
One Hundred Percent Read Rates with Optimized Weapon Rack Antenna Placement at Site 24. Thursday, September 24, 2015, Version 1-3

Purpose: Optimize rack antenna placement with nose and rail tags on live weapons at Site 24.

Background: Site 24 had temporary surface applied tags to test weapons and systems. Antennas for those initial tests were all horizontal as seen in Figure 1. After Visible obtained access to the weapons companies tags were designed and optimized for the specific weapons. That tag redesign also changed optimal orientation for antenna placement on racks. This white paper describes data collected on September 16th with the original orientation (horizontal) and the optimal orientation (see Figure 1) and shows that we obtain 100% read rates on the racks with high signal ranges on all tags.

Methods: Standard Part11 csv data audit files were collected for a single audit on September 16th 2015, and after the antennas were optimized as shown in Figure 1 again on September 22nd. These files were analyzed using DatDesk6 - a Data mining program widely used for analysis of point process data sets. The Part11 data files provide a list of all tag read events that includes signal strength, CRC results of read (0 or 1), cross-correlation, tag ID and if weapon is checked in or out. It is initially exported as a .csv file and imported into DatDesk6 - DataDesk provides a flexible, arbitrary statistical analysis of complex data sets. As an example, we show the statistics for all checked in weapons, and a scatter plot of tag ID vs signal strength at the bottom in "B" of Figure 2.

In all cases the green dots seen on the scatter plots indicate a positive CRC and an acceptable read. The signal is given in signal units (SU). Each 100 SU is equal to about 100 mgauss, and the maximum SU is 6,000. Typically we set a minimum SU threshold to 200 SU depending upon the background noise.

Results: Figure 3 shows general statistical results for Sep. 16th horizontal antenna configuration and Sep 22nd with optimized configuration. This data has simple filter for all positive reads CRC is equal to 1. It shows that means and medians are statically identical; Sep 16th has a mean of 1,674, and Sep22nd, 1717. The green dots on the scatter plot simply mean CRC was equal to 1 and it was a valid read. Both show that the minimum acceptable read level was 200 signal units.

Figure 4 shows the scatter plots for Sep 16th data in A and the histogram for same data in B. The filter in this case is set for the maximum SU value for an individual tag. Each tag is read by all antennas in the facility and each rack has three antennas for a total

of 30 attempted reads. That means a tag may be read by an antenna in the adjacent rack at a low SU value but be read by the correct rack (rack where weapon is located at a much high SU value. The SU value can be used as a tape measure and can be used to generally locate weapon in the room and rack. With additional antennas and sidewinders the X, Y Z location can be improved but becomes costly.

Figure 4 A shows that we missed five weapons (red dots below 200 SU). The histogram also shows maximum SU reads for weapons that are checked in below 200 SU.

Figure 5 is data from Sep. 22nd after the antennas have been optimized as shown in Figure 1 - antenna configuration B. These antennas now provide a co-planner optimal read no matter what the tag orientation. Figure 5A shows a 100% read rate with the lowest maximum SU value of 1,832 or 9.17 times the minimum acceptable SU of 200. The histogram in Figure 5B shows a healthy shift to the right from Figure 4B.

Figure 6 shows weapons on Sep 22nd that are checked out. As expected we have no false positives and all reads are below 200 with a mean of 52 SU indicating a missing weapon.

Conclusions: The optimized B antenna configuration shown in Figure 1, provides reads of all weapons with a safety factor of 9 times over minimum acceptable signal strength with a mean of 4,253 SU and median 4,462 providing a read safety factor of over 190 times minimum acceptable SU level of 200.

Figure 1
Site 24 - Racks 7-10
Sept. 16th

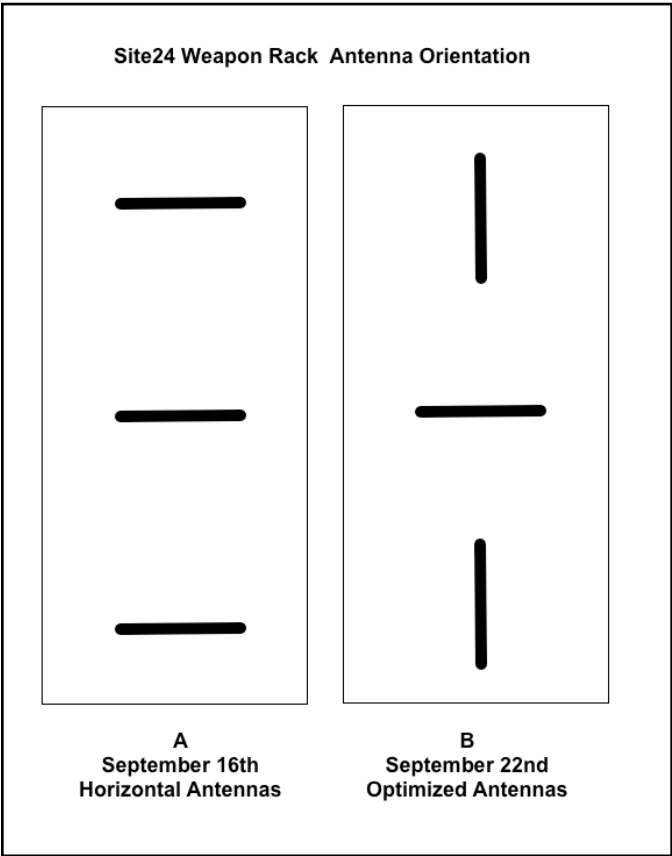


Figure 2

DataDesk6 provides comprehensive statistical data analysis, at the tag level, for each read or write event.

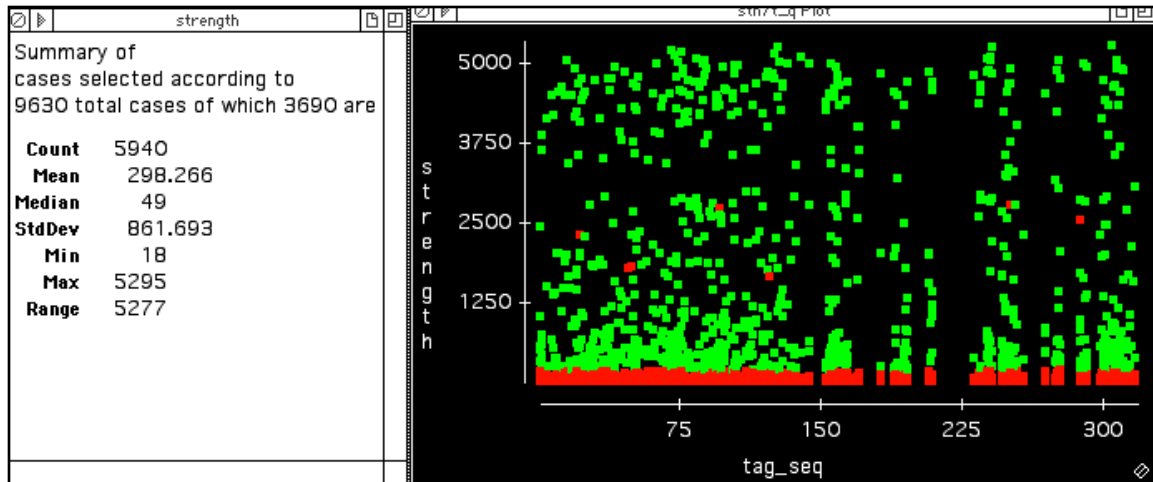
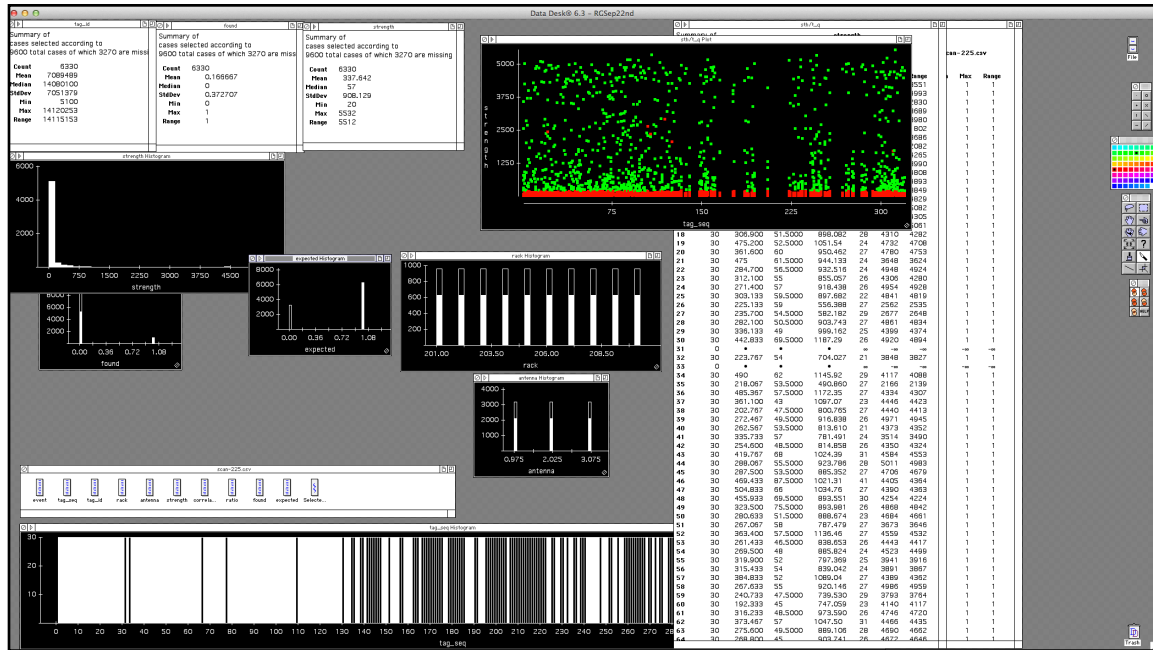
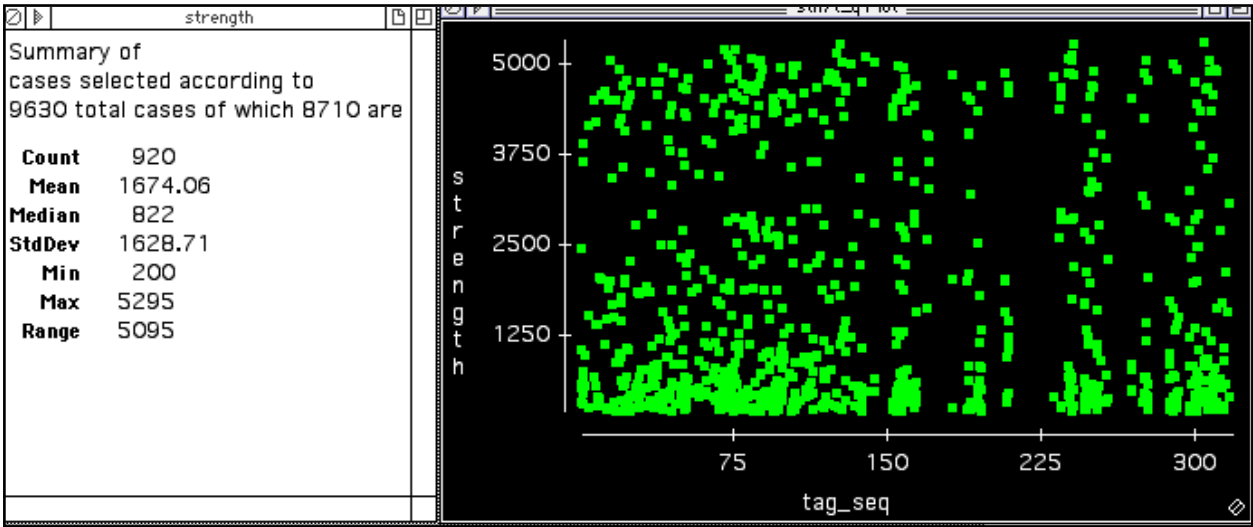


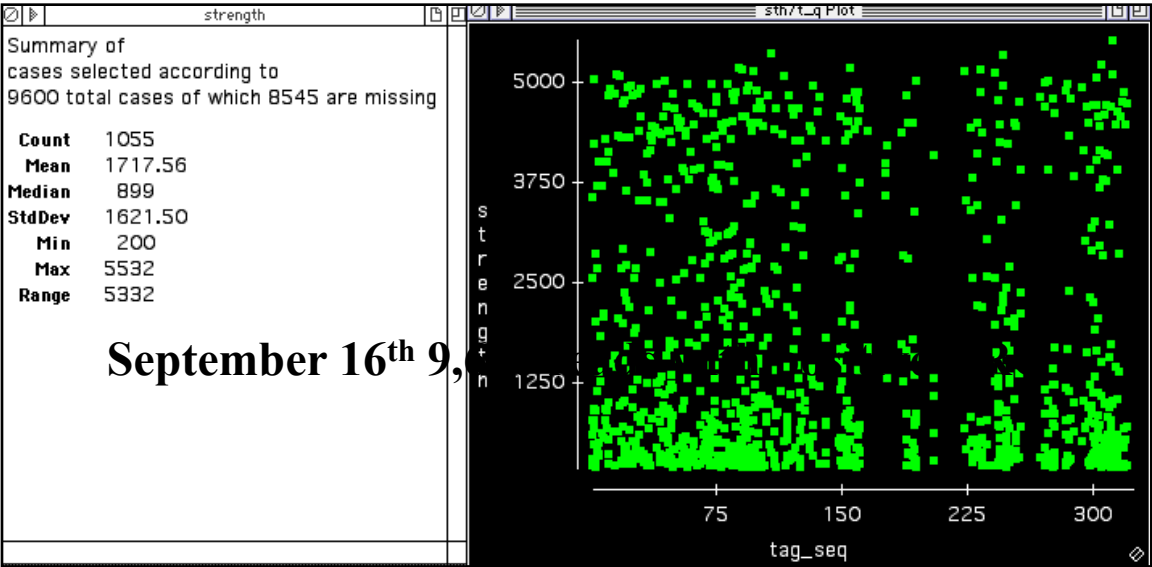
Figure 3

A



September 22nd 9,600 reads with positive CRC

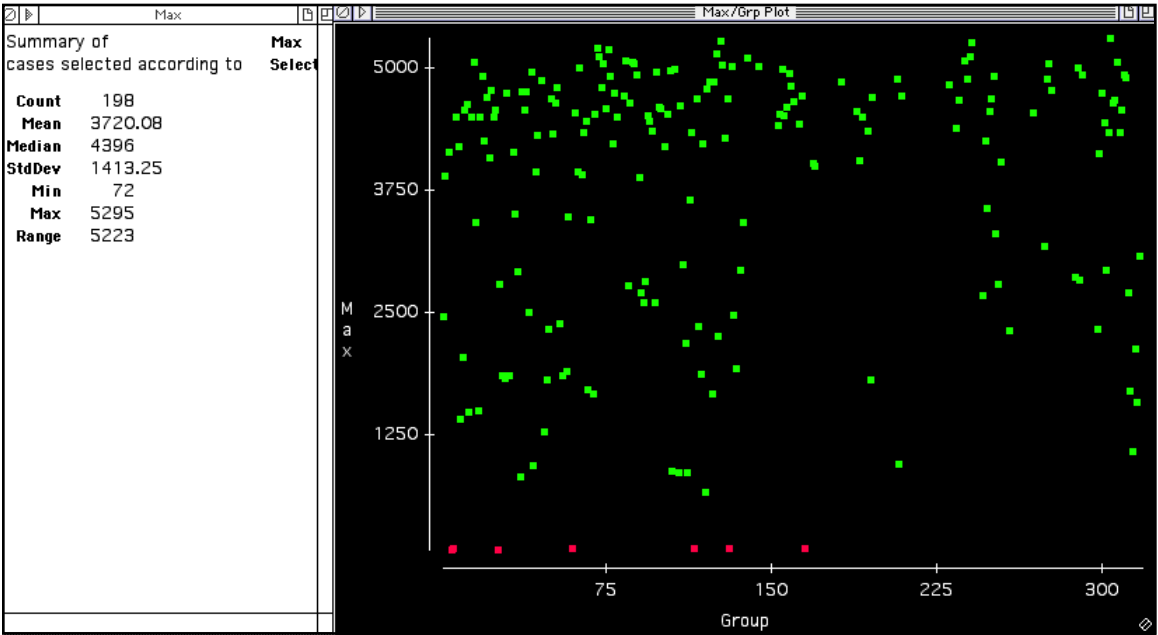
B



September 16th 9,

September 16th Statistics “A” Horizontal Antenna Configuration - Top filter set for tag maximum signal strength for checked in weapons only. Bottom same filter signal histogram. This data shown in Figure 4A shows five missed weapons (red dots) with lowest read of 72 or 2.7 times below minimum signal of 200.

A



B

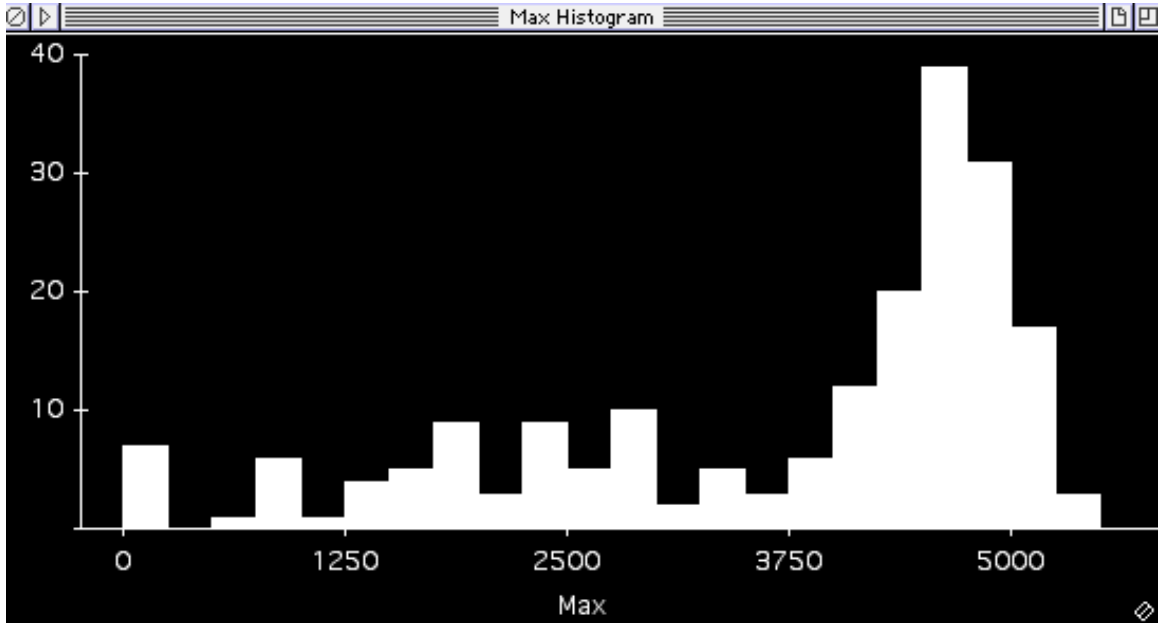
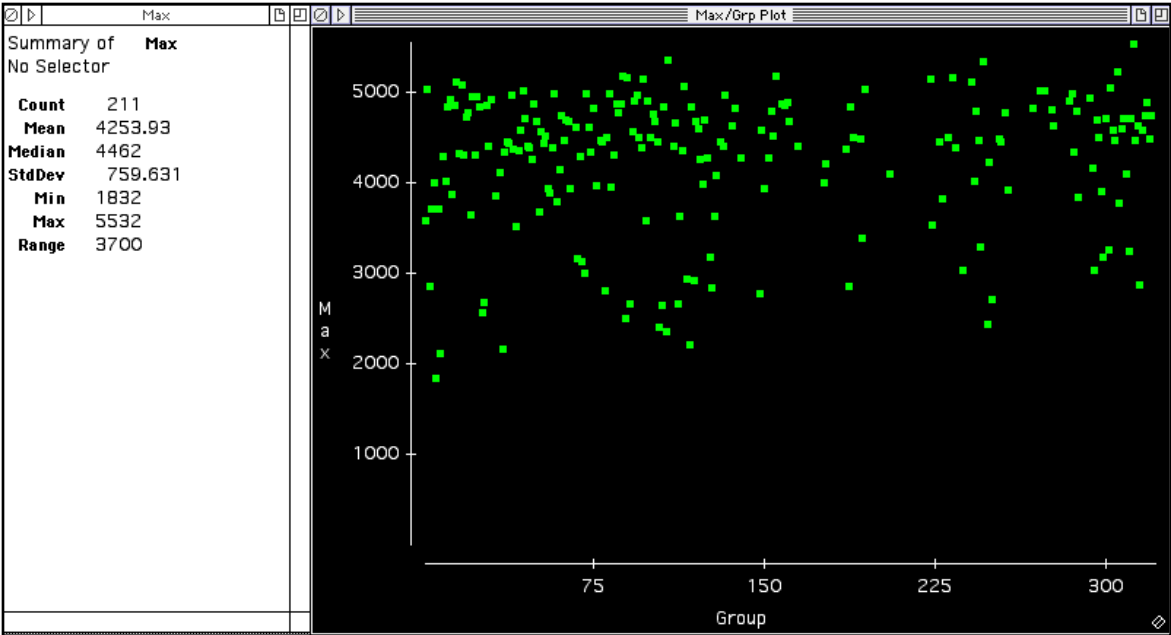


Figure 5

September 22nd Statistics Optimized “B” Antenna Configuration - Top filter set for tag maximum signal strength for checked in weapons only. Bottom same filter signal histogram. This data shown in Figure 5A shows 100% read rate with lowest read of 1,832 or 9.17 times minimum signal of 200.

A



B

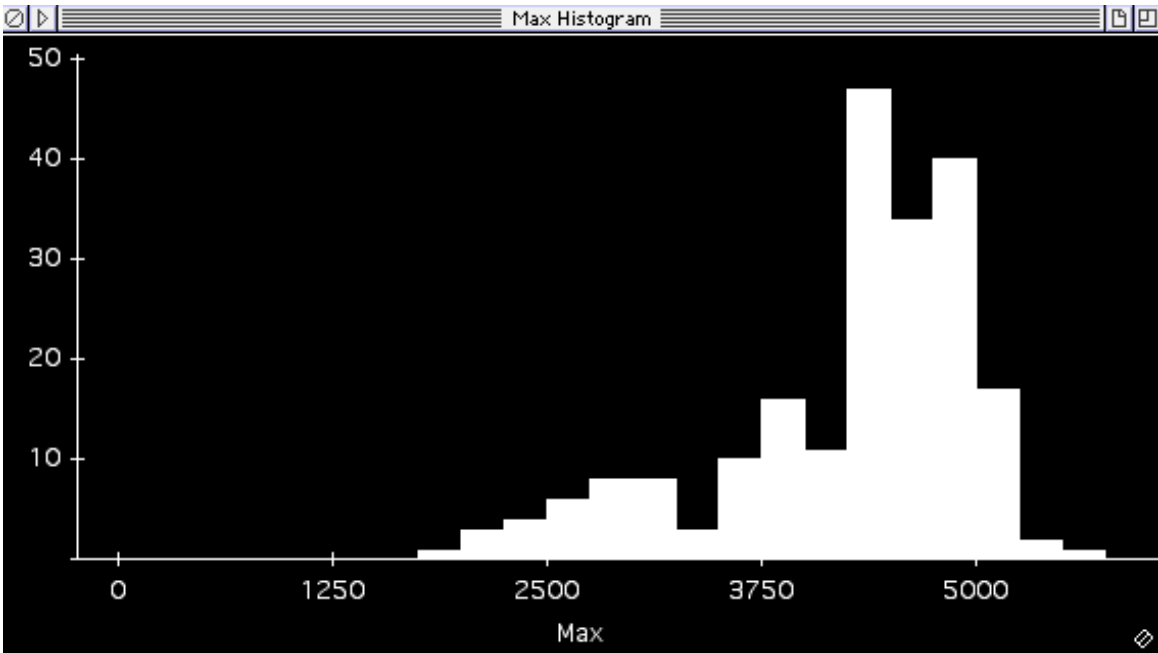
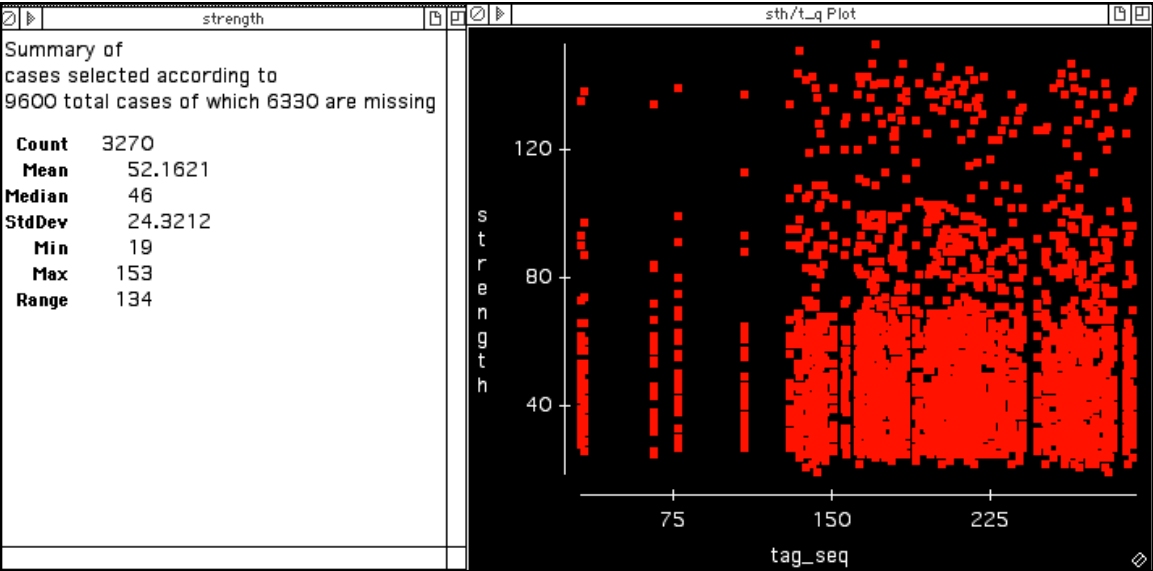


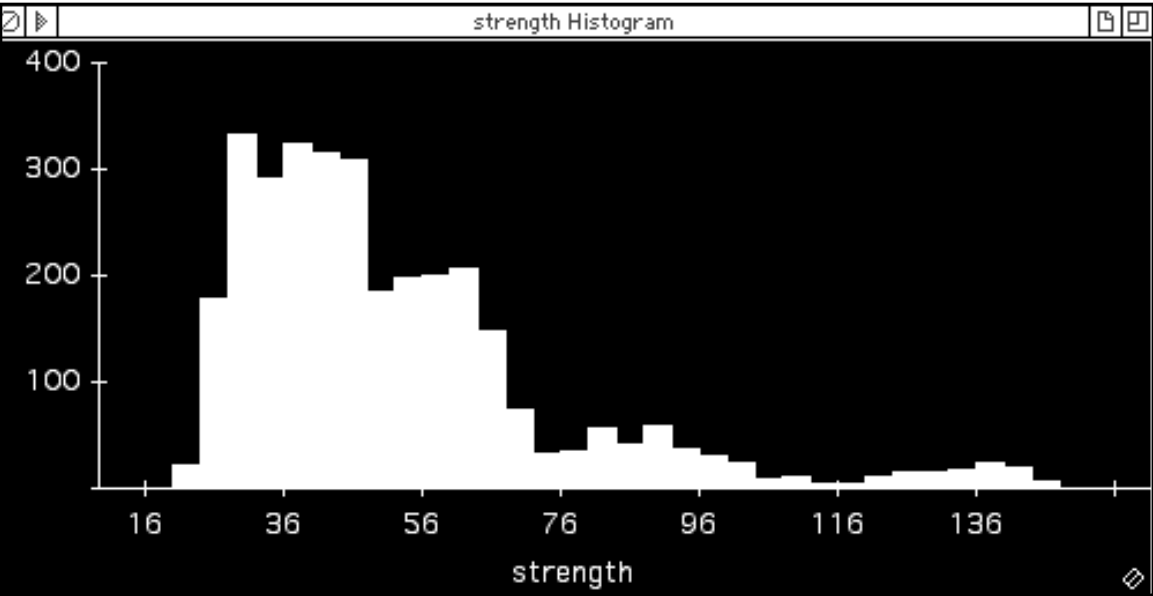
Figure 6

September 22nd Statistics Optimized “B” Antenna Configuration - Top filter set for checked out weapons. Bottom same filter signal histogram. Red dots indicate failed CRC a non-read. This data shows that all (100%) of checked out weapons with optimal antenna configuration are missing from racks.

A



B



Document Control

Document Status

9 Total Pages

Confidential:

No External Customer Circulation

Note: Site24 is classified must remain confidential

Revision Control and History

CW	Data Collection	Sep 22 nd , 2015	Version 1.1
JKS	Data Analysis	Sep 23 nd , 2015	Version 1.2
TP	Review	Sep 25 th , 2015	Version 1.2

Signatures

280607 V1-2

Visible