA messages

5. Summary and Conclusions

The improvements to the rooftop sensor system should allow for the installation of additional sensors. Future improvements may include the addition of servers for distributing data from the weather stations to clients. The current device servers allow only 1 connection at a time.

If you need additional information, such as IP addresses and ports, contact the author.

List of Symbols, Abbreviations, and Acronyms

ALC	US Army Adelphi Laboratory Center
ARL	US Army Research Laboratory
GPS	global positioning system
HDTV	high-definition television
IP	Internet Protocol
NE	northeast
NMEA	National Marine Electronics Association
NW	northwest
SE	southeast
SW	southwest

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