Isotrope WIRELESS

Thinking outside the sphere

Memorandum on Drive Test Flaw

To Ricardo Sousa
Cc Acton Planning Board
From David Maxson
Re AT&T PCS Drive Test
January 22, 2014

I have been noting an inconsistency between the drive test results and my coverage mapping. The inconsistency is most prominent in the area of Great Rd (Rts 2A and 119) and Concord Street. It is also evident in Acton on eastern Route 2 and near Craig Road.

In short, the drive test is flawed because it failed to capture the coverage of the most relevant sector of Annursnac Hill and the most relevant sector of Post Office Square, with respect to service in and around the Craig Road area, including Route 2.

Coverage from the Post Office Square cell site (MAU3371) should be robust in the area of Great Road, Concord Road, and Hosmer St (north). In particular Post Office Square Beta sector points directly at these roads. Annursnac Gamma sector also is directed at Great Road and Concord Road, as well as at Route 2 in Acton and School Street near Craig Road. Coverage from this sector should be robust in these areas.

The drive test data in these areas is significantly less robust than the computer model would suggest. In the rest of the area covered by the drive test, there is good correspondence between my mapping and the drive test data.

I parsed the drive test for the Pilot ID for each data point. The Pilot ID is usually a code number that is unique, at least among the neighboring sites. We discussed this on the phone, and the AT&T engineers looked up the Pilot IDs for key sectors and read them to me over the phone (This is what I had requested in my memo of last week but the AT&T people did not seem to understand).

What I find is that the Beta sector of Post Office Square is simply not included in the drive test. Moreover, the Gamma sector of Annursnac Hill has so few data points as to be irrelevant to the drive test.

I surmise that the Beta sector of Post Office Square is simply using a different radio channel than the two channels the C-Squared drive test scanner was set to. Of the three Post Office Square sectors, the Beta sector is the only one relevant to coverage down Hosmer Street toward the targeted area of the proposed facility. This alone invalidates the drive test in my opinion.

As for the Gamma sector of Annursnac, I surmise that it is either defective and radiating at a substantially lower level or different direction than specified, or its channel 437 is not in full time operation and was only captured opportunistically. Where there are in excess of 10000 data points for the entire drive test, there are only 72 data points capturing Annursnac Gamma sector. Of the three Annursnac sectors, the Gamma sector is the one directed at the subject area in Acton around Route 2 and Craig Road. Instead, the "spillover," as I shall call it, from the edge of the Annursnac Beta sector into Acton stands in the place of the Gamma sector coverage on this drive test. The Annursnac Beta antenna is not pointed at Acton. Consequently, the drive test failed to capture the primary source of signal into Acton and toward Craig Road from Annursnac Hill.

At this point, I have consumed all the billable time available (and more) under the current agreement between the Board and Isotrope. I have consumed an inordinate amount of time peeling the layers back on the information submitted by AT&T and identifying flaws and misstatements.

My first impression of the AT&T coverage maps was that the maps are overly pessimistic about the current state of AT&T PCS coverage. To pursue the discrepancy between my first-approximation of coverage and AT&T's coverage maps, we sought cell site data. This data was supplied (with a request that the particular information about the cell sites be kept confidential). My refined analysis was not significantly different than my first-approximation. The question remained regarding the differences in the AT&T PCS coverage analysis and Isotrope's.

Drive test data was sought by the Board. Between the September meeting and the January meeting, Mr Bartl was delegated authority by the Board to direct Isotrope to conduct an independent formal drive test, if the information to be supplied by AT&T was not sufficient to resolve major discrepancies. I deferred on conducting a formal drive test of my own when AT&T submitted a drive test map.

In response to my question about the map, I was led to believe there was no "normalization" done to the drive test data when it was mapped; I worked on my analysis accordingly. I reassured the Board that the drive test data seemed credible and useful to employ in the fact-gathering. Then upon submittal of the raw drive test data, I was informed that a 6 dB penalty was indeed added to the drive test data when mapped by AT&T to make an adjustment for "clutter losses" and alternately for "body losses". This is not best practice, and was not made known until I had spent time evaluating the printed drive test map against my mapping results.

With the raw drive test data in hand, I continued my evaluation on the understanding that the drive test was set up to capture the best cell site (at PCS) at each point on the map. I was reassured in response to a direct question that all the cell sites in the set were continuously using PCS channel 437. When I found a discontinuity between my mapped data and the drive test data that was not consistent with typical variations in computer modeling, I made a straightforward request for the Pilot ID numbers broadcast on channel 437 of each sector shown on the maps. (This Pilot ID information is included in the raw data.) The initial reply was

not responsive, for whatever reason. This required the phone call of January 17th (mentioned above) to resolve.

To verify, I have reproduced the Pilot IDs used on channel 437 by cell site and sector that I obtained over the phone. (table below) These are the most relevant to my analysis.

Cell Site	Location	Alpha	Beta	Gamma
MAU3031,2,3	Great Hill	42	50	
MAU3371	PO Square	31	471	39
MAU3408	Annursnac Hill		71	79
MAU3206	W Concord			
MAU3340	Knox Trail	330		

Appended to this memo are a set of "Most Likely Server" maps, with drive test data overlaid. The Most Likely Server maps take the computer generated coverage prediction and identify which cell site and sector is expected to have the best signal at each point on the map. The result is a colored map in which three colors radiate from each cell site. Each color represents where that particular cell site sector is expected to have the dominant coverage. There will be areas where two sectors have nearly the same signal strength, and the map coloration consists of an irregular arrangement of competing color points, typically at the overlap areas.

Note on the first two maps where the blue and red color regions indicate the likely dominance of the Annursnac Gamma (west) sector and the Post Office Square Beta (southeast) sector, respectively. The blue region envelops the Craig Road area.

On the first map, an overlay of the 72 data points of the drive test indicates where Annursnac Gamma sector was measured as the dominant sector (brown squares). The data points are much smaller than the squares. If all the data points of all the sectors were mapped at once, it would be hard to see the small number of Annursnac Gamma data points among the hundreds of other dominant sector data points on the same stretch of road.

To illustrate, the second map removes the Annursnac Gamma sector data points and overlays the Annursnac Beta sector (olive squares). The Annursnac Beta sector points southeast away from Acton (light blue region), yet it is the dominant sector far more often than Gamma is on Route 2, Great Road, Concord Street, and eastern School Street. This is the case even though Gamma sector is aimed directly at this area (dark blue region).

Based on this information, the drive test data is incomplete because it fails to capture the performance of two sectors critical to the Craig Road application. I cannot rely on it to fully corroborate my computer modeling for all cell site sectors of interest. In my computer analysis, I shut off the two missing drive sectors to simulate the apparent lack of signal from these two

sectors in the drive test. The results were quite consistent between my computer model and the drive test. This confirms the reliability of my computer model and supports my conclusion that the drive test indeed lacked an assessment of the coverage of two critical sectors.

I am prepared to conclude that my computer modeling, which I will present in my report, is more representative of existing AT&T PCS coverage than the AT&T computer modeling. I do not imagine there is anything that can be done to rectify the flaws in the drive test without conducting a new one with a revised methodology.

I would be happy to discuss this, with the understanding that any new work on my part, other than a quick phone call, is presently out of my scope.

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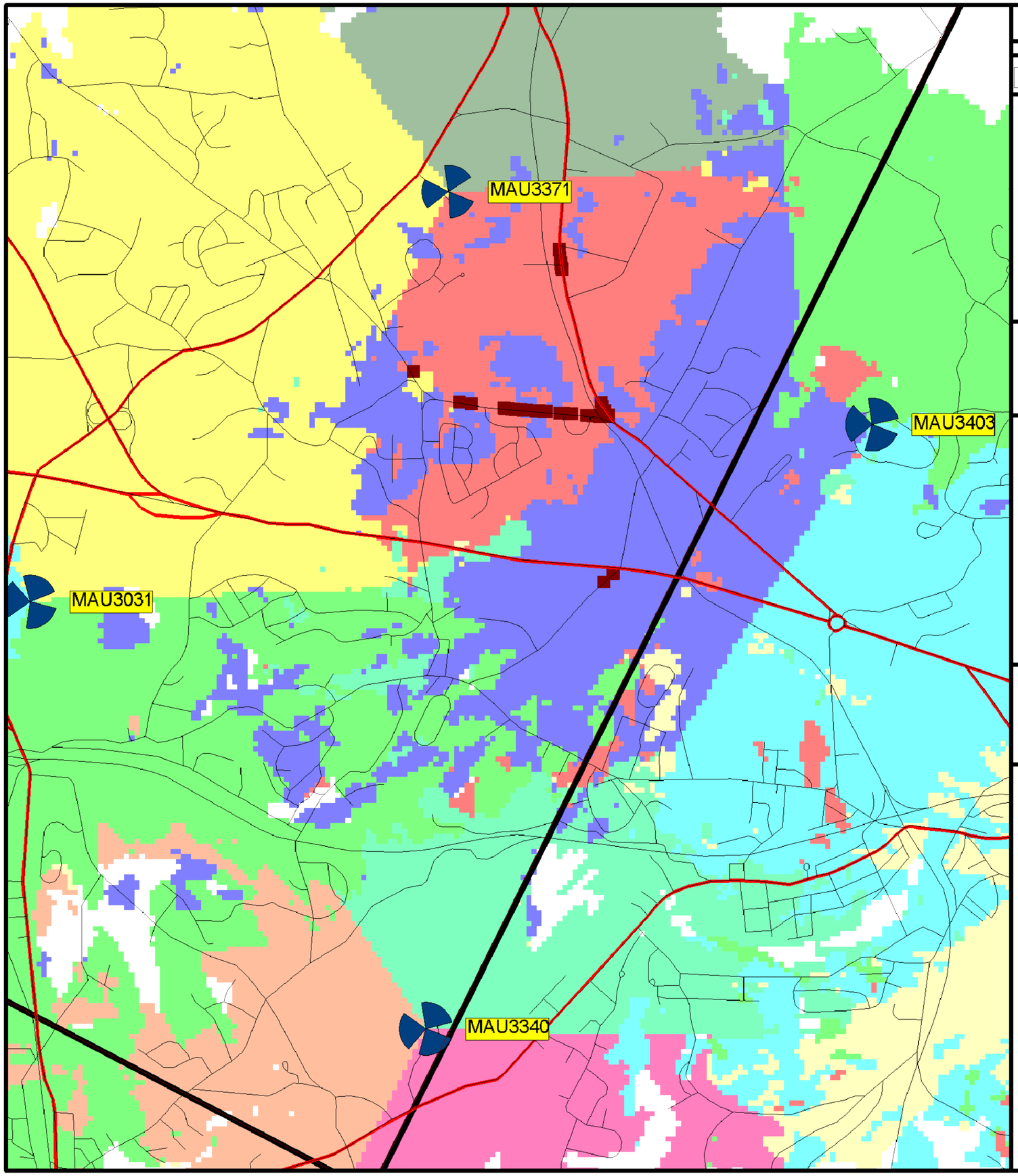

SIGNAL™: Acton 5 Craig Road

Town Lines

Notes

- Based on AT&T Existing Coverage
- Colors Indicate Sector That Should Have Dominant Coverage
- Dark Squares (Brown) show where MAU3403 west sector dominated in drive test.
- Blue region is where this is expected to be dominant.
- Gray Squares show where MAU3371 southeast sector dominated. (There are no gray squares)
- Red region is where this is expected to be dominant.

Note: squares are exaggerated size for visibility on map

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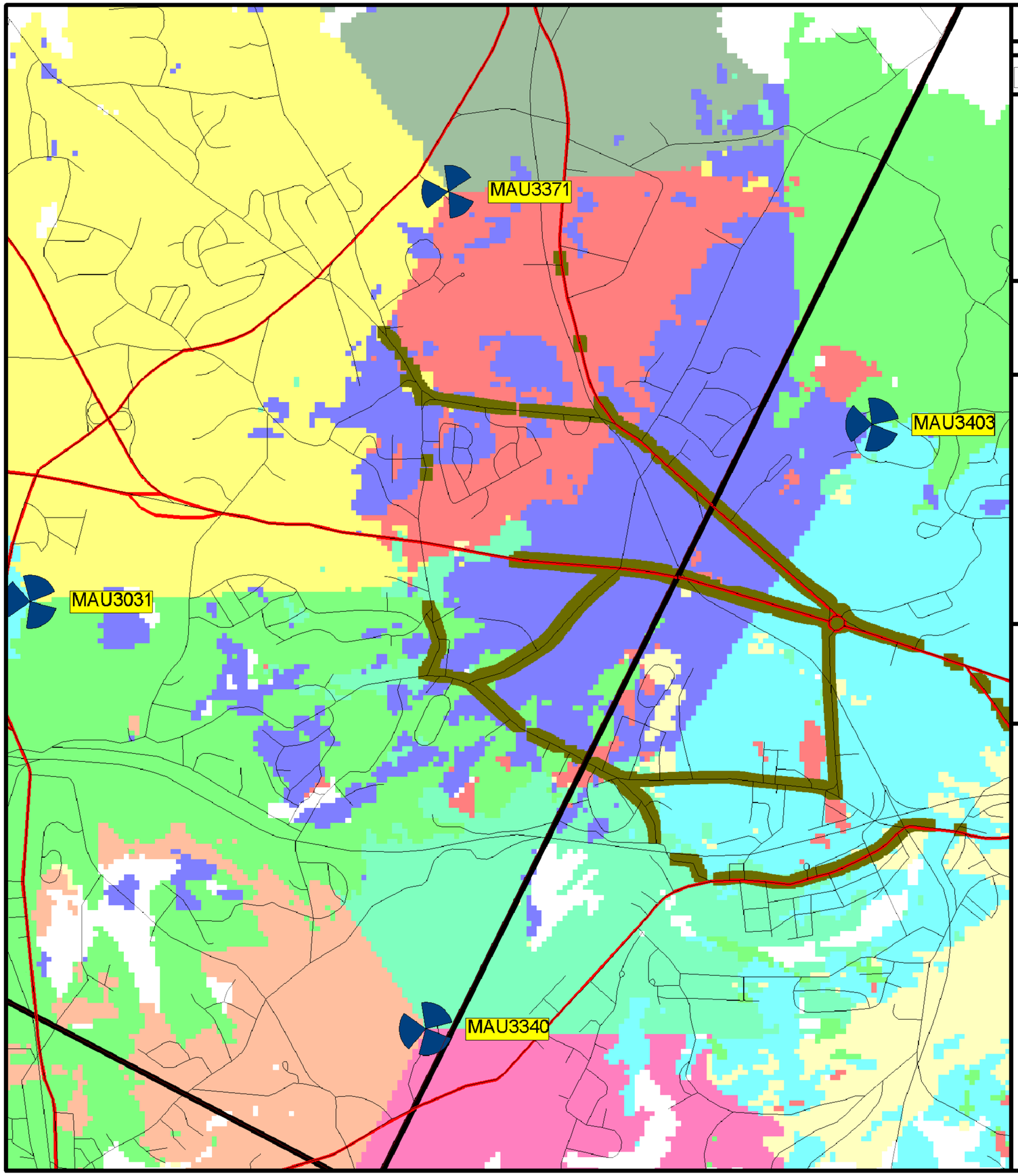
isotrope LLC

SBA: 5 Craig Road

ATT Most Likely Sector w/ Drive Data

Wed Jan 22 10:53:54 2014



SIGNAL™: Acton 5 Craig Road

Town Lines

Notes

- Based on AT&T Existing Coverage
- Colors Indicate Sector That Should Have Dominant Coverage
- Dark Squares (Olive) show where MAU3403 southeast sector dominated in drive test.
- Light Blue region is where this is expected to be dominant. Not expected to be dominant in dark blue and red regions
Note: squares are exaggerated size for visibility on map

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ATT Most Likely Sector w/ Drive Data 2

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