2016 ALERT Users Group Conference

ALERT2 Data Analytics

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Bio

- BS and MS from Colorado State University in Civil Engineering
- 2006 – Water & Earth Technologies, Inc. (Engineering and Env. Monitoring)
- 2015 – TriLynx Systems, LLC
We have seen large improvements in data quality going to ALERT2.
ALERT2 is more complex, when we do see a problem, trouble shooting is more complex.
Introduction

Have you ever come into the office......looked at your base station and seen the rain tip count look like this?

- 04/10/2016 12:00:00  65
- 04/10/2016 12:27:08  67
- 04/10/2016 12:29:53  68
- 04/10/2016 12:31:07  69
- 04/10/2016 12:40:10  76
- 04/10/2016 14:04:29  80

I thought ALERT2......
Introduction

..........was going to eliminate gaps like these?
Data Analytics

- The ability to look at additional content of the ALERT2 Airlink, MANT, and Application layer data to help us troubleshoot data collection problems.

- Currently we analyze the log files each month with the goal of developing automated tools that would run daily basis to identify problems.

- Report time, Receive time, Latency
- Data feed, Source Address (SA), Source Address2 (SA2)
- APDUID – Application Protocol Data Unit ID
- Inefficient data packets
- Decoding errors
The APDUID is a cyclical, incrementing counter from 0 to 6. Tracking skipped values and restarts of the APDUID counter provides useful insight into site performance and general network health.
Use the APDUID to Identify Problems

- Some transmitters look to be perfectly healthy as all data reports are received and stored in the database...............but on closer inspection of the APDUID......the transmitter may not be working like we think!
Suspicious APDUUID Signature

Data from this site looks good when viewing the database!
### What is happening?

Single Airlink 5 MANT packets 1 for each sensor

<table>
<thead>
<tr>
<th>Sensor ID</th>
<th>Report Time</th>
<th>APDUID</th>
<th>Data</th>
<th>Line</th>
<th>SA</th>
<th>SA2</th>
</tr>
</thead>
<tbody>
<tr>
<td>3078</td>
<td>3/31/2016 0:14</td>
<td>4</td>
<td>128</td>
<td>4</td>
<td>3070</td>
<td>6502</td>
</tr>
<tr>
<td>3070</td>
<td>3/31/2016 0:14</td>
<td>5</td>
<td>8</td>
<td>4</td>
<td>3070</td>
<td>6502</td>
</tr>
<tr>
<td>3073</td>
<td>3/31/2016 0:14</td>
<td>6</td>
<td>0</td>
<td>4</td>
<td>3070</td>
<td>6502</td>
</tr>
<tr>
<td>3074</td>
<td>3/31/2016 0:14</td>
<td>0</td>
<td>0</td>
<td>4</td>
<td>3070</td>
<td>6502</td>
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<tr>
<td>3075</td>
<td>3/31/2016 0:14</td>
<td>1</td>
<td>0</td>
<td>4</td>
<td>3070</td>
<td>6502</td>
</tr>
<tr>
<td>3078</td>
<td>3/31/2016 1:14</td>
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<td>128</td>
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<td>3070</td>
<td>6502</td>
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</tbody>
</table>
Inefficient Use of ALERT2

- This transmitter is using the GSR (General Sensor Report) to package up individual sensor readings to unique MANT packets for transmission.

- This works...........but not an efficient use of ALERT2 bandwidth.

- Should be using the MSR (Multi Sensor Report) to package up all sensor readings into a single Application and MANT packet.
I Thought ALERT2...........
Missing Data Packets

- Skipped values of the APDUID
- Missing ALERT2 packets
- Check transmitter logs to confirm the packets were sent
- Could we be experiencing interference from another ALERT2 transmitter?
- What does the radio path look like from this site?
- Radio interference from an external source?
- Radio frequency drift?
Bad neighbor?
Check your TDMA Plan & Transmitter Configs

- The site in question SA 50705: offset 80 sec in 120 sec frame
- A second site (SA 50710) shares an offset of 80 sec in the 120 sec frame but is on a different frequency
  - SA 50705 – 171.875
  - SA 50710 – 171.850

- Confirm that neighboring transmitters (70 & 90 offset) are configured correctly (save your configuration files at the office so you can easily check them!)
Uncorrectable bit errors

April 10 8:00 to April 11 8:00 - SA 50705

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Data Latency

- The elapsed time from when the data value was read in the field to the time the report was received by the ALERT2 base station decoder and the base station software.

- Sources include:
  - Transmitter
  - IP network
  - Repeater
  - Decoder

- Any of today’s base station software should provide ALERT2 latencies!
Network Architecture

- Remote Station
- Repeaters
- ALERT2 Decoder
- Base Stations
- Diamond Hill
- Internet
- Greenhouse
Time Division Multiple Access (TDMA)

Are you late to work...... or back from lunch early?

It should not take longer than 120 seconds for data to go from the field to the base station!

Remember, It’s better to arrive late than to arrive ugly!
TDMA PLAN

Freq 1, Remote station frame = 120 sec
Freq 2, Repeater frame = 20 sec
<table>
<thead>
<tr>
<th>Base</th>
<th>Latency</th>
<th>Time</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Remote</td>
<td></td>
<td>14:54:31</td>
<td>Packet created at remote site</td>
</tr>
<tr>
<td>Diamond Hill</td>
<td>0:08:31</td>
<td>15:03:02</td>
<td>Packet received at decoder from 6502</td>
</tr>
<tr>
<td>Diamond Hill</td>
<td>0:08:31</td>
<td>15:03:02</td>
<td>Data written to DB - insert</td>
</tr>
<tr>
<td>Greenhouse</td>
<td>0:08:31</td>
<td>15:03:02</td>
<td>Data written to DB - insert</td>
</tr>
<tr>
<td>Diamond Hill</td>
<td>0:08:34</td>
<td>15:03:05</td>
<td>Packet received at decoder from 6503</td>
</tr>
<tr>
<td>Diamond Hill</td>
<td>0:08:34</td>
<td>15:03:05</td>
<td>Data written to DB - ignore</td>
</tr>
<tr>
<td>Greenhouse</td>
<td>0:08:34</td>
<td>15:03:05</td>
<td>Data written to DB - ignore</td>
</tr>
<tr>
<td>Diamond Hill</td>
<td>0:08:38</td>
<td>15:03:09</td>
<td>Packet received at decoder from 6505</td>
</tr>
<tr>
<td>Diamond Hill</td>
<td>0:08:38</td>
<td>15:03:09</td>
<td>Data written to DB - ignore</td>
</tr>
<tr>
<td>Greenhouse</td>
<td>0:08:38</td>
<td>15:03:09</td>
<td>Data written to DB - ignore</td>
</tr>
<tr>
<td>Diamond Hill</td>
<td>0:08:41</td>
<td>15:03:12</td>
<td>Packet received at decoder from 6506</td>
</tr>
<tr>
<td>Diamond Hill</td>
<td>0:08:41</td>
<td>15:03:12</td>
<td>Data written to DB - ignore</td>
</tr>
<tr>
<td>Greenhouse</td>
<td>0:08:41</td>
<td>15:03:12</td>
<td>Data written to DB - ignore</td>
</tr>
</tbody>
</table>
Repeater Loading

ALERT2 Reports Received Through Each Repeater

Month

Reports Received

- West Creek (6001)
- Smoky (6502)
- Blue Mt. (6503)
- Lee Hill (6505)
- Gold Hill (6506)
Repeater Loading

In general each repeater will process an equivalent number of ALERT2 reports. A convenient mechanism to track real-time repeater performance is to monitor the continuous total ALERT2 reports passed by each repeater.

Repeater loading (total reports per hour or day) can be written to NovaStar5 and alarm thresholds can be defined to notify the system administrator when repeater throughput falls below a certain level.
What Next?

- Move from monthly post-event analyses to real-time operations
- Track latency by point within NovaStar5 and set alarms when latencies exceeding 120 seconds are identified
- Track repeater loading by hour and provide notification when loading changes
- Track “uncorrectable bit errors” with a synthetic point within NovaStar5 and set alarms when these occur
- Track APDUID performance in real-time
Questions