

Memo



Date: June 4, 2007
To: Kevin Stewart and Chad Kudym
From: Markus Ritsch
Subject: May 2007 ALERT Data Analysis

I. ALERT Data Source

Raw ALERT data records extracted from the Urban Drainage and Flood Control District's Nova Star 4.0 base station (ALERT 2) were analyzed for the period May 1 through May 31, 2007.

II. General System Analysis Summary

A total of 287,588 individual data records were analyzed. Meteorological sensors accounted for approximately 51 percent, water level sensors 19 percent and rain sensors 6 percent of the total monthly reports.

Ninety-nine percent of the received data reports were flagged as "good" by the Nova Star validation process. Roughly 4,268 reports were flagged as "bad". Of these "bad" reports, 3,618 originated from the wind sensor (ID 2189 and 2187) at Squaw Mountain.

The system-wide radio traffic loading this month was 9,277 reports per day with an average hourly loading of 387 reports. The peak hourly traffic load in terms of reports received at the base station was 1,341 reports, which occurred on May 14th between 7:00 PM and 8:00 PM. The actual number of reports during this hour was higher, probably on the order of 1,500 to 2,000 reports. A plot of monthly average and peak hourly traffic loading is provided.

A total of 1,827 rain tip reports were received from the Hayman gages this month. The Hayman gages accounted for less than 1% of the monthly total received radio traffic.

The sensors reporting most frequently this month include:

1. Boulder Creek at Broadway (ID 4583) with 7,505 reports,
2. SPR at 3rd Street (ID 1323) with 6,667 reports,
3. SPR at Henderson (ID 1659) with 5,208 reports,
4. Salisbury Park (ID 2727) with 3,498 reports,
5. Green Ditch (ID 4593) with 3,053 reports, and
6. Stapleton (IDs 1466 and 1464) with 2,853, and 2,833 reports respectively.

The sensors reporting infrequently this month include:

1. Stapleton (ID 1463 – Barometric Pressure and ID 1469 - Solar) with 2 and 5 reports respectively,
2. Boulder Jail (ID 4555 and ID 4550) with 6 and 16 reports respectively,
3. Button Rock Outlet (ID 4480) with 1 report, and
4. Lena @ U.S. Hwy 6 (ID 1043) with 13 reports.

III. Rain Sensor Timer Reporting Summary

The following analysis assumes that each rain sensor has a 12-hour timer reporting interval. System-wide the ALERT 2 base station received approximately 89 percent of the non-incrementing timer reports. The 5 worst-performing rain sensors for the month are summarized (Table 1).

Table 1. Monthly Summary of Sensors with Poor Timer Performance

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
750	1330	2310	1810	1810							
4470	1460	1710	540	310							
4560	2330	2350	310	540							
4240	4170	2240	850	850							
4510	4470	2250	1710	1710							
				900							

Sand Cr at Mouth (1810), Parker/Mississippi (540), Guy Hill Ranch (310), Flying J (850), Shop Creek (1710), and Aurora Res (900)

Sensors identified as having poor timer performance in multiple months are shaded with unique colors. A developing trend can thus be identified from the color shading as the year progresses.

Boulder Jail (ID 4550) had only 3 non-incrementing timer reports for the month.

Sensor ID 1460 has a 24-hour timer reporting interval and is not included in the timer reporting analysis.

IV. Rain Sensor Event Reporting Summary

A. District-Wide Total Tip/Count Statistics

The incrementing reports from all 1-mm rain sensors (excluding Hayman sensors) that reported for the entire month were analyzed to quantify the District-wide statistical total monthly tip summary (Table 2).

Table 2. District-Wide Total Tip/Count Statistical Summary

Statistical Parameter	Value	Comments
Mean	68.3	Only the 1-mm rain sensors were included in the analysis
Median	68	Only the 1-mm rain sensors were included in the analysis
Standard deviation	19.9	Only the 1-mm rain sensors were included in the analysis
Mean plus three standard deviations	127.9	Several sensors for the month are outside the Mean +/- 3 Std Dev
Minimum total count	14	Boulder Jail (ID 4550)
Maximum total count	137	Temple Pond at DTC (ID 630)

A monthly summary of the District-wide mean total tip/count is presented (Table 3).

Table 3. Monthly Summary of District-Wide Mean Total 1-mm Tip/Count

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Ave
2006	4.62	5.92	18.39	20.47	19.44	13.75	74.03	46.89	24.17	41.13	5.04	16.45	24.19
2007	11.56	5.40	29.75	65.03	68.3								

The average precipitation experienced district-wide in May was close to that experienced in April and it was considerably more than March. As in April, the precipitation experienced in May of 2007 was more than that experienced in the same month in 2006.

The rain sensor with the minimum tip count total for the month was Boulder Jail (ID 4550). This sensor stopped reporting on May 7, 2007.

One sensor experienced a total tip count of greater than the system-wide mean plus 3 standard deviations. This sensor was Temple Pond at DTC (ID 630).

B. Sensors with a Jump of Six or More in the Sequential Count

Seven rain sensors experienced a jump in their sequential tip count of more than six. The tip count series for these sensors was manually inspected and discussed in the following paragraphs. The majority of the sensors examined below had a large jump in tip count during the evening of May 14. This was a period of heavy rainfall and radio traffic.

1. Expo Park (ID 420)

On May 14th the count value jumped from 113 to 122 at 7:42:31 PM. The total jump in count of 9 was validated by the base station.

Date/Time	Sensor ID	Count
5/14/2007 12:10:15 PM	420	113
5/14/2007 7:42:31 PM	420	122
5/14/2007 7:43:31 PM	420	123
5/14/2007 7:44:48 PM	420	124

A second large jump in count value was experienced between 7:52:36 PM and 9:35:35 PM where a total of 4 tip counts were not received.

Date/Time	Sensor ID	Count
5/14/2007 7:50:54 PM	420	129
5/14/2007 7:52:36 PM	420	130
5/14/2007 9:35:35 PM	420	135
5/14/2007 9:47:09 PM	420	136

2. Temple Pond at DTC (ID 630)

On May 14th at 7:34:28 PM a transmission was received and invalidated because it did not follow the current tip count series. This may have been a data transmission that was stepped on by another transmission. At 7:37:22 PM a report was validated that resulted in a total jump in count value of 9.

Date/Time	Sensor ID	Count
5/14/2007 9:21:50 AM	630	157
5/14/2007 7:34:28 PM	630	2046
5/14/2007 7:37:22 PM	630	166
5/14/2007 7:45:10 PM	630	169
5/14/2007 7:56:11 PM	630	170

3. Chatfield COE (ID 1350)

On May 14th between 8:14:16 PM and 11:56:38 PM this sensor experienced a jump in sequential count from 1557 to 1561. A total jump of 4 was validated by the base station.

Date/Time	Sensor ID	Count
5/14/2007 7:42:46 PM	1350	1556
5/14/2007 8:14:16 PM	1350	1557
5/14/2007 11:56:38 PM	1350	1561
5/15/2007 3:14:18 AM	1350	1561

On May 23rd at 8:42:39 PM this sensor experienced a jump in sequential count from 1586 to 1593. A total jump of 7 in the count was validated by the base station.

Date/Time	Sensor ID	Count
5/23/2007 4:20:50 PM	1350	1583
5/23/2007 4:52:53 PM	1350	1584
5/23/2007 5:34:50 PM	1350	1586
5/23/2007 8:42:39 PM	1350	1593
5/24/2007 3:14:11 PM	1350	1595
5/25/2007 3:14:10 AM	1350	1595

4. Sand Creek at Mouth (ID 1810)

This sensor was missing data for a 9 day period extending from May 7th through May 16th. A total jump in count of 15 was validated by the base station on May 16 when data was again reported.

Date/Time	Sensor ID	Count
5/6/2007 3:28:20 PM	1810	112
5/7/2007 2:18:09 AM	1810	112
5/16/2007 2:13:40 PM	1810	127
5/17/2007 8:13:40 AM	1810	127

5. Gold Lake (ID 4180)

On May 5th the count value jumps from 153 to 161. A total jump in count of 8 is validated by the base station.

Date/Time	Sensor ID	Count
5/5/2007 11:22:54 AM	4180	153
5/5/2007 11:23:58 AM	4180	153
5/5/2007 12:43:08 PM	4180	161
5/5/2007 11:21:57 PM	4180	161

6. Squaw Mountain (ID 2190)

Between May 4th and May 7th this sensor experienced a large number of invalid data reports. The correct incrementing series begins at 726 on May 4th at 12:52:38 PM and ends at 728 on May 8th at 12:52:44 PM which are both timer reports. In between May 4th and May 8th, a number of erroneous data transmissions are received that present a problem for the base station to accurately decipher. These corrupt reports result in an erroneous accounting of rainfall for this period.

Date/Time	Sensor ID	Count
5/4/2007 12:52:38 PM	2190	726
5/4/2007 10:53:51 PM	2190	1139
5/5/2007 12:08:52 AM	2190	237
5/5/2007 3:53:49 AM	2190	304
5/5/2007 7:23:50 AM	2190	471
5/5/2007 10:42:45 AM	2190	727
5/5/2007 7:08:53 PM	2190	471
5/6/2007 1:08:51 AM	2190	471
5/6/2007 12:52:43 PM	2190	728
5/6/2007 7:53:55 PM	2190	189
5/6/2007 9:08:55 PM	2190	1113
5/6/2007 10:53:56 PM	2190	401
5/6/2007 11:08:56 PM	2190	471
5/7/2007 12:52:42 AM	2190	734
5/7/2007 2:38:54 AM	2190	279
5/7/2007 2:53:54 AM	2190	1988
5/7/2007 3:08:54 AM	2190	1246
5/7/2007 3:23:54 AM	2190	471
5/7/2007 7:08:55 AM	2190	475
5/8/2007 12:52:44 AM	2190	728

7. Ward C-1 (ID 4710)

On May 2nd the tip count value jumps from 663 to 687 in a span of 25 seconds. A total jump of 24 was validated by the base station. This equates to approximately 0.94 inches of rain in a 25 second period. Was maintenance performed at this station during this time?

Date/Time	Sensor ID	Count
5/1/2007 4:13:56 PM	4710	661
5/2/2007 11:40:54 AM	4710	663
5/2/2007 11:41:19 AM	4710	687
5/2/2007 11:49:31 AM	4710	687

C. Sensor-by-Sensor Incrementing Count Summary

The system-wide reception rate of incrementing, 1-mm, tip reports for the month was approximately 86 percent. A total of 8,738 incrementing reports were received and a total of 10,171 were expected. The total loss of incrementing reports for the month was approximately 14 percent. Those sensors with the worst rain event transmission performance characteristics are summarized (Table 4).

Table 4. Monthly Summary of Sensors with the Most Missed Tips

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
2320	1330	540	1350	860							
2190	4080	310	310	4710							
4710	1640	4470	1100	1810							
4090	4050	850	860	1350							
4820	4180	4570	540	400							
				4570							

* Sand Creek at Colfax (860), Ward C-1 (4710), Sand Creek at Mouth (1810), Chatfield COE (1350), Montview Park (400), St. Antons (4570)

Sensors identified as having poor event performance in multiple months are shaded with unique colors. A developing trend can thus be identified from the color shading as the year progresses.

1. Sand Creek at Colfax (ID 860)

This sensor reported data for the entire month and experienced numerous missing single and double increment reports. This sensor did not miss more than 2 sequential incrementing reports.

2. Ward C-1 (ID 4710)

This sensor reported for the entire month and experienced missing single and double increment reports. This sensor did experience one occurrence of a jump in sequential count of more than 6 tips which was described earlier in the report.

3. Sand Creek at Mouth (ID 1810)

This sensor was missing data from May 8th through May 15th and experienced missing single and double increment reports for the remainder of the month. This sensor did experience one occurrence of a jump in sequential count of more than 6 tips, as described earlier.

4. Chatfield COE (ID 1350)

This sensor reported for the entire month and experienced missed single incrementing reports. This sensor had one occurrence of missing three sequential tip reports and one occurrence of missing 5 sequential tip reports. This sensor did experience one occurrence of a jump in sequential count of more than 6 tips.

5. St. Antons (ID 4570)

This sensor reported for the entire month and had both timer and event reporting characteristics below 80 percent. This sensor had several occurrences of missing 1 tip and 2 sequential tips.

6. Montview Park (ID 400)

This sensor reported for the entire month and experienced missing single, double, triple, and quadruple increment reports. A period of particular poor data reception occurred the evening of May 14th.

Date/Time	Sensor ID	Count
5/14/2007 7:24:56 PM	400	101
5/14/2007 7:27:06 PM	400	102
5/14/2007 7:28:33 PM	400	103
5/14/2007 7:32:49 PM	400	107
5/14/2007 7:34:50 PM	400	109
5/14/2007 7:37:05 PM	400	112
5/14/2007 7:37:57 PM	400	113
5/14/2007 7:39:00 PM	400	114
5/14/2007 7:41:51 PM	400	116
5/14/2007 7:43:08 PM	400	117
5/14/2007 7:47:17 PM	400	119
5/14/2007 8:48:52 PM	400	122
5/14/2007 9:08:21 PM	400	123
5/14/2007 9:44:55 PM	400	125

V. Heavy Radio Traffic Hour Analysis

Periods exceeding 600 messages per hour were analyzed independently in an attempt to identify rain gage sequences where 3, or more, sequential messages were lost. For the month there were 30 occurrences where a rain sensor missed 3 sequential incrementing reports, 14 occurrences where a rain sensor missed 4 sequential incrementing reports and 3 occurrences of missing 5 sequential reports.

A. May 14, 2007

The heaviest radio traffic period for the month occurred on May 14th when a series of sever thunderstorms developed in the evening between approximately 7:00 PM and 11:00 PM. These storms led to flash flooding along Lakewood Gulch. This storm generated significant radio traffic from the ALERT gages.

Several occurrences of hourly traffic exceeding 600 messages were identified.

- 5/14/2007 from 6:00 pm to 7:00 pm (530 reports)
- 5/14/2007 from 7:00 pm to 8:00 pm (1,341 reports)
- 5/14/2007 from 8:00 pm to 9:00 pm (1,050 reports)
- 5/14/2007 from 9:00 pm to 10:00 pm (828 reports)
- 5/14/2007 from 10:00 pm to 11:00 pm (651 reports)
- 5/14/2007 from 11:00 pm to 11:59 pm (625 reports)

The peak hour of traffic occurred on May 14th from 7:00 PM to 8:00 PM when 1,341 reports were received. The period of heaviest traffic was generally a 4 hour period from 7:00 PM to 11:00 PM. The ALERT data for the 4-hour period was examined more closely to characterize the distribution of sensor traffic (Table 5). During this time the radio traffic was dominated by rain and water level reports.

Table 5. Peak Traffic Period Sensor Report Distribution

Sensor Group	Reports	Percent
Water Level PT-HSE	1,478	38.2%
Precipitation	994	25.7%
Wind Gust	192	5.0%
Water Level Float	191	4.9%
None-ALERT-ID (computed at base station)	180	4.7%
Wind Speed Average & Azimuth	170	4.4%
Temperature	135	3.5%
Relative Humidity	91	2.4%
Precipitation - Mean	78	2.0%
Water Level PT	77	2.0%
Wind Direction	64	1.7%
Wind Speed Average	58	1.5%
Battery Voltage HSE	53	1.4%
Battery Voltage Digital	22	0.6%
Barometric Pressure	17	0.4%
Solar Radiation	15	0.4%
Hayman Precipitation	11	0.3%
Handar 585 ALARM Status	10	0.3%
Fuel Moisture	8	0.2%
Fuel Temperature	8	0.2%
Battery Voltage Analog	7	0.2%
Repeater Pass List	3	0.1%
12Hr Status Report	2	0.1%
Longmont Flow Gage	2	0.1%
Precipitation - Test	2	0.1%
Longmont Water Level PT	1	0.0%
Repeater Status Report	1	0.0%
Total	3,870	100.0%

Incrementing rain records for the period were examined to characterize the loss of sequential incrementing tip transmissions (Table 6).

Table 6. Peak Traffic Analysis - Loss of Incrementing Tip Reports – May 14, 2007

Heavy Traffic Period May 14, 2007	Occurrences of loss of sequential tip reports during 4-hour period			
	Loss of 2 tips	Loss of 3 tips	Loss of 4 tips	Loss of 5 tips
7:00 pm to 11:00 pm	50	15	8	1

Lost rain reports are evident during the entire 4 hour period on May 14 from 7:00 pm to 11:00 pm. The majority of lost reports include single and double tip reports. During the 4 hour period the loss of 3 or more sequential tip reports occurred a total of 24 times.

Thirty percent of the incrementing rain reports were lost during the storm period.

Twelve rain sensors experienced lost reports that exceeded 3 sequential counts. These rain sensor IDs include: 700, 730, 1710, 400, 410, 440, 620, 760, 1320, 1460, 1800, and 2330. Eight rain sensors, IDs 760, 1800, 420, 650, 800, 840, 900, and 1700 had multiple occurrences of missing 4 sequential tip count values.

The loss of 3 or more sequential data reports forms a limit of data degradation that causes a serious problem in the evaluation of alarm threshold conditions to support the flood mitigation needs of emergency responders within the District. The loss of sequential reports is a problem at stream sensors because it could cause the delay in triggering critical alarm conditions. A quick evaluation of water level sensors was conducted to see if the loss of sequential reports was also present in stream sensors.

A pressure transducer is used to monitor water level at Lakewood Gulch at 10th (ID 1563). The data from this sensor is plotted to evaluate the loss of reports during the May 14 storm (Figure 1). The data from this sensor looks good; few data reports are missing.

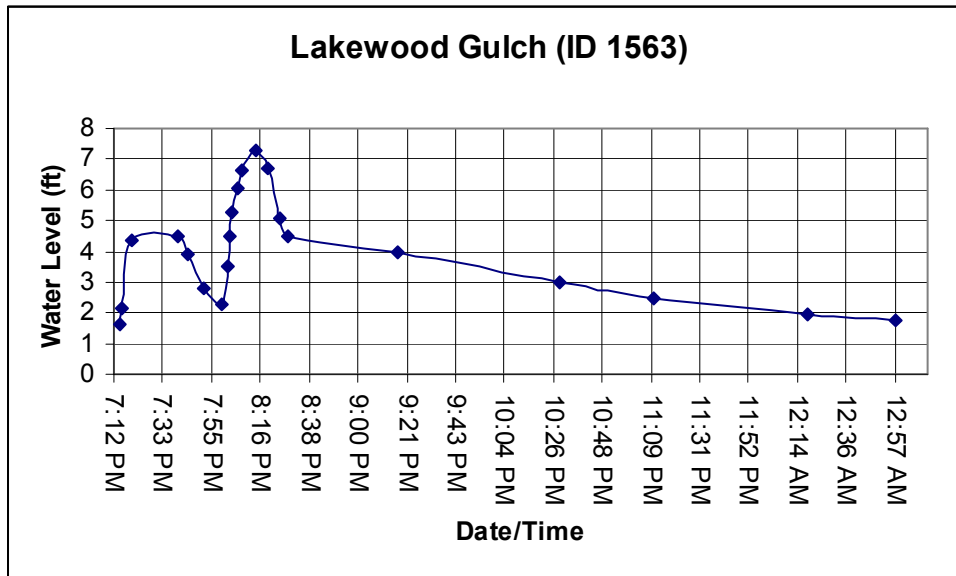


Figure 1. Lakewood Gulch Water Level Plot for May 14 Storm Period

Another water level sensor is located at Union Avenue. This sensor is programmed to report 4 times each hour. Periods where 1 and 2 sequential incrementing reports are missing are evident from the data record (Figure 2).

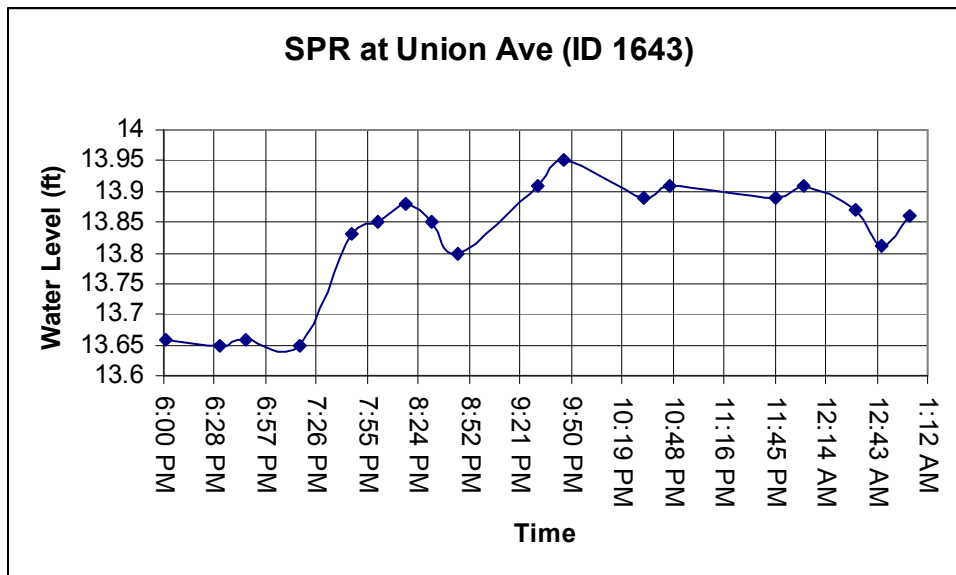


Figure 2. SPR at Union Ave Water Level Plot for May 14 Storm Period

B. May 23, 2007

A second storm in May produced heavy rainfall and excessive radio traffic. This storm occurred during the afternoon of May 23rd from approximately 2:00 PM through 7:00 PM. This storm generated significant radio traffic from the ALERT gages. Several occurrences of hourly traffic exceeding 600 messages were identified.

- 5/23/2007 from 2:00 pm to 3:00 pm (671 reports)
- 5/23/2007 from 3:00 pm to 4:00 pm (981 reports)
- 5/23/2007 from 4:00 pm to 5:00 pm (842 reports)
- 5/23/2007 from 5:00 pm to 6:00 pm (682 reports)
- 5/23/2007 from 6:00 pm to 7:00 pm (571 reports)

The peak hour of traffic on May 23rd occurred from 3:00 PM to 4:00 PM when 981 reports were received. The period of heaviest traffic was generally a 5 hour period from 2:00 PM to 7:00 PM. The ALERT data for the 5-hour period was examined more closely to characterize the distribution of sensor traffic. As with the event of May 14, the traffic loading was dominated by reports from rain and water level sensors which made up approximately 75 percent of the total traffic.

Incrementing rain records for the period were examined to characterize the loss of sequential incrementing tip transmissions (Table 7).

Table 7. Peak Traffic Analysis - Loss of Incrementing Tip Reports – May 23, 2007

Heavy Traffic Period May 23, 2007	Occurrences of loss of sequential tip reports during 4-hour period			
	Loss of 2 tips	Loss of 3 tips	Loss of 4 tips	Loss of 5 tips
2:00 pm to 7:00 pm	15	2	0	0

The majority of lost reports include single and double tip reports. During the 5 hour period the loss of 3 or more sequential tip reports occurred only twice.

Fifteen percent of the incrementing rain reports were lost during the May 23 storm event which was a much smaller percentage than the May 14 event.

Two rain sensors experienced lost reports that exceeded 3 sequential counts. These rain sensor IDs include: 540 and 1420.

VI. Unknown Device Analysis – Received Data Log

The ALERT IDs present in the audio signal received by the decoder are compared against a list of “active” device IDs that are defined within NovaStar. Those IDs received by the decoder that are not defined within NovaStar are considered to be “unknown” and may be the result of radio noise or problems with the telemetry system. The reception of “unknown” device reports for the month is summarized (Table 8).

Table 8. Summary of Unknown IDs

Description	Quantity
Total number of unknown IDs (IDs without a device definition)	172
Total reports from unknown IDs	709
Unknown IDs with only a single received report (potential noise)	117
Total reports from active “known” IDs – entire month	243,905
Unknown reports as a fraction of total active “known” reports	0.29%

The total number of reports from unknown sensor IDs is small relative to the total reports received for the month from the active sensors.

A number of “unknown” sensors had multiple reports which may indicate the existence of a transmitter that is sending information on an ID that is not currently defined within NovaStar. The unknown IDs with multiple reports including the number of reports received by each are quantified (Table 9).

Table 9. Reports Received by Unknown IDs

Unknown Sensor ID	Number of Reports
2754	251
4095	61
2239	60
4013	56
1339	16

Unknown Sensor ID	Number of Reports
1470	15
1327	12
2200	7
2204	7
754	4
4139	4

The “unknown” device reports were analyzed temporally to understand when they were received during the day (Table 10). The goal of this analysis is to determine a pattern of occurrence that may correspond to a source of noise in the system, such as the use of a wireless microphone nearby.

Table 10. Temporal Distribution of Unknown Reports

Hour (AM)	Reports	Hour (PM)	Reports
0:00-12:59	15	12:00-12:59	18
1:00-1:59	46	1:00-1:59	46
2:00-2:59	5	2:00-2:59	17
3:00-3:59	12	3:00-3:59	7
4:00-4:59	34	4:00-4:59	45
5:00-5:59	11	5:00-5:59	9
6:00-6:59	18	6:00-6:59	11
7:00-7:59	48	7:00-7:59	42
8:00-8:59	38	8:00-8:59	38
9:00-9:59	61	9:00-9:59	60
10:00-10:59	55	10:00-10:59	47
11:00-11:59	16	11:00-11:59	10

Unknown reports were received during each hour and their distribution throughout the day is shown (Figure 3). There seems to be a small spike in unknown reports every three hours.

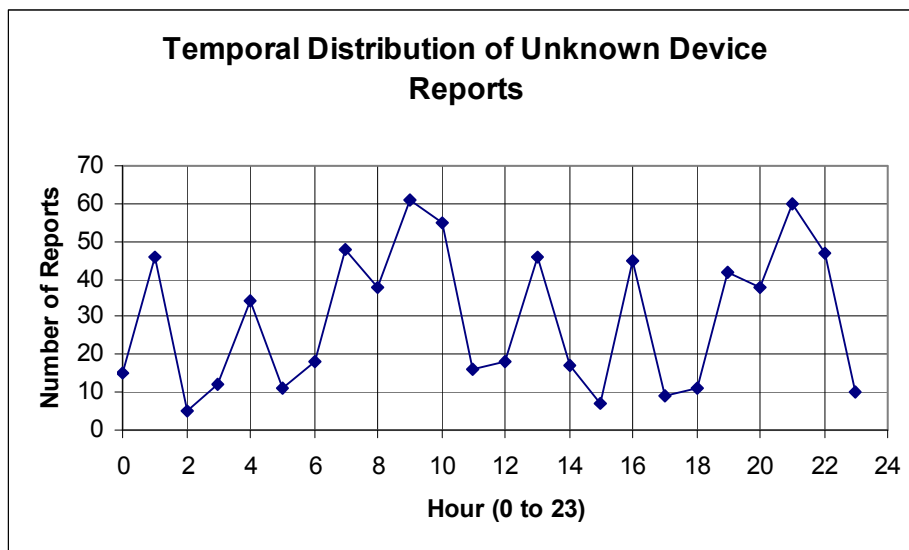


Figure 3. Daily Distribution of Unknown Device Reports

VII. Issues Continued from Previous Month

The following issues were identified last month.

1. The **Stapleton rain gage (ID 1460)** had a timer reporting interval of 24 hours instead of 12 hours.
2. **Guy Hill Ranch (ID 310) and Parker/Mississippi (ID 540)**: These sensors had poor timer and event performance.
3. Sensors reporting infrequently last month include:
 - a. Stapleton (ID 1463 – Barometric Pressure and ID 1469 - Solar) with 5 reports each,
 - b. SPR at Dartmouth (ID 1626) with 3 reports,
 - c. Button Rock Outlet (ID 4480) with 3 reports, and
 - d. Lena @ U.S. Hwy 6 (ID 1043) with 1 report
4. The large number of lost sequential reports experienced on April 24, 2007 led to the following question: Is the current radio telemetry architecture employed by the UDFCD able to reliably handle the traffic during an extreme event? The quantification of ALERT reports from the NovaStar base station for April 24 indicates the telemetry system is not able to handle large sustained volumes of radio traffic if the District's design criterion is to miss 3-or-more sequential transmissions from any one gage.

VIII. Issues Identified this Month

Further investigation into the following issues is recommended:

1. Those sensors reporting most frequently this month include:
 - a. Boulder Creek at Broadway (ID 4583) with 7,505 reports,
 - b. SPR at 3rd Street (ID 1323) with 6,667 reports,
 - c. SPR at Henderson (ID 1659) with 5,208 reports,
 - d. Salisbury Park (ID 2727) with 3,498 reports,
 - e. Green Ditch (ID 4593) with 3,053 reports, and
2. Several sensors reported infrequently including:
 - a. Stapleton (ID 1463 – Barometric Pressure and ID 1469 - Solar) with 2 and 5 reports respectively,
 - b. Boulder Jail (ID 4555 and ID 4550) with 6 and 16 reports respectively,
 - c. Button Rock Outlet (ID 4480) with 1 report, and
 - d. Lena @ U.S. Hwy 6 (ID 1043) with 13 reports
3. **Boulder Jail (ID 4550)**: This sensor stopped reporting on May 7, 2007.
4. **Sand Cr at Mouth (ID 1810), Parker/Mississippi (ID 540), Guy Hill Ranch (ID 310), Flying J (ID 850), and Shop Creek (ID 1710)**: These sensors all exhibited poor timer performance for the second month in a row.
5. **Sand Creek at Mouth (ID 1810)**: This sensor was missing data for a 9 day period extending from May 7th through May 16th.
6. **Aurora Reservoir (ID 900)**: This sensor had poor event and timer transmissions characteristics.
7. **Ward C-1 (ID 4710)**: On May 2nd the tip count value from this sensor jumps from 663 to 687 in a span of 25 seconds. A total jump of 24 tips was validated by the base station which equates to approximately 0.94 inches of rain in a 25 second period. Was maintenance performed on this sensor during this period?

8. **Storm of May 14, 2007:** Thirty (30) percent of the incrementing rain reports were lost during the 4-hour storm period on May 14 from 7:00 PM to 11:00 PM. The evening of May 14 was a busy period in terms of radio traffic. The peak hour of radio traffic occurred between 7:00 PM and 8:00 PM when approximately 1,341 reports were received at the base station and approximately 1,800 reports/hour or more were actually transmitted (1,341 plus 30% loss of rain transmissions and does not include lost water level reports).
9. Twelve rain sensors experienced lost reports that exceeded 3 sequential counts during the May 14 storm. These rain sensor IDs include: 700, 730, 1710, 400, 410, 440, 620, 760, 1320, 1460, 1800, and 2330. Eight rain sensors, IDs 760, 1800, 420, 650, 800, 840, 900, and 1700 had multiple occurrences of missing 4 sequential tip count values.
10. A number of “unknown” sensors had multiple reports which may indicate the existence of a transmitter that is sending information on an ID that is not currently defined within NovaStar.

Unknown Sensor ID	Number of Reports
2754	251
4095	61
2239	60
4013	56
1339	16
1470	15
1327	12
2200	7
2204	7
754	4
4139	4

General System Analysis

Database Name P:\A207-UDFCD-Data-Analysis\2007_May\Novastar_extract_2007May.mdb

First Date in Database	5/1/07 12:00 AM	Total Days	31.0
Last Date in Database	5/31/07 11:59 PM	Total Hours	744.0

Total Records Analyzed 287588

Records by Group

None-ALERT-ID	44683	16%
Water Level PT-HSE	43058	15%
Wind Gust	35313	12%
Relative Humidity	32687	11%
Temperature	27856	10%
Wind Speed Average & Azimuth	18723	7%
Precipitation	17920	6%
Wind Direction	15873	6%
Wind Speed Average	11156	4%
Water Level Float	6829	2%
Battery Voltage HSE	6455	2%
Water Level PT	4913	2%
Battery Voltage Digital	4637	2%
Solar Radiation	2833	1%
Precipitation - Mean	2787	1%
Barometric Pressure	2228	1%
Hayman Precipitation	1827	1%
Fuel Moisture	1444	1%
Fuel Temperature	1438	1%
Handar 585 ALARM Status	942	0%
Battery Voltage Analog	835	0%
Repeater Pass List	611	0%
Repeater Status Report	489	0%
Longmont Flow Gage	483	0%
Precipitation - Test	243	0%
12Hr Status Report	224	0%
Longmont Water Level PT	200	0%
Battery	118	0%
Soil Moisture	93	0%
Solar Power	5	0%
Total	286903	

Records by Major Group

Meteorologic Sensors	146669	51%
Water Level Sensors	55483	19%
Rain Sensors	17920	6%
Sensor Status Transmissions	14198	5%
Soil and Fuel Sensors	2975	1%
Total	237245	

Records by Validation Type

Good	0	283320	99%
Questionable	1	4268	1%
Total		287588	

Sensors With Most Invalid Data

Description	Sensor	Reports
Squaw Mountain	2189	2515
Squaw Mountain	2187	1103
Louisville Lake	4744	37
Elbert	1439	35
Salisbury Park	2724	34

Traffic Loading Summary

Alert Reports	287588	
Average Daily Traffic	9277	
Average Hourly Traffic	387	
Median Hourly Traffic	379	hour beginning
Peak Hourly Traffic	1341	5/14/07 7:00 PM

General System Analysis

Description	Reports per Sensor		Fraction of Total
	Sensor	Reports	
Boulder Cr at Broadway	4583	7505	3%
SPR at 3rd Ave	1323	6667	2%
None-ALERT-ID	9233	5904	2%
SPR at Henderson	1659	5208	2%
Stapleton	1461	4653	2%
None-ALERT-ID	9353	3530	1%
Salisbury Park	2727	3498	1%
Quincy Reservoir	747	3115	1%
Green Ditch	4593	3053	1%
Stapleton	1466	2853	1%
Stapleton	1464	2833	1%
Elbert	1439	2775	1%
Stapleton	1465	2759	1%
Stapleton	1467	2755	1%
Salisbury Park	2724	2726	1%
Castle Rock	2744	2707	1%
None-ALERT-ID	9241	2680	1%
None-ALERT-ID	9273	2672	1%
Marston Lake North	1521	2629	1%
Squaw Mountain	2187	2623	1%
None-ALERT-ID	9272	2610	1%
None-ALERT-ID	9231	2545	1%
None-ALERT-ID	9211	2532	1%
Hiwan G.C.	2208	2529	1%
Squaw Mountain	2189	2515	1%
Squaw Mountain	2188	2501	1%
Blue Mountain	138	2473	1%
Louisville Lake	4744	2460	1%
Diamond Hill	1414	2406	1%
Elbert	1438	2398	1%
Quincy Reservoir	751	2372	1%
Englewood Dam	1603	2360	1%
None-ALERT-ID	9271	2329	1%
Salisbury Park	2732	2326	1%
Castle Rock	2747	2274	1%
None-ALERT-ID	9251	2264	1%
Sugarloaf	4724	2247	1%
SPR at Union Ave.	1643	2212	1%
Highlands Ranch WTP	2704	2188	1%
None-ALERT-ID	9354	2164	1%
Ward C-1	4704	2155	1%
None-ALERT-ID	9351	2120	1%
Brighton	1914	2101	1%
None-ALERT-ID	9352	2099	1%
None-ALERT-ID	9262	2084	1%
None-ALERT-ID	9201	2014	1%
Basin Avg-Bear Creek □	9100	2003	1%
Blue Mountain	139	1972	1%
Salisbury Park	2731	1945	1%
Louisville Lake	4751	1899	1%
None-ALERT-ID	9261	1894	1%
Highlands Ranch WTP	2711	1891	1%
Castle Rock	2751	1884	1%
Aurora Reservoir	906	1875	1%
None-ALERT-ID	9355	1835	1%
Brighton	1921	1816	1%
Louisville Lake	4747	1815	1%
None-ALERT-ID	9221	1813	1%
Hiwan G.C.	2212	1788	1%
Highlands Ranch WTP	2712	1724	1%
Cal-Wood Ranch	4771	1712	1%
Cal-Wood Ranch	4772	1707	1%
Blue Mountain	142	1699	1%
Brighton	1922	1693	1%
Ward C-1	4712	1690	1%
Highlands Ranch WTP	2707	1676	1%
Sugarloaf	4731	1674	1%
Sugarloaf	4732	1661	1%
Ward C-1	4711	1660	1%
Louisville Lake	4752	1631	1%
None-ALERT-ID	9232	1594	1%
Stapleton	1462	1584	1%
Diamond Hill	1422	1582	1%
Cal-Wood Ranch	4764	1531	1%
Quincy Reservoir	752	1510	1%
Button Rock	4791	1508	1%
Diamond Hill	1417	1484	1%
Squaw Mountain	2192	1442	1%

Rain Timer Performance

Analyze Rain Sensors

systemwide average (days)
0.5198

Systemwide Average
89%

Rain Sensor ID	Received	Average Timer Interval	Expected	Performance
4550	3	0:00	62	5%
1810	25	19:07	62.00	40%
1460	28	1:15	62.00	45%
310	33	17:27	62.00	53%
900	40	15:16	62.00	65%
4080	43	14:30	62	69%
540	44	14:25	62.00	71%
4570	46	14:53	62	74%
110	47	14:10	62.00	76%
850	48	13:45	62.00	77%
1710	48	14:20	62.00	77%
2270	48	13:30	62	77%
2340	48	12:36	62	77%
4560	48	15:18	62	77%
4820	49	13:30	62	79%
1200	50	13:27	62.00	81%
4060	50	14:13	62	81%
4170	50	14:05	62	81%
530	51	14:03	62.00	82%
700	51	14:02	62.00	82%
1350	51	12:56	62.00	82%
2190	51	12:19	62	82%
2330	51	13:08	62	82%
760	52	13:07	62.00	84%
1700	52	13:10	62.00	84%
4180	52	12:51	62	84%
4200	52	13:23	62	84%
4470	52	12:49	62	84%
4490	52	13:04	62	84%
4730	52	12:56	62	84%
4790	52	13:27	62	84%
1030	53	13:03	62.00	85%
2260	53	12:19	62	85%
4090	53	12:14	62	85%
100	54	12:31	62.00	87%
650	54	12:48	62.00	87%
810	54	12:46	62.00	87%
1520	54	12:16	62.00	87%
1640	54	13:08	62.00	87%
2350	54	13:10	62	87%
2370	54	12:16	62	87%
4050	54	12:49	62	87%
4240	54	13:23	62	87%
4290	54	12:56	62	87%
4810	54	12:46	62	87%
220	55	12:47	62.00	89%
440	55	13:01	62.00	89%
500	55	13:19	62.00	89%
510	55	12:32	62.00	89%
620	55	12:33	62.00	89%
1110	55	12:15	62.00	89%
1300	55	12:35	62.00	89%
1600	55	12:29	62.00	89%
4010	55	12:51	62	89%
4150	55	12:50	62	89%
4340	55	12:20	62	89%
4520	55	13:23	62	89%
4530	55	12:14	62	89%
4710	55	12:20	62	89%
150	56	12:00	62.00	90%
300	56	12:13	62.00	90%
420	56	11:58	62.00	90%
1020	56	12:52	62.00	90%
1060	56	12:14	62.00	90%
1100	56	13:00	62.00	90%
1370	56	12:15	62.00	90%
1480	56	13:15	62.00	90%
1540	56	12:27	62.00	90%
1660	56	12:46	62.00	90%
1800	56	12:57	62.00	90%
2220	56	12:50	62	90%
2230	56	12:18	62	90%
2250	56	12:58	62	90%
2820	56	12:16	62	90%

4020	56	12:31	62	90%
4030	56	12:30	62	90%
4750	56	12:46	62	90%
4840	56	13:03	62	90%
140	57	12:17	62.00	92%
410	57	11:58	62.00	92%
520	57	12:14	62.00	92%
640	57	12:22	62.00	92%
730	57	12:27	62.00	92%
800	57	12:44	62.00	92%
840	57	12:30	62.00	92%
1010	57	12:28	62.00	92%
1360	57	12:15	62.00	92%
1400	57	11:57	62.00	92%
1530	57	12:28	62.00	92%
1620	57	12:30	62.00	92%
1900	57	12:13	62.00	92%
2210	57	12:34	62	92%
2280	57	12:17	62	92%
2360	57	12:51	62	92%
2840	57	12:47	62	92%
4300	57	11:57	62	92%
4510	57	12:32	62	92%
120	58	12:29	62.00	94%
200	58	12:27	62.00	94%
210	58	11:58	62.00	94%
630	58	11:57	62.00	94%
820	58	11:57	62.00	94%
830	58	12:33	62.00	94%
870	58	12:32	62.00	94%
1050	58	11:57	62.00	94%
1330	58	12:15	62.00	94%
1420	58	12:15	62.00	94%
1500	58	12:13	62.00	94%
1920	58	12:14	62	94%
2240	58	12:00	62	94%
2810	58	12:15	62	94%
4110	58	12:14	62	94%
4220	58	12:15	62	94%
4260	58	11:45	62	94%
320	59	12:14	62.00	95%
400	59	11:58	62.00	95%
610	59	11:57	62.00	95%
720	59	11:58	62.00	95%
750	59	12:00	62.00	95%
1000	59	11:57	62.00	95%
1040	59	12:14	62.00	95%
1310	59	12:13	62.00	95%
1320	59	11:58	62.00	95%
1340	59	12:14	62.00	95%
1440	59	12:31	62.00	95%
1610	59	12:22	62.00	95%
2310	59	12:00	62	95%
2750	59	12:16	62	95%
4040	59	12:13	62	95%
4070	59	12:28	62	95%
4160	59	12:29	62	95%
4310	59	12:13	62	95%
4330	59	11:46	62	95%
4830	59	12:28	62	95%
330	60	12:00	62.00	97%
710	60	12:12	62.00	97%
740	60	11:59	62.00	97%
2710	60	12:00	62	97%
4100	60	12:14	62	97%
4230	60	12:42	62	97%
4360	60	12:27	62	97%
600	61	11:58	62.00	98%
1720	61	12:00	62.00	98%
2730	61	12:00	62	98%
4130	61	11:13	62	98%
4190	61	11:56	62	98%
4270	61	11:43	62	98%
4770	61	12:00	62	98%
4140	62	11:58	62	100%
4350	62	12:01	62	100%
4250	64	10:33	62	103%
860	105	6:30	62.00	169%
2320	204		62	

Rain Event Performance			Analyze Rain Sensors													
		Reports Received	8738													
		Systemwide Avg	10171													
		86%	14.09%													
Sensor	Performance	1-tips	2-tips	3-tips	4-tips	5-tips	6-tips	>6-tips	Received	Expected	Missed	hold-off	Bucket			
860	68%	33	18	4	0	0	0	0	55	81	26	0	0.0393701			
4710	68%	60	5	1	0	0	0	1	66	97	7	0	0.0393701			
1810	68%	43	6	1	0	0	0	1	50	73	8	0	0.0393701			
840	69%	28	8	3	0	1	0	0	40	58	18	0	0.0393701			
400	69%	47	13	5	1	1	0	0	67	97	30	0	0.0393701			
800	69%	41	7	4	0	1	1	0	54	78	24	0	0.0393701			
900	71%	34	5	3	1	1	0	0	44	62	18	0	0.0393699			
4290	71%	36	5	1	1	2	0	0	45	63	18	0	0.0393701			
4550	71%	6	4	0	0	0	0	0	10	14	4	0	0.0393701			
4490	72%	32	4	4	0	1	0	0	41	57	16	0	0.0393701			
1700	73%	46	10	3	1	1	0	0	61	84	23	0	0.0393701			
1350	73%	54	9	0	1	0	1	1	65	89	17	0	0.0393701			
760	73%	41	6	3	1	1	0	0	52	71	19	0	0.0393701			
1710	73%	49	10	1	2	0	1	0	63	86	23	0	0.0393701			
4180	74%	34	4	1	0	0	0	1	39	53	6	0	0.0393701			
1800	74%	41	10	1	1	1	0	0	54	73	19	0	0.0393701			
4470	75%	43	8	4	1	0	0	0	56	75	19	0	0.0393701			
620	75%	45	13	2	1	0	0	0	61	81	20	0	0.0393701			
850	76%	38	12	2	0	0	0	0	52	68	16	0	0.0393701			
110	77%	31	11	1	0	0	0	0	43	56	13	0	0.0393701			
410	77%	47	9	3	1	0	0	0	60	78	18	0	0.0393701			
4130	77%	31	6	3	0	0	0	0	40	52	12	0	0.0393701			
650	77%	56	13	2	0	1	0	0	72	93	21	0	0.0393701			
700	77%	44	8	1	2	0	0	0	55	71	16	0	0.0393701			
4790	77%	43	10	0	2	0	0	0	55	71	16	0	0.0393701			
440	78%	38	2	4	1	0	0	0	45	58	13	0	0.0393701			
730	78%	35	4	1	2	0	0	0	42	54	12	0	0.0393701			
820	79%	37	9	2	0	0	0	0	48	61	13	0	0.0393701			
870	79%	46	12	2	0	0	0	0	60	76	16	0	0.0393701			
710	79%	33	7	2	0	0	0	0	42	53	11	0	0.0393701			
420	79%	63	5	0	0	1	0	1	69	87	9	0	0.0393701			
750	79%	39	9	2	0	0	0	0	50	63	13	0	0.0393701			
4570	79%	46	9	3	0	0	0	0	58	73	15	1	0.0393701			
1030	80%	51	8	4	0	0	0	0	63	79	16	0	0.0393701			
2340	80%	42	3	3	1	0	0	0	49	61	12	0	0.0393701			
2330	81%	62	9	3	1	0	0	0	75	93	18	0	0.0393701			
320	81%	52	11	0	0	1	0	0	64	79	15	0	0.0393701			
540	81%	54	8	2	1	0	0	0	65	80	15	0	0.0393701			
1360	81%	60	11	3	0	0	0	0	74	91	17	0	0.0393701			
1720	82%	62	9	4	0	0	0	0	75	92	17	0	0.0393701			
830	82%	47	4	4	0	0	0	0	55	67	12	0	0.0393701			
1600	82%	31	4	2	0	0	0	0	37	45	8	0	0.0393701			
1000	83%	54	10	2	0	0	0	0	66	80	14	0	0.0393701			
4250	83%	42	9	1	0	0	0	0	52	63	11	0	0.0393701			
810	83%	47	8	2	0	0	0	0	57	69	12	0	0.0393701			
1420	83%	73	11	2	1	0	0	0	87	105	18	0	0.0393701			
630	83%	101	12	1	0	0	0	1	114	137	14	0	0.0393701			
2730	83%	24	6	0	0	0	0	0	30	36	6	0	0.0393701			
4730	84%	30	5	1	0	0	0	0	36	43	7	0	0.0393701			
520	84%	56	9	2	0	0	0	0	67	80	13	0	0.0393701			
2370	84%	43	10	0	0	0	0	0	53	63	10	0	0.0393701			
1530	84%	65	6	4	0	0	0	0	75	89	14	0	0.0393701			
500	84%	59	9	2	0	0	0	0	70	83	13	0	0.0393701			
530	85%	57	8	2	0	0	0	0	67	79	12	0	0.0393701			
510	85%	61	11	1	0	0	0	0	73	86	13	0	0.0393701			
1460	85%	78	9	2	1	0	0	0	90	106	16	0	0.0393701			
4140	85%	30	3	0	1	0	0	0	34	40	6	0	0.0393701			
610	85%	63	9	2	0	0	0	0	74	87	13	1	0.0393701			
4520	85%	48	10	0	0	0	0	0	58	68	10	0	0.0393701			
1660	85%	30	4	1	0	0	0	0	35	41	6	0	0.0393701			
2820	86%	50	10	0	0	0	0	0	60	70	10	0	0.0393701			
1440	86%	47	9	0	0	0	0	0	56	65	9	0	0.0393701			
4060	86%	33	4	1	0	0	0	0	38	44	6	0	0.0393701			
4170	87%	23	4	0	0	0	0	0	27	31	4	0	0.0393701			
2320	87%	54	5	2	0	0	0	0	61	70	9	0	0.0393701			
1520	87%	65	9	1	0	0	0	0	75	86	11	0	0.0393701			
4240	87%	38	2	0	0	1	0	0	41	47	6	0	0.0393701			
4530	87%	42	5	1	0	0	0	0	48	55	7	0	0.0393701			
120	87%	61	6	2	0	0	0	0	69	79	10	0	0.0393701			
310	88%	51	3	1	1	0	0	0	56	64	8	0	0.0393701			
740	88%	49	6	1	0	0	0	0	56	64	8	0	0.0393701			
1620	88%	54	9	0	0	0	0	0	63	72	9	0	0.0393701			
4070	88%	30	5	0	0	0	0	0	35	40	5	0	0.0393701			

150	88%	50	6	1	0	0	0	0	57	65	8	0	0.0393701
1110	88%	25	4	0	0	0	0	0	29	33	4	0	0.0393701
1010	88%	78	9	0	1	0	0	0	88	100	12	0	0.0393701
1040	88%	77	10	1	0	0	0	0	88	100	12	0	0.0393701
4150	88%	45	7	0	0	0	0	0	52	59	7	0	0.0393701
1400	88%	72	9	1	0	0	0	0	82	93	11	0	0.0393701
2840	88%	33	5	0	0	0	0	0	38	43	5	0	0.0393701
4820	89%	34	5	0	0	0	0	0	39	44	5	0	0.0393701
1330	89%	84	8	2	0	0	0	0	94	106	12	0	0.0393701
2230	89%	78	8	0	1	0	0	0	87	98	11	0	0.0393701
600	89%	72	6	2	0	0	0	0	80	90	10	0	0.0393701
1320	89%	72	7	0	1	0	0	0	80	90	10	1	0.0393701
4810	89%	36	5	0	0	0	0	0	41	46	5	0	0.0393701
2190	89%	59	7	0	0	0	0	1	66	74	7	0	0.0393701
4750	89%	29	4	0	0	0	0	0	33	37	4	0	0.0393701
1340	89%	67	9	0	0	0	0	0	76	85	9	0	0.0393701
200	90%	54	5	1	0	0	0	0	60	67	7	0	0.0393701
1920	90%	23	3	0	0	0	0	0	26	29	3	0	0.0393701
4360	90%	46	6	0	0	0	0	0	52	58	6	0	0.0393701
100	90%	66	6	1	0	0	0	0	73	81	8	0	0.0393701
210	90%	50	6	0	0	0	0	0	56	62	6	0	0.0393701
4010	90%	42	5	0	0	0	0	0	47	52	5	0	0.0393701
4040	90%	35	2	1	0	0	0	0	38	42	4	0	0.0393701
1060	91%	78	9	0	0	0	0	0	87	96	9	0	0.0393701
1310	91%	63	4	0	1	0	0	0	68	75	7	0	0.0393701
720	91%	36	4	0	0	0	0	0	40	44	4	0	0.0393701
1200	91%	45	5	0	0	0	0	0	50	55	5	0	0.0393701
2250	91%	74	4	2	0	0	0	0	80	88	8	0	0.0393701
2310	91%	74	6	1	0	0	0	0	81	89	8	1	0.0393701
2710	91%	57	2	2	0	0	0	0	61	67	6	0	0.0393701
4200	91%	38	4	0	0	0	0	0	42	46	4	0	0.0393701
4110	91%	39	4	0	0	0	0	0	43	47	4	0	0.0393701
4230	91%	40	2	1	0	0	0	0	43	47	4	0	0.0393701
2350	92%	70	5	1	0	0	0	0	76	83	7	0	0.0393701
4510	92%	60	6	0	0	0	0	0	66	72	6	0	0.0393701
1500	92%	74	5	1	0	0	0	0	80	87	7	0	0.0393701
4220	92%	53	5	0	0	0	0	0	58	63	5	0	0.0393701
300	92%	66	4	1	0	0	0	0	71	77	6	0	0.0393701
1480	92%	66	4	1	0	0	0	0	71	77	6	0	0.0393701
2280	93%	91	8	0	0	0	0	0	99	107	8	21	0.0393701
2810	93%	81	7	0	0	0	0	0	88	95	7	0	0.0393701
2270	93%	94	6	1	0	0	0	0	101	109	8	0	0.0393701
4030	93%	35	3	0	0	0	0	0	38	41	3	0	0.0393701
220	93%	47	4	0	0	0	0	0	51	55	4	0	0.0393701
1370	93%	60	3	1	0	0	0	0	64	69	5	0	0.0393701
2240	93%	72	4	1	0	0	0	0	77	83	6	0	0.0393701
640	93%	84	7	0	0	0	0	0	91	98	7	0	0.0393701
2210	93%	60	5	0	0	0	0	0	65	70	5	0	0.0393701
4300	93%	61	5	0	0	0	0	0	66	71	5	0	0.0393701
4190	93%	49	4	0	0	0	0	0	53	57	4	0	0.0393701
4080	93%	39	1	1	0	0	0	0	41	44	3	0	0.0393701
330	93%	64	5	0	0	0	0	0	69	74	5	0	0.0393701
1100	93%	39	3	0	0	0	0	0	42	45	3	0	0.0393701
1640	94%	68	3	1	0	0	0	0	72	77	5	0	0.0393701
1900	94%	57	4	0	0	0	0	0	61	65	4	0	0.0393701
4310	94%	60	2	1	0	0	0	0	63	67	4	0	0.0393701
4830	94%	45	3	0	0	0	0	0	48	51	3	0	0.0393701
1300	94%	61	4	0	0	0	0	0	65	69	4	0	0.0393701
4270	94%	47	3	0	0	0	0	0	50	53	3	0	0.0393701
4090	95%	36	2	0	0	0	0	0	38	40	2	0	0.0393701
4340	95%	55	3	0	0	0	0	0	58	61	3	0	0.0393701
2360	95%	75	4	0	0	0	0	0	79	83	4	0	0.0393701
4840	96%	48	2	0	0	0	0	0	50	52	2	0	0.0393701
4350	96%	53	2	0	0	0	0	0	55	57	2	0	0.0393701
2260	97%	85	3	0	0	0	0	0	88	91	3	0	0.0393701
4260	97%	59	2	0	0	0	0	0	61	63	2	0	0.0393701
1540	97%	60	2	0	0	0	0	0	62	64	2	1	0.0393701
4050	97%	36	1	0	0	0	0	0	37	38	1	0	0.0393701
4100	98%	40	1	0	0	0	0	0	41	42	1	1	0.0393701
140	98%	47	1	0	0	0	0	0	48	49	1	0	0.0393701
1050	98%	47	1	0	0	0	0	0	48	49	1	0	0.0393701
4160	98%	47	1	0	0	0	0	0	48	49	1	1	0.0393701
4020	98%	48	1	0	0	0	0	0	49	50	1	0	0.0393701
4770	98%	56	1	0	0	0	0	0	57	58	1	0	0.0393701
4330	99%	66	1	0	0	0	0	0	67	68	1	0	0.0393701
2750	100%	55	0	0	0	0	0	0	55	55	0	0	0.0393701
Total Tips		7646	891	154	30	14	3	7	8738	10171	1360		

Radio Traffic Plot

