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October 21, 2014

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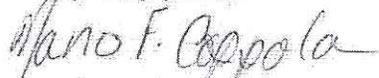
Re: Docket No. 448 – Cellco Partnership d/b/a Verizon Wireless Application For A Certificate of Environmental Compatibility and Public Need For The Construction, Maintenance And Operation Of A Telecommunications Facility Located At 831 Derby Milford Road, Orange, Connecticut

Dear Ms. Bachman and Mr. Stein:

Pursuant to Section 16-50j-22a of the Regulations of Connecticut State Agencies, please accept this letter as a written request for permission from the Connecticut Siting Council to accept the original and fifteen (15) copies of the Report by David Maxson, dated October 20, 2014, hand delivered to the Council for filing this morning. Copies of this letter and this morning's filing were sent via electronic and regular mail, postage prepaid, to all parties and intervenors of record.

If you have any questions please feel free to contact me.

Very truly yours,


Mario F. Coppola

MFC/kaa

cc: Kenneth Baldwin, Esq.
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State Representative Paul Davis
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STATE OF CONNECTICUT
CONNECTICUT SITING COUNCIL

IN RE:

APPLICATION OF CELLCO PARTNERSHIP
D/B/A VERIZON WIRELESS FOR A
CERTIFICATE OF ENVIRONMENTAL
COMPATIBILITY AND PUBLIC NEED FOR
THE CONSTRUCTION, MAINTENANCE AND
OPERATION OF A WIRELESS
TELECOMMUNICATIONS FACILITY AT
831 DERBY MILFORD ROAD, ORANGE
CONNECTICUT

DOCKET NO. 448



OCTOBER 20, 2014

REPORT BY DAVID MAXSON, WCP ON THE MISSED OPPORTUNITIES AND MISINFORMATION CONTAINED
WITHIN THE TECHNICAL EVIDENCE, AND/OR LACK THEREOF, IN THE RECORD

Dear Mr. Chairman and Members of the Council,

I, David Maxson, WCP, have participated in two sessions of the hearing on Connecticut Siting Council (the "Council") Docket 448 and I am writing this report to follow up regarding issues that were discussed during the hearing so far. I have provided my testimony as an impartial technical analyst¹, as I have done in over 500 separate wireless facility application proceedings² for over 150 different regulatory entities (land use boards, councils, commissions, selectboards – collectively "Finders of Fact") over the past two decades. It is this extensive experience that informs my discussion of best practices employed by Finders of Fact in wireless facility siting matters. In Appendix 1 I discuss how I present evidence in a structured manner.

In this report I address several fact-finding aspects of the Docket 448 proceeding, as well as certain contentions of the applicant.³ The following issues are, in my experience, ones that most Finders of Fact in wireless facility placement matters attend to:

- "Wireless data demand is on a steep growth curve" is a true statement, but to demonstrate a particular facility is needed – and to what degree – the facts of the case must support it. In my Appendix 7 I discuss the nature of the applicant's generalizations about the evidence of need for the proposed facility.
 - It is also erroneous to assume that because the applicant will be spending hundreds of thousands of dollars developing a new facility that the applicant must be correct that it

¹ It is a matter of record that the bulk of my wireless facility siting permit work has been on behalf of Finders of Fact, and that my other work as a wireless communications engineering technologies professional has been for both proponents and opponents of new facilities, from time to time.

² Note in contrast with my wireless analyst experience that the sum total of all dockets addressed by the Siting Council since 1973, including both utility and wireless proceedings, is 448 – a total that is less than my experience.

³ This document is comprehensive. The layers of overlooked facts, misdirection and confusing testimony require careful deconstruction to get to the truth.

needs the proposed facility. For example, the applicant fortunately caught such a mistake in Docket 430 and withdrew. The Finder of Fact is the gatekeeper to prevent improper development of unnecessary facilities that slip past even the applicant's notice.

- The Applicant has not shown the requisite needs for this application. I show in Appendix 8 how overwhelming the capacity relief would need to be to be at all effective, and how Orange North fails to scratch the surface of providing said relief – based on forward-looking data.
- The Council must understand the difference between the “need” for the provision of wireless service in the general sense, and the “need” or lack thereof for a particular proposed facility.

With respect to the applicant's presentation in this matter, the applicant has created a moving target of assertions and redirections that result in a muddled and misleading record.

- In the present matter, the applicant has misinformed the Council regarding the applicant's license holdings in the PCS spectrum in New Haven County and has erroneously charged the intervenors' expert with misrepresenting the facts. Please see my Appendix 2 for a discussion of this misleading and incorrect testimony.
- The applicant employs revisionism and obfuscation when it changes its position on its 700 MHz and 2100 MHz LTE coverage maps. They have been produced, labeled and verified as representing one thing for 16 applications over 5 years, including the present matter. Please see my Appendix 3 for a list of these Dockets. When pressed in this matter, the applicant has retracted its assertion and revises the supposed LTE “coverage” standard mid-hearing.
 - The applicant told the Council and the intervenors that the LTE threshold was -85 dBm and reaffirmed that in response to interrogatories.
 - Then at a late hour the applicant chose to recant its labeling of the LTE maps in the present matter and came up with an incredible new interpretation.
 - LTE coverage analysis is based on network characteristics that are independent of CDMA characteristics. The applicant made no distinction between the thresholds for CDMA and LTE for five years, a misleading thing in its own time
 - The applicant has acknowledged that its assertion is untrue that -85 dBm is the applicant's national standard for coverage mapping and specifically for LTE coverage mapping. The applicant has acknowledged this by admitting (or claiming) that LTE uses a different threshold mechanism than the supposed -85 dBm national standard it originally asserted was applicable. The applicant has also acknowledged this by indicating that in other states, the local engineers might indeed use different criteria.
 - Now the applicant revises its map label to assert the present LTE maps use the preposterous unit “RLOPL” to demonstrate a signal level threshold.
 - The applicant's assertion that “120 dB RLOPL” is a coverage threshold is obfuscatory⁴. The applicant misdirects the Council when it states in its revision that it used the 120 dB RLOPL threshold to represent coverage on the LTE maps

⁴ Obfuscate: To render obscure, unclear or unintelligible.

in the present matter. A 120 dB RLOPL is not a signal strength. See my Appendix 6.

- Even if it were customary to present 120 dB RLOPL maps instead of signal strength maps, the 120 dB figure employed in the purported RLOPL threshold is unreasonable and unsubstantiated. Please see my Appendix 6 for a tutorial on this method.
 - Moreover, it is extremely unlikely that all sixteen sets of LTE maps produced for the Council – by at least five different Verizon engineers – in the past 5 years were produced with a 120 dB RLOPL instead of a -85 dBm threshold. The initial use of -85 dBm for LTE was never substantiated and the revision to RLOPL is not credible.
 - If the applicant maintains its position that 120 dB RLOPL is the threshold for the LTE maps, then it has effectively established a new coverage threshold varying near -57 dBm – an unrealistically high threshold lacking any substantiation that is a significant departure from the originally purported “national standard” of -85 dBm.
- The applicant, when pressed on its due diligence in determining the Orange North search ring, dissembles repeatedly in the record by describing what it customarily does rather than what it did in the present instance. Please see my Appendix 7 for an example of the record on this concern. The Applicant also raises secret but specious methods that purport to be necessary to arrive at a conclusion. I discuss this in Appendix 5. In Appendix 4 I address the misleading claims that most-likely server mapping is purportedly withheld for good cause, is said to have never been presented to the Council before, and is not included on the applicant’s list of key information necessary to arrive at a conclusion.

It is my belief that the Council can do more to demand responsible and thorough presentation of evidence from the applicant and that the applicant in this matter has been misleading the Council by providing false information, unnecessarily withholding information, being non-responsive to questions, changing its positions, failing to teach the theory, and dissembling.

The proposed facility is not necessary by the standards articulated by the applicant.

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Appendix 1 – Expert Testimony –Teaching over Opinion-making

Based on commentary of some Council members at the September 16, 2014 meeting, it appears there may be a misunderstanding of the role of fact versus opinion in trying the facts of a case. One perspective is that an expert under oath can give opinions without backing them up with evidence, and that unsubstantiated testimony can have equal weight compared to testimony given with evidence to support it. The applicant would have the council weigh the testimony of its RF experts against that of the intervenor's expert based on *what* they claim and not on *how* they get to the claim.

For example, on the transcript of September 16th (p560), the following exchange was heard,

DR. KLEMENS: I think all these witnesses are sworn. The testimony is sworn. It's a job of the Council to look at the testimony to determine the credibility of the witnesses to make their case. I think that's a substantively different standard than someone who wants to go take an application and look for things to punch holes in it. So I think to inflate the concept that we can't make a decision based on what we have because Mr. Maxson can't adequately review it is erroneous. That's my opinion.

THE CHAIRMAN: Well, I haven't seen or heard --

MR. HANNON: I agree with Dr. Klemens.

It should be understood that experts are not present simply to give opinions under oath. The role of an expert is to teach the trier of fact. Once taught, the trier of fact can come to a reasoned and responsible conclusion on its own. This is what I have endeavored to do as an expert involved in this matter. I have explained the method for evaluating the geographic area of influence of a new facility in a fully covered, capacity-limited environment. The Council should be able to understand and follow my reasoning. The result is more than merely "punching holes" in the applicant's claims. My analysis is a thorough indictment of the basis of the applicant's claims.

My understanding about expert testimony is based on the countless times I have made presentations to Finders of Fact. One of the guides I rely on for providing testimony is based on the law of the land, the Federal Rules of Evidence⁵ Article VII. *Opinions and Expert Testimony* outlines Testimony by an Expert Witness in Rule 702:

A witness who is qualified as an expert by knowledge, skill, experience, training, or education may testify in the form of an opinion or otherwise if:

- (a) the expert's scientific, technical, or other specialized knowledge will help the trier of fact to understand the evidence or to determine a fact in issue;
- (b) the testimony is based on sufficient facts or data;
- (c) the testimony is the product of reliable principles and methods; and
- (d) the expert has reliably applied the principles and methods to the facts of the case.

⁵ I do not say whether or not the FRE applies in the present matter; that is up to the Council's interpretation of its legal authority and obligations. I make reference to federal guidelines because they are best practices that I find helpful to adhere to in my activities in wireless facility siting matters. Moreover, with the potential for any denied application to be appealed to federal court, it could be helpful to have the federal guidelines in mind when fact-finding. I leave it to the Council and others to argue the legal basis for any evidentiary policies it employs.

I have underlined key phrases in each point. I have made considerable effort to help the trier of fact – the Council – to understand the evidence. I believe I have been quite thorough about it.

Based on my testimony, I believe that the Council is able to draw the requisite inference about how documented dominant server analysis shows the applicant's 8-sector-relief claim is not only unsubstantiated, but also excessive and refuted.

In the present matter, I have provided evidence that conforms to the federal criteria, which I will address point by point comparatively with that of the applicant.

- (1) *Theory has been tested and not a subjective conclusory approach.* I have explained
- a. how one evaluates the areas of dominant service of overlapping sectors,
 - b. how this, and not coverage modeling, identifies where a new sector has the opportunity to offload demand from an existing sector, and
 - c. how this is customary practice in situations where capacity improvement is the primary objective, evidenced in part by the applicant's admission of the use of dominant server analysis, by the discussion of dominant server characteristics in the literature and by my experience with various propagation modeling software packages that provide dominant server mapping capability.
 - d. how there is a low probability of significant variation between dominant server analyses of the same system – in other words, if you have seen one such analysis it is likely there will only be minor differences between it and another analysis based on the same inputs.

The applicant has provided coverage maps, with no sectorization and no dominant server analysis. The applicant asks the Council to trust the applicant that, in essence, it is merely too complicated for the trier of fact to understand. Other than that generalized argument, the applicant presents no theory on how the location of capacity relief can be properly inferred from the information it says it relies upon. The applicant employs a subjective, conclusory approach. Keep in mind that my discussion here focuses on the inability of the proposed facility to solve the alleged problem. I have also presented evidence following the same method to show that the problem (amount of relief the applicant is looking for) is also unsubstantiated; however, even if the problem were as the applicant describes, the proposed solution fails to address the problem.

- (2) *Theory subject to peer review and publication.* I discussed this in general in my August 27th report. The technical literature takes the LTE dominant server principle as a given in network design. For example, a Fujitsu white paper discusses the "no-dominant server problem" in LTE, which occurs at the cell edges where two or more sectors overlap at similar signal levels, causing

poor network performance until a server becomes dominant.⁶ I also noted that professional propagation modeling software authored for cellular style networks provides dominant server modeling tools specifically for the purpose. Such software is based on decades of radio propagation science. There should be no question that best practices involve the use of dominant server analysis to verify the likely benefits provided by a proposed new-capacity facility.

- (3) *The known potential error rate of the applied theory.* As I explained in my report and my testimony, because the dominant server analysis evaluates the *difference* between the strength of two or more overlapping sectors, the propagation uncertainties tend to cancel out. Moreover, because the dominant server analysis is mainly not dependent on a specific signal strength threshold, the server is dominant regardless of the final signal level threshold that is chosen. In a nearly full coverage condition such as the current case, it is not so much about whether -85 dBm or -95 dBm or some other level should be the coverage threshold, and is about where each sector will provide the service. The dominant server method is the primary reliable method for performing this analysis.
- (4) *Existence and maintenance of standards and controls.* Propagation modeling in general relies on well proven terrain and land use databases and on peer reviewed and generally accepted modeling algorithms (equations). The standard known as TIA TSB88 provides science-based modeling factors (attenuation) for use in computer modeling of the effects of vegetation and land use on radio signals. Generally quite accurate without any fine tuning, these attenuation factors are tweaked by engineers to more precisely account for the particulars of vegetation in a given region. For example, forest attenuation in the northeastern USA may be somewhat different on the average from forest attenuation in the Pacific Northwest, requiring minor adjustments to the signal loss assumptions in mapping coverage in or over a forest. It is customary to validate or fine tune the standard land cover attenuation model based on periodic drive tests in a chosen region, which Isotope and Verizon both do in the northeastern USA. Capacity analysis is not specifically standardized in a formal published practice. However, to assess where a particular cell will provide service in the face of competing cells, best practice involves using the dominant server tools available in carrier-class propagation modeling software.
- (5) *Generally accepted theory.* See #2 above.

In addition to these five non-exclusive tests, my presentation to the Council also conforms to the other factors cited in FRE 702:

- (1) *Testify about matters growing naturally and directly out of research they have conducted independent of the litigation.* I employed my customary analysis, which is the same analysis I would provide in a similar situation and which analysis is customarily applied by others in the field. In short, I did not invent a standard to apply to the present matter. I applied the general practice for this type of analysis to the specifics of the fact pattern in this case.

⁶ <http://www.fujitsu.com/downloads/TEL/fnc/whitepapers/Enhancing-LTE-Cell-Edge.pdf>

- (2) *Unjustifiably extrapolated from an accepted premise to an unfounded conclusion.* I have taught the basics of how to look at geographic areas of dominant service to determine where a new sector will take over the role of providing service. In contrast, the applicant provides coverage maps that do not account for the interference overlap that determines which server dominates at any given location. The applicant insists that its rudimentary coverage information is sufficient to substantiate their claim that 8 sectors will obtain substantial capacity relief from the proposed facility. Then the applicant asserts that the information available on the record is in fact not sufficient for a peer to draw the same conclusions. Ultimately, the applicant's extrapolation jumps from a faulty premise (coverage mapping as substitute for dominant server mapping) to the unsubstantiated conclusion that 8 sectors will obtain significant capacity relief from three new sectors. No rational basis is provided by the applicant testimony or evidence.
- (3) *Obvious alternative explanations.* The alternative explanation provided by the applicant relies on conventional coverage mapping, which I have demonstrated is no alternative. The alternative also relies on the "it-is-too-complicated-and-is-proprietary-anyway" theory (conclusory). The applicant's alternative is no alternative because it relies on a secret sauce of irrelevant data analysis
- a. Contrary to the applicant's assertions, drive testing and link budget details are not necessary to assess the potential benefits of a proposed facility; and
 - b. Traffic mapping is only useful in evaluating a proposed cell site if
 - i. it shows a concentrated area of usage (not the case here), and
 - ii. is performed in conjunction with dominant server analysis to show how that usage will be redistributed to a new sector (not disclosed by the applicant).
- (4) *Expert is as careful as in expert's regular work.* I am somewhat more careful in documenting and teaching in matters such as the present one than in my regular work. It is easy in daily work to arrive at an opinion or recommendation based on good engineering practice and not teach the client the details. However, in matters before a trier of fact, I take the extra effort to teach the theory so the trier of fact can understand the issue first, and then arrive at a reasoned conclusion. In this matter I have been particularly careful to be thorough and accurate in my analysis.
- (5) *The field of expertise is known to reach reliable results.* RF engineering is science based. Wireless communications technology is dependent on the field of RF engineering to establish and maintain the nationwide cellular networks that have been highly successful in the past several decades. While propagation modeling has a statistical variation from field results, it is well researched and controlled. The various carrier-class software platforms for modeling radio propagation employ well-tested methods for producing results. Moreover, the question of where each server is dominant is a differential analysis that reduces the uncertainties in propagation modeling. In contrast, the applicant's coverage mapping in an overlap environment cannot provide geographic information on which server will be the one that the user can expect to be assigned.

Based on the foregoing, my testimony conforms to evidentiary principles outlined in the Federal Rules of Evidence Article VII Sec. 702 while the applicant's does not. The Council can learn from my testimony, apply the principles and arrive at a conclusion. The Council does not have to simply take my word for it.

My evidence shows *how* the applicant has failed to demonstrate the purported benefits of the proposed facility. Moreover, my evidence shows *how* the applicant has positioned its proposed facility in a location that fails to satisfy its own design criteria.

Appendix 2 – Applicant Misinformation about 1900 MHz

At the continued hearing in Docket 448 on September 16, 2014, during cross examination, Mr Latorre of Verizon was granted an opportunity to critique the August 27th Isotrope report. His comments amounted to mostly quibbling about details (“punching holes”) that do not materially affect my primary conclusions. The applicant has not directly challenged my analysis about the lack of demonstrated need for capacity relief (in the various ways explained) and the lack of ability of the proposed facility to address the purported need.

Of greatest importance among Mr Latorre’s points, Mr Latorre incorrectly accused my report of misrepresenting the facts about Verizon’s 1900 MHz licensed bandwidth. I note that first, in cross examination, Mr Baldwin asked me if I knew what the bandwidth of Verizon’s 1900 MHz license was. I did not recall exactly at the time, as my focus on preparing my report was on the 700 and 2100 MHz bands. Then, during Mr Latorre’s critique of my report, Mr Latorre said that Verizon’s 1900 MHz license was for 5 MHz and not for the 20 MHz that I had indicated in my report on page 11.

The Witness (Mr. Latorre)... Verizon Wireless is actively laying the groundwork to deploy our 1900 megahertz LTE services as the existing 3G legacy network can be removed from there. So that is a fact...

He [Mr. Maxson] also makes a statement here, again, just to read it, that "The 1900 megahertz spectrum will provide an additional 20 megahertz of new LTE spectrum to further spread out demand." This just isn't simply true. Verizon has to own 20 megahertz' worth of PCS spectrum, 1900 megahertz spectrum, in order to provide 20 megahertz of new LTE spectrum to further spread out demand. Verizon Wireless doesn't own 20 megahertz of 1900 megahertz spectrum in this area, so we can't possibly provide that much additional capacity at this facility at that frequency level. We can provide the 5 megahertz F block that we currently own, and there is a potential, as we've seen in the past in the industry, that as technologies are ready to be deployed in an area and the different companies are working on that, there is occasionally spectrum swaps where different companies will come to a business agreement to share different frequencies, and it's all managed by the FCC. As RF design engineers, we can only testify to what we know we own today, and we don't own 20 megahertz of 1900 megahertz spectrum, so we can't -- I deem that inaccurate.

[Sept 16th Transcript p.519-521]

Mr Latorre is incorrect, and I was correct in my report. I said in my report, “Moreover, at some point well before 2021, the 1900 MHz spectrum will become available for conversion to LTE service. This provides an additional 20 MHz of new LTE spectrum to further spread out demand. No assessment of the longer term impact of this spectrum on capacity utilization is provided.”

The total assigned bandwidth⁷ that Verizon holds under its PCS licenses in New Haven County is 20 MHz, as I stated. In reviewing my original report preparation materials, I had indeed looked up the applicant’s

⁷ The term “total assigned bandwidth” as defined by the International Telecommunications Union Rec. ITU-R SM.1541-5, includes the entire bandwidth of the license(s). In this context, that includes the uplink plus the downlink bandwidth.

licenses. The following table shows all the FCC licenses held by Verizon in New Haven County (source: FCC Dashboard)

d/b/a Name	Band	Uplink frequencies Downlink frequencies	Licensee	Market Designation	License Call Sign
Verizon Wireless	700 MHz	746 - 757 776 - 787	Cellco Partnership	REA001 - Northeast	WQJQ689
Verizon Wireless	AWS - 1	1720 - 1730 2120 - 2130	Cellco Partnership	BEA010 - New York-No. New Jer.-Long Isl	WQGA906
Verizon Wireless	AWS - 1	1710 - 1720 2110 - 2120	Cellco Partnership	CMA049 - New Haven-West Haven-Waterbury	WQGB280
Verizon Wireless	Broadband PCS	1890 - 1895 1970 - 1975	Cellco Partnership	BTA318 - New Haven-Waterbury-Meriden, C	KNLH262
Verizon Wireless	Broadband PCS	1895 - 1910 1975 - 1990	Cellco Partnership	BTA318 - New Haven-Waterbury-Meriden, C	WQEM953
Verizon Wireless	Cellular	824 - 835 845 - 846.5 869 - 880 890 - 891.5	Cellco Partnership	CMA049 - New Haven-West Haven-Waterbury	KNKA313

Source: FCC Dashboard Search October 6, 2014

Particular attention must be paid to the second Broadband PCS entry. It appears that this license – WQEM953 – is for 15 MHz uplink plus 15 MHz downlink. However, the FCC Dashboard lists the full width of the PCS “C Block” in this table. Upon closer inspection of the license (not shown), it is apparent that the license is for a portion of the C Block which is called “C3”. C3 Block is 5 MHz uplink plus 5 MHz downlink. Coupled with the 5+5 MHz of the adjacent “F Block” that Mr. Latorre mentioned (license KNLH262 above), the total assigned bandwidth of the applicant’s PCS holdings in New Haven County is the “20 MHz of new LTE spectrum” that I said will be available once it is retired from CDMA service.

The applicant has insinuated that the 1900 MHz band licenses represent a small, potentially inconsequential bandwidth for supplementing LTE capacity. There should be no impression that the 1900 MHz spectrum will be of little use for LTE capacity relief. There will be as much Verizon spectrum available for LTE in the not-too-distant future at 1900 MHz as there is now at 700 MHz. When 1900 MHz

becomes available, and in concert with 2100 MHz, the total network capacity from a combined 700/1900/2100 MHz sector will be four times that of 700 MHz alone.

Appendix 3 –

List of Dockets with Erroneous Cellco 700 MHz LTE Coverage Maps

All 700 MHz LTE coverage maps in these Dockets use -85 dBm and include an inappropriate CDMA loading factor in the legend. In some cases, the -85 dBm is not on the map labels, but is answered in applicant responses to Council interrogatories.

1. Dec 9 2009 **DOCKET NO. 397** - Cellco Partnership d/b/a Verizon Wireless, 445 Prospect Street, Woodstock, Connecticut.
2. Feb 5, 2010 Dany Bustamante RF Eng. **DOCKET NO. 400** - Construction Services Towers (CST) 343 Daleville Road, Willington, Connecticut. [Cellco a Party]
3. May 6, 2010 **DOCKET NO. 402** - Cellco Partnership d/b/a Verizon Wireless, 16 Bell Road Extension, Cornwall, Connecticut.
4. July 9, 2010 Chris Gaines RF Eng. **DOCKET NO. 403** - Cellco Partnership d/b/a Verizon Wireless, 174 South Grand Street, Suffield, Connecticut.
5. Sept 2, 2010 **DOCKET NO. 405** - Cellco Partnership d/b/a Verizon Wireless, 422 Rockville Road or 81 James Road, Voluntown, Connecticut.
6. Oct 20, 2010 Mark Brauer RF Eng **DOCKET NO. 410** - Cellco Partnership d/b/a Verizon Wireless, 234 Melba Street, Milford, Connecticut
7. Dec 10, 2010 Mark Brauer RF Eng **DOCKET NO. 413** - Cellco Partnership d/b/a Verizon Wireless, 723 Leetes Island Road, Branford, Connecticut.
8. Dec 15, 2010 Mark Brauer RF Eng **DOCKET NO. 414** - Cellco Partnership d/b/a Verizon Wireless, 36 Ritch Avenue, Greenwich, Connecticut.
9. Jan 28, 2011 Mark Brauer RF Eng **DOCKET NO. 415** - Cellco Partnership d/b/a Verizon Wireless 87 West Quasset Road, Woodstock, Connecticut.
10. Feb 11, 2011 Mark Brauer RF Eng **DOCKET NO. 416** - Cellco Partnership d/b/a Verizon Wireless, off Day Hill Road, Bloomfield, Connecticut.
11. May 20, 2011 Mark Brauer RF Eng **DOCKET NO. 419** - Cellco Partnership d/b/a Verizon Wireless, 146 Old Colchester Road or 164 Old Colchester Road, Waterford, Connecticut. WITHDRAWN
12. Jan 18, 2013 Mark Brauer RF Eng **DOCKET NO. 434** – Cellco Partnership d/b/a Verizon Wireless, relocated telecommunications facility at 139 North Main Street, West Hartford, Connecticut
13. May 10, 2013 Mark Brauer RF Eng **DOCKET NO. 438** - Cellco Partnership d/b/a Verizon, one of two sites: 596 Pendleton Hill Road or 53 Gallup Road, Voluntown, Connecticut.
14. Feb 26, 2014 Ryan Ulanday RF Eng **DOCKET NO. 446** – Cellco Partnership d/b/a Verizon Wireless, the Pilot Corporation of America property, Trumbull Tax Assessor Map K/09 Lot 20, 60 Commerce Drive, Trumbull, Connecticut.
15. Aug 17, 2012 **DOCKET NO. 430** – Cellco Partnership d/b/a Verizon , 77 Milford Street, Burlington, Connecticut. WITHDRAWN Drive test of new Bristol facility showed proposed facility is not needed. http://www.ct.gov/csc/lib/csc/pendingproceeds/docket_430/withdraw.pdf

There is a total of sixteen applications (including the present Docket 448), from at least five RF engineers providing the maps.

Appendix 4 – Misleading Testimony about Best-Server Mapping

The applicant has not provided good cause for concealing its best/dominant/most likely server analysis. The applicant suggests this information has never been revealed to the public. In my opening remarks on September 16th, I held up a copy of such a map prepared and submitted by the applicant as early as 1995.

September 16, 2014 Transcript Page 339

Maxson:

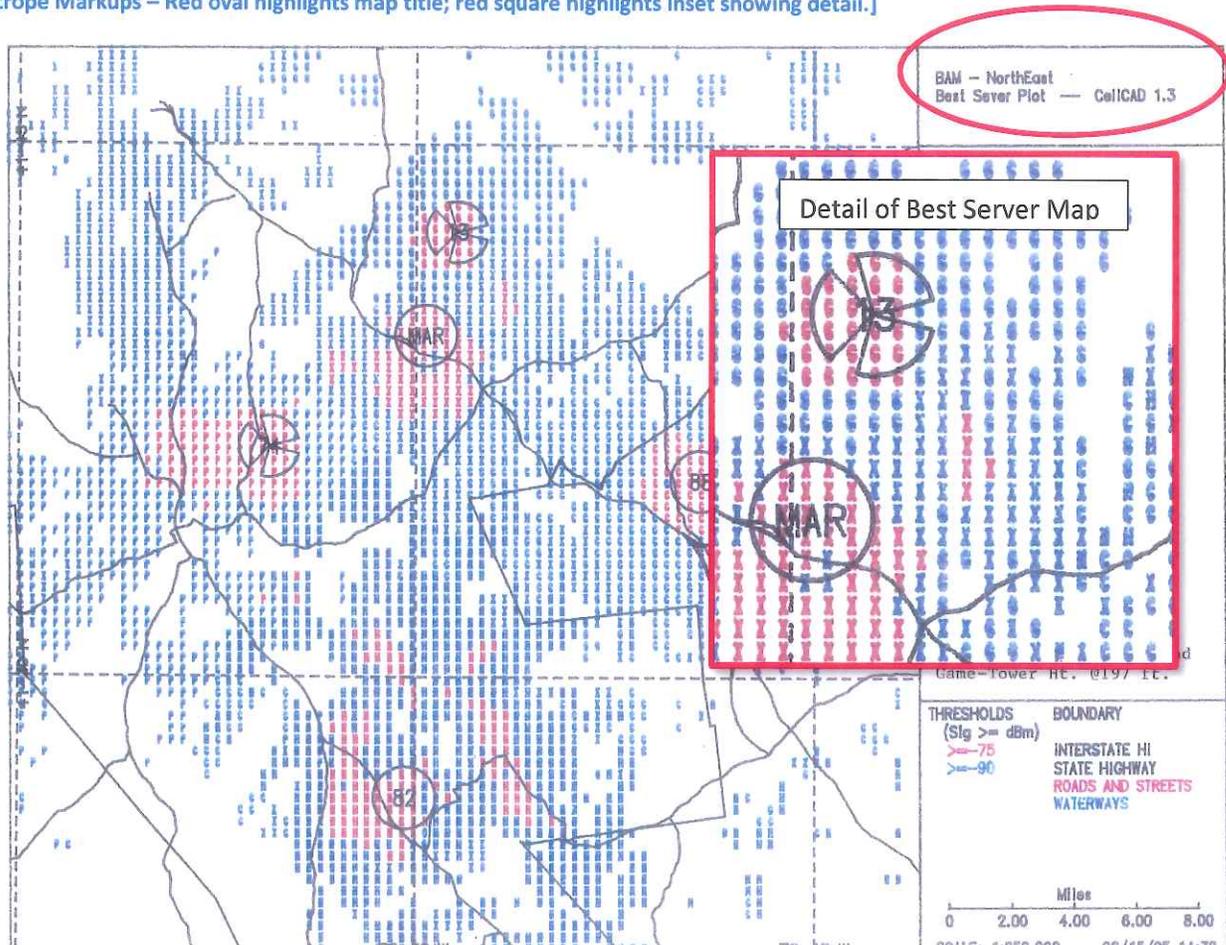
And specifically, I would like to point out that in 1995, when I was the expert for the Town of Marlborough in Docket 169 before this Council, Mr. Baldwin, on behalf of the same Applicant, then known as Bell Atlantic Mobile, submitted dominant server maps with no claim of propriety of the dominant server maps at that time. I do not see any reason today to claim that dominant server maps are proprietary.

Even after my testimony, the applicant's attorney testified incorrectly the applicant had not submitted such information in 25 years:

Ibid p.556

Baldwin ... So to put the burden on Verizon, as the Applicant, to provide proprietary information that it has never disclosed in my 25 years of doing this, I think will get us nowhere, but again, there's a burden on the Intervenor side also.

Figure 1 - Best Server Plot (one of several) Provided by Applicant (Formerly Bell Atlantic Mobile) in Docket 169 in 1995 [Isotrope Markups – Red oval highlights map title; red square highlights inset showing detail.]



The 1995 Best Server plot shown above, and others, were filed in the Marlborough, Connecticut Docket 169. Twenty years ago the mapping technology was less elegant in presenting results. Consequently, the best server maps of the day relied on techniques like the one above in which a letter indicates which cell site is the predicted best server at each location on the map. The map inset shows these letters in detail. Today, best server maps typically show regions of color instead of regions of text.

A best server map is just a coverage map with a little more information. The applicant has no issue with disclosing coverage mapping. In the Marlborough case, the applicant volunteered the Best Server maps to illustrate why it preferred one proposed site over an alternative. The fact that this is twenty years old shows best server mapping is obviously not new, having been a component of wireless network planning from the start.

The applicant in the present matter is concealing its dominant⁸ server information without good cause. And the trail of explanation is quite diffuse. Specifically, when asked about dominant server mapping, the applicant says, indirectly, its "RF Propagation modeling tool" is proprietary, and is silent on its dominant server information.

Question No. 54 [63] [Applicant's RESPONSES OF CELLCO PARTNERSHIP d/b/a VERIZON WIRELESS TO INTERVENORS' PRE-HEARING INTERROGATORIES AND REQUESTS FOR PRODUCTION (SET 2) DATED SEPTEMBER 2, 2014, submitted September 9, 2014]

In the process of establishing the Orange North search ring, did Verizon perform any research and/or analysis of the geographic areas to which any or each particular existing sector is the dominant server? If so, what information did Verizon obtain? If not, why?

Response

Yes. Cellco's RF Design Engineers review topographic and geographic information through the use of its proprietary "Geo Plan" RF Propagation modeling tool.

Question No. 55 [64]

Please provide a copy of any documents in Verizon's possession (including but not limited to any and all papers, reports, records and communications, including electronic) pertaining to any research and/or analysis that Verizon performed of the geographic areas to which any or each particular existing sector is the dominant server.

Response

Data and information incorporated into Cellco's Geo Plan modeling tool is proprietary and cannot be disclosed.

The applicant is saying the software is proprietary, and not explicitly saying dominant server mapping is proprietary. Of course, the coverage maps originally provided by the applicant (Attachment 6 of the Application) were generated from the same proprietary modeling tool. The difference between the applicant's coverage maps and the dominant server mapping, apparently, is that no dominant server map documents were ever generated. The information is not a "document" and only resides in the computer when it is instructed to show dominant server maps on the screen. That would explain the distinction between the following two statements of Mr Laredo:

Sept 16 Transcript Page 550

⁸ Just a reminder that these terms are interchangeable: "best", "most likely" and "dominant" server.

MR. COPPOLA: With regard to Interrogatory Number 57, also numbered as 66 on page 21 of Exhibit 15, is it correct that there's certain records and information pertaining to any research and/or analysis that Verizon performed where the existing and proposed Orange North sectors will be the dominant server which hasn't been disclosed so far in this proceeding?

MR. BALDWIN: Same objection, Mr. Chairman.

THE WITNESS (Laredo): No.

It says there are no undisclosed "certain records and information" regarding dominant server locations.

Contrast with Page 551:

MR. COPPOLA: Mr. Laredo, does your dominant server map show Orange North providing any dominant coverage over Derby Beta or Derby North Gamma service areas?

THE WITNESS (Laredo): I'm sorry. Can you please refer to which specific information?

MR. COPPOLA: I guess I'm referencing the dominant server map that you referenced -- that has been referenced within this proceeding but hasn't been disclosed.

THE WITNESS (Laredo): Yes.

MR. COPPOLA: So the question is: Does your dominant server map show Orange North providing any dominant coverage over Derby Beta or Derby North Gamma service areas?

THE WITNESS (Laredo): Yes.

Mr. Laredo testified that he did review a dominant server map and asserts his map showed him the proposed Orange North facility would provide at least "any" dominant coverage over Derby Beta or Derby North service areas. Being in software and not a discoverable document (apparently), that map reportedly does not presently exist. Moreover, when Mr. Laredo was asked to describe the dominant server map from memory, Mr. Latorre coached Mr. Laredo and ultimately answered additional questions about what Mr. Laredo knows.

p. 551 continuing

MR. COPPOLA: It does. Okay. So how much?

THE WITNESS (Laredo): I don't have the exact answer.

MR. COPPOLA: Could you give me an approximate answer?

Excuse me. Mr. Chairman, I would ask that if I ask one of the witnesses a question that another witness doesn't speak to him while he --

MR. BALDWIN: Mr. Chairman --

THE CHAIRMAN: No. I'm sorry, we want to get the best answer. So that's happened at every meeting I've been where they can collaborate on an answer. I'm sorry.

MR. COPPOLA: All right. Just let the record reflect that then. Thank you.

THE WITNESS (Laredo): It would create some new dominance in the service area.

MR. COPPOLA: What will create some new dominance in the service area?

THE WITNESS (Latorre): The Orange North facility will provide some areas where it will become more dominant than where today the Derby North Beta and Gamma sectors are currently the most dominant server in the area.

MR. COPPOLA: Could you please mark that on a map for us so that we have a clue as to what location you're referring to?

THE WITNESS (Latorre): I'm unable to do that, documenting the specific areas where a particular installation is dominant or not dominant. It goes into an area of propriety that we're unable to go into.

This, finally, is the conclusive statement by a representative of the applicant that dominant server mapping itself (not just the software) is supposedly considered proprietary by the applicant in this proceeding. Nowhere has the applicant explained any good cause for dominant server maps to be proprietary.

The Council missed an opportunity to request dominant server mapping and analysis from the applicant. I maintain that the applicant's information, as long as it is based on the same inputs the applicant provided to the record and is generated in good faith, the dominant server map and data will be substantially the same as the information provided by Isotrope. The applicant has asserted that Orange North will provide substantial capacity relief to Derby North Gamma and Derby Beta sector service areas, and has asserted that the applicant's undisclosed dominant server maps show that. My dominant server analysis shows that assertion to be incorrect.

Attachment G:
Dracut Alpha Sector Footprint with Proposed Methuen 4 Offload

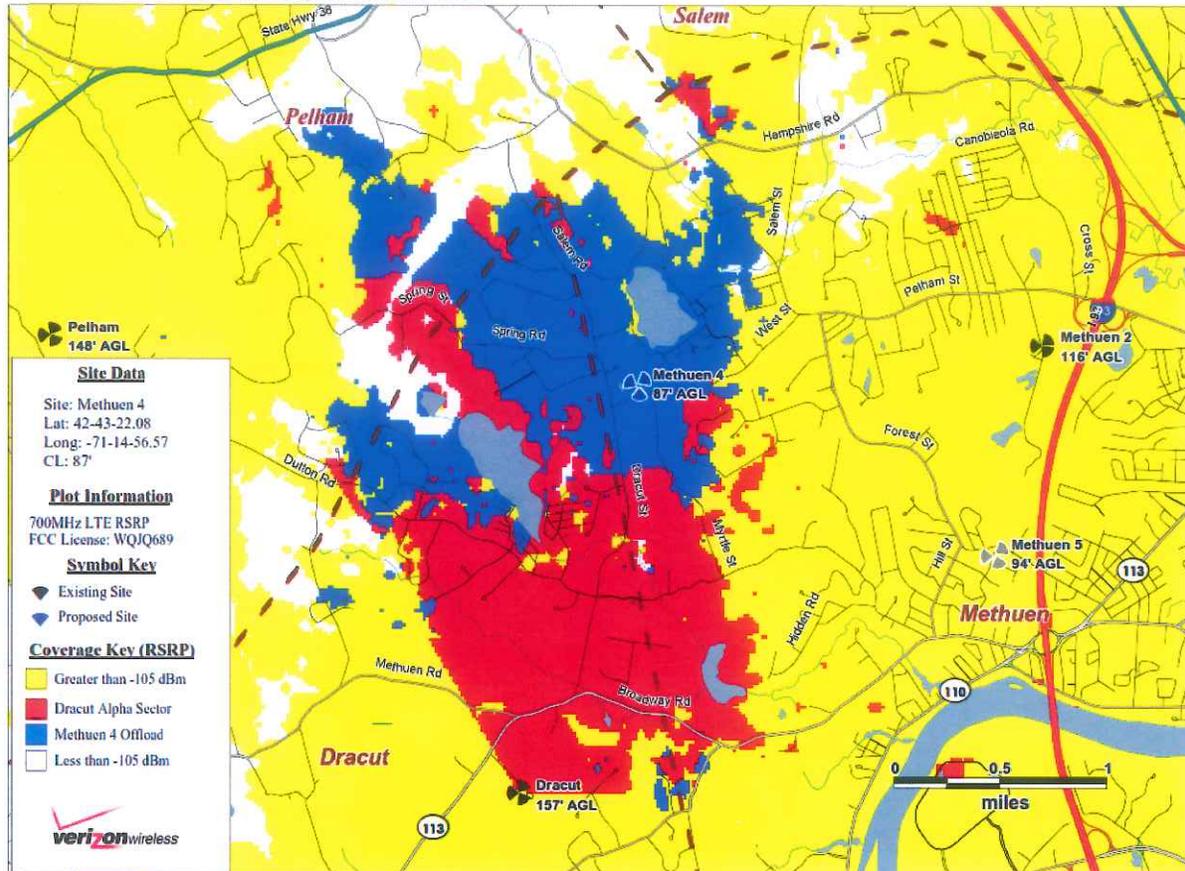


Figure 2 - Verizon Wireless LTE Dominant Server Map Submitted to the City of Methuen, Massachusetts, August 1, 2014

For the record, above is a sample from a Cellco/Verizon Massachusetts⁹ August 2014 submission to the Methuen Community Development Board titled Dracut Alpha Sector Footprint with Proposed Methuen 4 Offload. It is an LTE dominant server map showing the manner in which a proposed new facility (blue)

⁹ There may be a temptation to disregard information from out of state, but bear in mind that there is only one Finder of Fact on cell tower placements in Connecticut, so one must look out of state for any contrasting methodology of the applicant. Moreover, the applicant has asserted its claims of propriety are corporate in nature, just as it asserted its -85 dBm threshold applied nationally and to both CDMA and LTE technology on the various radio bands. Evidence from out of state contradicts these claims.

and a key sector of an existing facility (red) divide up the territory. All other active sectors are shown in yellow to simplify interpretation. There is a companion map that I have not produced, showing only the existing sector, with a much larger (red) footprint.

The Methuen map illustrates the value of best-server mapping to help substantiate capacity offload claims for a proposed facility for the public record. There is no conceivable risk that a competitor can exploit a dominant server map found on the public record any more than it can exploit a plain coverage map. Moreover, wireless providers submit both kinds of maps to the record routinely and no ill consequence has ever been reported in my 26 years of participating in wireless facility siting matters as an impartial technical analyst on over 500 cases, and consultant to proponents and opponents on numerous others.

Compounding the Applicant's misdirection in the present matter, the applicant fails to acknowledge the value of dominant server mapping in the assessment of capacity offload. The applicant only lists drive test data, traffic maps, and link budget data as the key decision-making information that the applicant has withheld from the record.

P504

THE WITNESS (Latorre) ... The information Mr. Maxson doesn't have available to him is the Verizon Wireless proprietary data such as our operation, our link budget --

MR. COPPOLA: Excuse me. If you'd just go slow.

THE WITNESS (Latorre): Sure. Our link budget, our drive data analysis, our traffic map analysis that Verizon Wireless uses to make strong determinations on what proposed facilities will do for both coverage and capacity enhancements to the network.

MR. COPPOLA: So I just want to make sure I'm correct. So did you just testify that he's missing the link budget, number one; number two, the drive data analysis; and number three, the traffic map analysis? Is that correct?

THE WITNESS (Latorre): He's not purveyed to have that data; that's correct.

MR. COPPOLA: Okay. But is there anything else that I'm missing? So those three documents. Is there anything else that he should have?

THE WITNESS (Latorre): Those three documents are data that would provide or allow an engineer to better assess the demand and capacity and coverage of a particular area.

Considering Mr. Latorre's and Mr. Laredo's collaborative testimony that they viewed dominant server information (cited above) and cannot talk about specifics, it would seem that there is an agreement between the applicant and Isotrope that dominant server analysis is a valid and important resource in evaluating any proposed facility in a capacity-limited environment. The absence of the applicant's dominant server information on the record is telling.

Appendix 5 – Specious Claims about Missing Information

The applicant has gone to considerable length to insinuate and claim that I do not have sufficient information to replicate the applicant’s process for deciding the proposed facility is necessary. The reasons given are specious.¹⁰

September 16, 2014 transcript P467

LAREDO: I just want to add that, other than the coverage plots that we normally look at, we also evaluate the area based from other data-like drive tests and actual traffic locations. So it might appear that some of the sectors are totally not going to experience any off-load from Orange North facility, but based from actual drive tests, we can pinpoint and confirm with the help of traffic data location where a facility will be off-loading a sector or not...

Summary: The withheld key information is “actual drive tests and actual traffic locations.” [Also note how the statement is a generalization and not an assertion specifically about the proposed facility.]

P504

THE WITNESS (Latorre) ... The information Mr. Maxson doesn't have available to him is the Verizon Wireless proprietary data such as our operation, our link budget --

MR. COPPOLA: Excuse me. If you'd just go slow.

THE WITNESS (Latorre): Sure. Our link budget, our drive data analysis, our traffic map analysis that Verizon Wireless uses to make strong determinations on what proposed facilities will do for both coverage and capacity enhancements to the network.

MR. COPPOLA: So I just want to make sure I'm correct. So did you just testify that he's missing the link budget, number one; number two, the drive data analysis; and number three, the traffic map analysis? Is that correct?

THE WITNESS (Latorre): He's not purveyed to have that data; that's correct.

MR. COPPOLA: Okay. But is there anything else that I'm missing? So those three documents. Is there anything else that he should have?

THE WITNESS (Latorre): Those three documents are data that would provide or allow an engineer to better assess the demand and capacity and coverage of a particular area.

Summary: The withheld key information is “link budget”, “drive data analysis” and “traffic map analysis.” This adds one to the previous statement.

P541

THE WITNESS (Latorre): I testified that a third-party consultant doesn't have all the information necessary to provide an accurate approval or review of the proposed facility and can't properly convey all of the benefits of the proposed facility because they don't have the data -- all of the data that Verizon Wireless uses to make decisions about location of new facilities.

The withheld key information is “all of the data that Verizon Wireless uses.”

Page 545

THE WITNESS (Latorre): My opinion is that we've provided significant data that would allow someone to make a reasonable assessment of what the potential off-load and capacity relief of this proposed site and its overall function would be. However, in reviewing Mr. Maxson's report, I don't feel that he was able to reach conclusions based on the data today that are accurate and accurately depict the proposed location's enhancement to our network.

Summary: Information (“data”) on the record enables a “reasonable assessment” of the capacity-relief benefits of the proposed facility. Despite the availability of the “data” that enables a “reasonable assessment” Mr. Maxson’s conclusions are reportedly not accurate. This is a different claim than the one that says there is insufficient information available to make a full assessment. It appears the

¹⁰ A Google definition: Specious - superficially plausible, but actually wrong.

applicant is arguing it both ways: 1) Data missing from the record is needed to form a reasonable assessment, and 2) Sufficient data is on the record but Mr. Maxson is said to be wrong.

P555 Baldwin

The Intervenors have hired their own RF expert. He's very capable, if you read his credentials, of producing information that makes his case, and he's done some of that in his report. Most likely-- I think he calls them most likely server plots.

Summary: Mr. Maxson has produced some of the information he is capable of to make his case. No admonition whether there is additional information necessary for Mr. Maxson to make his case.

p. 414

MR. BALDWIN: To prepare your testimony and your report, did you perform any drive tests in the Orange and Derby area?

THE WITNESS (Maxson): I did not.

MR. BALDWIN: Did you have access to any of Verizon's current or future frequency deployment plans in the area?

THE WITNESS (Maxson): Only what the Applicant has put on the record, which is quite thin.

MR. BALDWIN: Did you have any access to any information regarding the availability of resources and the loading on the adjacent cell sites in the area other than what's been provided?

THE WITNESS (Maxson): I have not.

MR. BALDWIN: Did you have any access to Verizon's customer data or customer feedback information?

Summary: Mr. Maxson performed no drive tests in the area, has no additional information on Verizon's current or future frequency deployment plans than what is on the record, has no additional information regarding the availability of resources and the loading other than what is on the record, and has no access to Verizon's customer data or customer feedback information. The insinuation is that this information, in addition to the information listed by Mr. Latorre, is necessary to come to a conclusion about the need for capacity relief at certain locations and the need for the proposed facility at the proposed site.

The Council could have cleared the air and erased all doubt whether the missing information is necessary for the Council or independent experts to form conclusions. It could have done so by insisting on disclosure by the applicant.

Let us parse these specious criteria posed by the applicant, one at a time. First, an analogy to put these claims in perspective – We can say that we always set the table with three forks, a knife and a spoon. This does not mean that at every meal, all five utensils are necessary to consume the meal. Likewise, drive testing and traffic mapping are tools that might be helpful or even necessary to arrive at a conclusion about a specific situation, or not. Without evaluating the “meal” for whether there is a salad (fork #1 – a drive test) or soup (spoon – a traffic map analysis), it is not appropriate to assume that these utensils will be needed at a particular meal.

Drive Testing

To say (vaguely) that drive testing is necessary is like saying a fork is needed at our meal, without describing which fork and what its purpose is. In my experience, lack of drive testing is occasionally trotted out as an argument why a peer reviewer cannot evaluate the claims in an application. No reasoning is given to make the connection between drive testing and the specifics of the case.

In plenty of applications in my experience the applicant does no specific drive test of the subject area to establish a search ring or validate a proposed site. Sometimes the applicant supplies a drive test report to buttress his claim, or agrees to perform, after the fact, a drive test to verify a claim. Drive tests come in several general forms, and each has a purpose. It is misleading to just say “drive data analysis” is a key component of all site selection processes without specifying in a particular case what kinds of drive data analysis actually went onto the selection and how.

General Computer Model Validation by Drive Testing

Drive testing is used as a form of meta-analysis to maintain the computer model. Drive tests are used in a general way to validate the coverage mapping settings, and to fine-tune the calculations. These tests do not have to occur in the exact area of interest. With well validated models, coverage modeling can be performed on various existing and proposed conditions without having to validate each area with a drive test. This distinction is often overlooked when an applicant insists that a peer reviewer has not performed a drive test of the specific area in question. It is misleading to equate the general notion of drive testing to validate computer modeling in a region with a presumed need to drive test every locus modeled. Isotope validates and tunes its models with drive testing that it does in the region.

Existing Coverage Drive Testing

In evaluating existing coverage, certain drive tests – often called “scan tests” – are conducted to provide a more detailed analysis particularly of areas where the computer modeling shows some uncertainty, such as at the edge of coverage on a particular route or locus of importance.

In the present matter, our modeling resources are sufficiently tuned with drive testing and other techniques to provide good coverage assessments. Moreover, in the present matter, it is not coverage per se that is the issue. As described in my prior report, it is the most likely server information that is valuable. The most likely server information is derived from coverage analysis, but relies on the differences between predicted levels of various sectors to identify the most likely server at each point on the map. This increases the reliability of the result by canceling out to some degree any offsets in the coverage computations.

In short, there is really no need to perform a drive test to evaluate existing coverage or most likely servers in the present matter. It may be reassuring, but is not necessary.

To provide such a degree of reassurance to my most likely server computer model and demonstrate that a drive test of existing coverage was unnecessary, Isotope conducted a drive test of existing coverage and plotted the serving sector. This is a close approximation of a most-likely server analysis the way the computer does it, with a minor difference. The most likely server map simply identifies the server with the strongest predicted received signal level at each point on the map. The drive test logs the currently selected server. In some cases, the stronger server is temporarily withheld until it is clear to the

network that the stronger server will remain stronger. This is part of a “hysteresis” function to prevent rapid jumping back and forth between two servers.

By analogy, a thermostat is set to heat a room to 70 degrees. The room cools off to 69 and the heat comes on. The room heats up to 71 and the heat turns off. If the thermostat was designed to operate at 69.9 and go off at 70.1, the heat would be coming on and off frequently, which is inefficient. So it is with network handoffs – the better server has to show it is better by a wide enough margin for a long enough time to be selected.

This hysteresis plays into three of the eighteen transitions on the map below. The vehicle was moving counterclockwise around the main outer loop and on three occasions, the connection to the first sector was held briefly as the vehicle entered the new sector of the same cell tower. The other fifteen transitions between servers occurred essentially where my most likely server map said they would. This drive test confirms that my most likely server analysis is accurate. This drive test provided no useful new information for adjusting my most likely server results.

The image below is my original most likely server map for existing coverage plus a new drive test overlay. The underlying map still has the 18 existing sectors provided by the applicant. These most likely server areas of the sectors are color coded. To simplify interpretation, the drive test trail is not colored for all 18 sectors, but for each of the 8 sectors in question in Docket 448, with a gray trail representing all other sectors. The drive test was conducted on October 5, 2014 with an inside-windshield mounted Verizon LTE smartphone operating on 700 MHz.

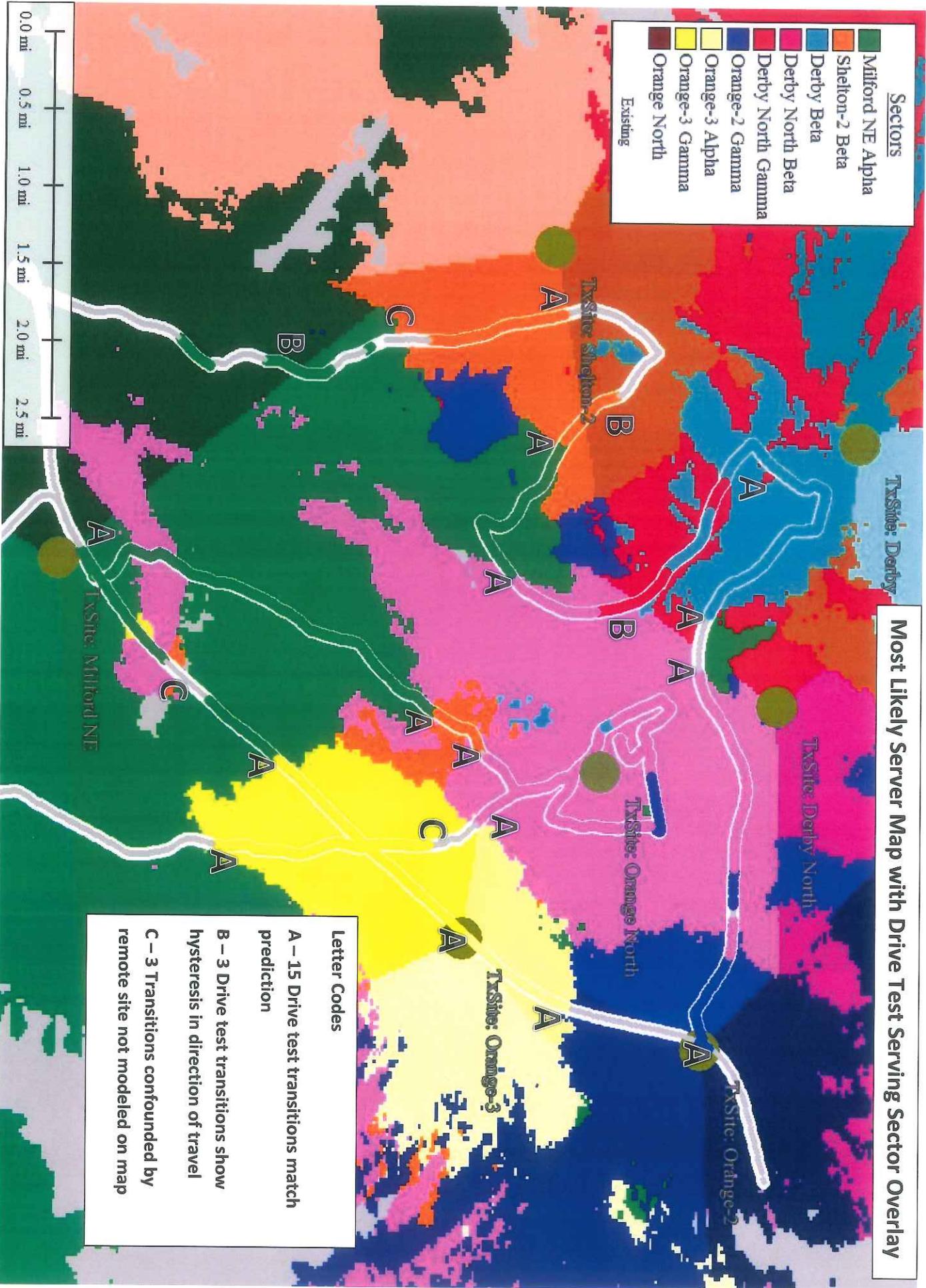
I have marked the 15 server transitions on the drive test that coincide quite well with the transitions on the original most likely server map (Points labeled “A”). I have marked the three transitions that were delayed as the vehicle moved from sector to another (“hysteresis” points labeled “B”). These three transitions occur only when motion is lateral between two sectors of one cell site. Some transitions are confounded by the reception of sectors that are outside the 18 sectors on the model¹¹ (Marked “C”). There are some minor variations that can be expected due to the nature of modeling. These variations show that on a small scale, there can be minor deviations between the computer model and results in the field. However, on a large scale, the service areas of each sector are well represented by the model.

Ultimately, the existing coverage drive testing conducted by Isotope confirms the results obtained by modeling.

¹¹ This illustrates my answer to Dr. Bell’s question about the impact of sectors outside the 18 on the map (Sept 16, 2014 Transcript, p. 363, “Is it your intention that the mapping that you’ve provided in your report that we’ve just been discussing can be made independent of your knowledge of other Verizon towers in the general area wider than the area where you have the specific information?” I responded, in part, “...I don’t expect any of those cell sites farther away would have any material impact on most likely server performance within the subject area of the Orange North facility.”

Most Likely Server Map with Drive Test Serving Sector Overlay

Sectors	
■	Milford NE Alpha
■	Shelton-2 Beta
■	Derby Beta
■	Derby North Beta
■	Derby North Gamma
■	Orange-2 Gamma
■	Orange-3 Alpha
■	Orange-3 Gamma
■	Orange North
■	Existing



Letter Codes

A – 15 Drive test transitions match prediction

B – 3 Drive test transitions show hysteresis in direction of travel

C – 3 Transitions confounded by remote site not modeled on map

Network Performance Drive Testing

In addition to scan testing, the existing network can be tested in a stimulus/response fashion by automating voice calling or data downloads/uploads and recording various performance metrics. (The basis of the long-retired “Can you hear me now?” advertising campaign.)

This drive testing is typically performed in a general way to evaluate the network on a larger scale to assess the customer experience and adjust policy or protocol. On the smaller scale, there may be a localized area of poor performance that needs to be evaluated. Such testing can identify network configuration issues, antenna aiming issues, and interference issues of various kinds. Customer complaints are an unscientific version of performance testing – helpful in a small way, but dependent on further network analysis to determine the nature and extent of an issue. Similarly, network data (such as the capacity trend data provided in the present matter) is also available to identify sectors with issues, if not the actual locations of the issues.

There is no evidence on the record that here is anything more than a simple capacity planning issue with respect to the present matter. Performance drive testing will not provide any deeper insight into how the proposed facility will or will not provide substantial capacity relief to 8 other sectors.

Proposed Coverage Drive Testing

In evaluating proposed coverage, computer modeling is heavily relied upon, because it can be costly or even impracticable to conduct a test of what a proposed facility’s coverage will be. This kind of test is called a “Continuous Wave” or “CW” test. A test antenna is elevated to the proposed height at the proposed location (usually with a crane) and a test signal is transmitted. The test signal is not a fully modulated wireless signal (not LTE, CDMA, etc.). Instead, it is simply a simple unmodulated sine wave carrying no information. This CW signal is measured in a test vehicle driven around the subject area. With the resulting data, the path loss between the antenna and the receiver is calculated. The path loss is the combination of the effects of distance, terrain and land cover between the transmitter and receiver.

A CW test is sometimes performed for a proposed cell site to verify performance to a degree that the computer model may not resolve or may have too much uncertainty. One variation of a CW test involves using more than one test antenna height to determine how low a proposed tower can be and still address a coverage issue.

The applicant has implied that it conducted a CW test from the proposed site.

September 16, 2014 transcript P467

LAREDO: ...based from actual drive tests, we can pinpoint and confirm with the help of traffic data location where a facility will be off-loading a sector or not... And based from my analysis, it will do an off-load for the rest of the surrounding sectors...

Mr. Laredo did not explicitly say that such a drive test was done in the present matter. He says he can use drive tests to “pinpoint... where a facility will be offloading a sector or not.” The only way to pinpoint the performance of a proposed facility with a drive test is with a CW or similar test. CW test results can be combined with scan test results to assess where the proposed facility is likely to become

the dominant server (at least along the roads driven). This information could be used to validate a dominant server computer analysis of the proposed facility. However, as shown above, the computer modeling of dominant server is sufficiently reliable that drive testing is not needed to prove it. This is as true for existing conditions as it is for existing-plus-proposed conditions.

Mr. Latorre echoed the misleading position,

p.504

THE WITNESS (Latorre): Sure. Our link budget, our drive data analysis, our traffic map analysis that Verizon Wireless uses to make strong determinations on what proposed facilities will do for both coverage and capacity enhancements to the network.

Again, the only drive test that will show what the proposed facility is expected to do is a CW test. The applicant is certainly able to present its CW test data to show how its computer model of proposed coverage is confirmed by its CW test. However, by itself, a CW test is only a coverage assessment of a proposed facility. It must be combined with a scan test to evaluate what the proposed facility would “do for... capacity enhancements...” Combining CW and scan test data is cumbersome and requires the making of some assumptions to align the CW measurement with the scan measurement. It is much simpler and quite reliable to use a good computer model of the dominant server areas to assess where the new facility will provide capacity enhancement.

Traffic Maps Are Moot in this Matter

As the various quotes from the record above indicate, the applicant holds out the vague notion that its traffic maps are necessary for one skilled in the art to arrive at the same conclusions the applicant has in this matter. Traffic maps are described elsewhere in the record, and in testimony in Docket 446, Trumbull, of which the Council has taken administrative notice.

The intervenors asked the applicant about traffic maps in the present matter (August 5th response to intervenor interrogatories – p. 21).

Question No. 58 [67]

In the process of establishing the Orange North search ring, did Verizon prepare and/or review any so-called traffic maps of the eight existing sectors reported in this Application? If so, what information did Verizon obtain? If not, why?

Response

Cellco assumes that the term "traffic map" as used in this question refers to specific "mapped" locations of data sessions and/or data use traffic concentration information. Cellco's RF Design Engineers use this customer specific data, along with other data, as a part of its overall needs analysis.

Note that the question was not answered. A general case (“RF Engineers use this data”) was given, but no admission of having used such data in the present matter is given. Also note that while this response refers to “mapped locations of data sessions and/or data use traffic concentration”, it is more compactly described in other testimony as identifying a “specific use or customer,” which includes things like office buildings. Traffic map data is therefore not necessarily “customer-specific.”

Question No. 59 [68]

Please provide a copy of any documents in Verizon's possession (including but not limited to any and all papers, reports, records and communications, including electronic) pertaining to any traffic maps of the eight existing sectors that Verizon prepared and/or reviewed.

Response

The customer specific information described in response to Question 58 [67] above is confidential information that Cellco cannot disclose.

The applicant still does not admit that there is any traffic map information that was consulted in the establishment of the Orange North search ring. However, the applicant also stipulates that there is no "specific use or customer" within the area of the Orange North facility that is affecting the capacity needs:

Question No. 32 [42]

Did Verizon determine whether the capacity needs that it is claiming as part of this Docket 448 "relate to a specific use or customer"?

Response

No. The capacity problems described in the Docket No. 448 proceeding do not relate to a specific use or customer.

The term "specific use or customer" directly relates to the use of traffic maps.

July 8, 2014 Prefiled testimony of Mr Laredo, Response to Q.7

...If the capacity problems relate to a specific use or customer we can look at alternative facilities that may solve the more precise problem. For example, if a capacity problem is related to a high capacity user in a particular area (a large office building, college campus or corporate park), a dedicated in-building system or small cell installation on or in that building may resolve the capacity problem...

Aug 5th Response to interverners, Question No. 10

In the prefiled testimony of Jamie Laredo, Jr., dated July 8, 2014, Mr. Laredo testified that - "[0]nce a capacity problem is identified we look at several options before we issue a search ring for a new cell site." Did Verizon consider any "options" before issuing a search ring for the subject property at 813 Derby Milford Road, Orange, CT (the "Subject Property")? If so, what "options" did Verizon consider?

Response

The options that are considered are as described in Mr. Laredo's testimony. They include, analyze ways to optimize the surrounding cell sites in an effort to relieve capacity problems; identify coverage or capacity solutions related to a specific use or customer, if one exists; and before proposing a new tower site, search for existing towers, buildings, water tanks or other tall structures that may satisfy Cellco's wireless service objective in an area.

In Docket 446, the April 29, 2014 transcript has RF Engineer Mr. Ulanday explaining how "snapshots" in the form of traffic maps are taken to isolate the geographic locations of network traffic (p.34):

THE WITNESS (Ulanday): Actually, we have software that we use, a program which takes a snapshot of our network in a certain -- in a specific time. And when I say, a snapshot, it takes -- on that specific time, it takes all the subscribers in that cell site, all subscribers that are making a voice call, texting, doing downloadings or just idle. And together with that information there is what we call, like, a timing advance where -- where the -- where the handset sends out how just -- what are we to call this? It sends out how high is the signal that is receiving from the -- from the cell site. And with that signal the -- the

cell site then estimates how far it is, how far the handset is from the cell site. And, actually, we can gather all that data and plot it on a map. We call it a traffic map. So right now with this proposed site we're seeing all that traffic concentrated on the corporate park.

Based on the foregoing, it is clear that there is no specific use or customer that creates any centralized areas of demand around Orange North. Therefore, traffic mapping is not relevant to the present matter. It is misleading to suggest that my lack of the applicant's traffic map information has any bearing on the completeness of my review.

The Lack of Disclosed Link Budget Information Is a Non Sequitur

Link Budget Role is Minimal in this Case

The applicant says I need access to its link budget assumptions to review the applicant's conclusions. However, the lack of detailed link budget assumptions does not prevent peer review of the applicant's coverage maps. The -85 dBm threshold on the coverage map is derived from the link budget assumptions. If one accepts the threshold, one is accepting the undisclosed link budget and coverage maps can be created without knowing the link budget details.

Moreover, the record shows there is good coverage in the subject area, with a few coverage holes. Coverage is not the issue. Dominant server area is the critical element in this matter. In a full coverage situation such as this, even the signal level threshold is not a major factor. It is the difference in signal level of the various serving sectors at each point that matters. The link budget is moot in the most likely server analysis.

How a Link Budget Works

The link budget describes the parts of the signal path from transmitter to receiver. Each step in the path causes a loss or gain in the signal level.

In the example below, the network receiver threshold is -103.5 dBm. This is 18.5 dB lower than the -85 dBm threshold published by the applicant. We can deduce that in this example, the carrier's undisclosed link budget margin is 18.5 dB. What is undisclosed is just how much of that 18.5 dB is being deducted for the separate components like fade margin or building penetration or body loss. Nevertheless, the carrier's link budget margins are incorporated in the -85 dBm threshold.

Between the 62 dBm effective power from the antenna and the -85 dBm threshold is a 147 dB difference.¹² This is the amount of path loss allowed due to distance, terrain and land cover.

The applicant provided transmitter and antenna information that produces similar antenna output levels compared to line "d" of the table below, about 62 dBm EIRP. We can rely on the example table to determine the approximate losses allowed by the -85 dBm threshold in the applicant's case. After accounting for the applicant's approximately 18.5 dB link budget margins, the path loss allowed on the coverage maps is up to 147 dB as calculated above.

¹² In case the reader is wondering, dBm represents an actual level while dB represents the difference in dB between two absolute levels.

Table 1 - Typical LTE Downlink Budget

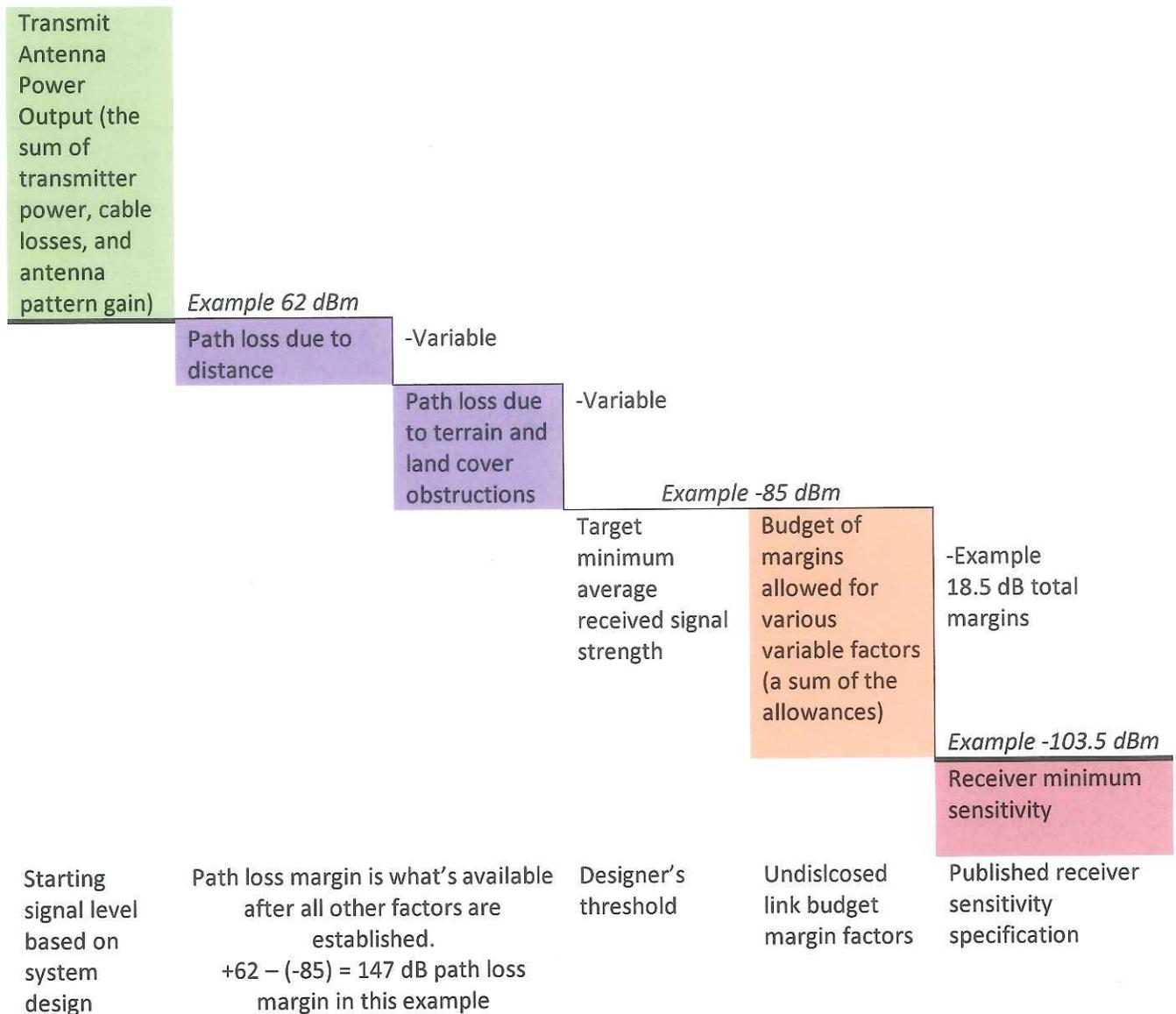
LTE Downlink Link Budget for 1 Mbps with dual-antenna receiver terminal

Data rate (Mbps)	1		Isotrope Remarks
Transmitter – eNode B			
a	HS-DSCH power (dBm)	46.0	Starting Point is the power output of the transmitter. Antenna gain and cable loss combine with transmitter power to create an effective radiated power from the antenna
b	TX antenna gain (dBi)	18.0	
c	Cable loss (dB)	2.0	
d	EIRP (dBm)	62.0 = a + b + c	
Receiver – UE			
e	UE noise figure (dB)	7.0	User Equipment (for example, a smartphone) has an internal noise level, and the environment has an external noise level.
f	Thermal noise (dBm)	-104.5= $k(\text{Boltzmann}) * T(290K) * B(360kHz)$	
g	Receiver noise floor (dBm)	-97.5 = e + f	The signal has to be more than some minimum level with respect to the noise. The result is a sensitivity specification for the receiver. Additional design factors raise the minimum level necessary to make the UE work. Adjusted receive threshold is -107.5 + 3 + 1 = -103.5 dBm.
h	SINR (dB)	-10.0 From Simulations performed in [1]	
i	Receiver sensitivity (dBm)	-107.5 = g + h	
j	Interference Margin (dB)	3.0	
k	Control Channel Overhead (dB)	1.0	
l	RX antenna gain (dBi)	0.0	Not added here are carrier-selected factors describing the UE antenna, the signal losses due to coupling with the body, and other losses like fade margin or building penetration margin. This area of the table is where the undisclosed link budget information would apply.
m	Body Loss (dB)	0.0	
Maximum path loss		165.5 = d – i – j – k + l – m	This is the maximum amount of loss allowed between the transmit antenna and the receive antenna, which must be divided between the propagation losses and the margins in the carrier's link budget.

Source: LTE Encyclopedia

Figure 3 - Signal Loss Steps by Category from Transmitter to Receiver

From Transmitter ----- to ----- Receiver



Putting it graphically, in the chart above, the horizontal lines represent a particular signal level (dBm). The vertical lines represent reductions in signal level (dB) as the chart is followed from left to right. The starting point is upper left. A signal is coming out of the base station antenna at, say, 62 dBm. The next part of the link illustrates what happens to the signal as it passes through space to the receiver (path loss). This is the part that the computer model calculates.

Now, working from right to left (the receiver side of the chart), the end point is at the minimum level that phone will work at on a particular technology (the example level is shown). The second to last box (orange) on the right represents the sum of the applicant's undisclosed link budget margins.

The applicant resists, in this matter, disclosing these individual margins. However, this does not affect anyone's coverage analysis, as long as the applicant's total link budget margin is assumed to be correct.

For the foregoing reasons, the applicant's assertion that a peer reviewer cannot replicate the applicant's analysis because the link budget margins are not disclosed is incorrect and misleading.

In fully evaluating a claim, it is preferable to also review the link budget margins to verify the threshold is chosen reasonable. Without that information, coverage can still be analyzed at the applicant's chosen threshold based on the undisclosed margins. In the present matter, the coverage aspect of the existing and proposed facilities is dwarfed by the need for dominant server analysis.

Appendix 6 – “120 dB RLOPL” Is Misleading

The applicant’s reversal on its -85 dBm LTE threshold claim (Sept 16th transcript pp. 461-466) was a cumbersome gambit to redefine the LTE threshold in impenetrable terms. The applicant announced the LTE coverage maps in the present matter as having been mislabeled,

“The only omission was that the signal threshold label was incorrect, but the data that's presented first as far as the maps in purple showing what Verizon Wireless determines as the threshold of reliable coverage on the LTE network is accurate, and we can stand behind that. I just want to take the opportunity to correct that signal threshold.”

The thresholds shown on the LTE maps submitted by the applicant (Application Attachment 6) are now said to represent “120 dB Reverse Link Operating Path Loss.” Let us consider this in three parts:

- RLOPL is not a Signal Level Threshold
- Setting Fixed RLOPL Creates a Variable Signal Level Threshold
- RLOPL Comes from Uplink Analysis, not Downlink Analysis and Does Not Apply Anyway.

RLOPL Not a Signal Level Threshold

Mr. Latorre “... just want[ed] to take the opportunity to correct that signal threshold.”

“...[The Map Legend] should read, "Coverage is depicted at a signal threshold of 120 dB RLOPL." And that acronym stands for Reverse Link Operational Path Loss.”

While he correctly describes it as a “reduction of signal” (quotation below), Mr. Latorre still leaves an impression that 120 dB RLOPL it is a signal level threshold. It is not. It simply represents the path loss between two points (quotation below) and exists regardless of the power levels used or the receiver characteristics used. The map maker who shows coverage based on this theory could input 2 watts or 2 million watts and the coverage of the base station would not change.

RLOPL Creates a Variable Signal Level Threshold

Figure 3 in the previous section shows the path loss components in lavender in the second and third blocks. The RLOPL figure is intended to represent the margin for the path loss in the link, which is represented by these two blocks. Mr. Latorre explains it this way on p.462 of the Sept 16th transcript,

So to restate, RLOPL is Reverse Link Operational Path Loss, and basically what the Reverse Link stands for is meaning the signal **from the transmitter**, the antennas at the top of the tower, **to the receiver unit, the user equipment**, your cell phone or your iPad, et cetera, et cetera. And what it's basically measuring is all of the different attenuation factors or reduction of signal that can occur in the network from the point the signal leaves to the point it is received by the user device. So that could be just simple path loss that comes with being X amount of miles away from the cell. It can take into account reflection or refraction of the signal that can occur as the signal travels from the antennas down to the user device.

Mr. Latorre indeed describes RLOPL as being loss due to propagation conditions between the base transmitter and the receiver (this direction of communication is customarily called the “forward link” or “downlink”). As shown above, in order to establish an available propagation path loss, one has to have these components:

- Transmitted EIRP (green block in Figure 3)
- Receiver sensitivity (red block in 3)
- Link budget margins (orange block in figure 3)

The available propagation loss is calculated from these elements and is the result of the link budget calculation, not an input. It is not customary to start with a path loss threshold in matters like this.

One major flaw with the RLOPL approach is the map will not capture the variations in transmitted power level due to the specifics of the site and the antenna at each sector. The advantage of having a higher gain base station antenna at one site versus another is lost in this type of analysis. The result is a hodge podge of varying signal level thresholds. Table 2 employs common power, gain and loss values found at cell sites to provide two examples of signal level thresholds derived from 120 dB RLOPL.

Table 2 – Examples of Variations in Sector Power Levels Affecting the Minimum Received Signal Strength.

Characteristic	Example 1	Example 2
Transmitter power	46 dBm	48 dBm
Line losses	-2 dB	-1 dB
Antenna gain	13 dBi	16 dBi
Radiated Power EIRP	57 dBm	63 dBm
RLOPL	-120	-120
Threshold of signal reception	-63 dBm	-57 dBm

As Table 2 shows, there can be a significant difference in the power outputs of two sectors, and if only applying the 120 dB RLOPL to map the sectors' coverage, the result is a varying signal level threshold. The more powerful site ends up being shown to have less coverage than it really does.

The resulting signal strength thresholds derived from the transmitter information and the RLOPL are orders of magnitude higher than the -85 dBm originally attested to (-57 to -63 dBm, some 22 to 26 dB stronger than -85 dBm). The applicant makes no effort to teach the Finder of Fact about the significant differences between the original LTE modeling assertions (contained in 16 different Dockets) and the newly announced version.

Reverse Link Path Loss Does not Apply to Forward Link

As quoted above, Mr. Latorre explains that the reverse link is the link from the base station to the user. This is incorrect. The reverse link is the link from the user to the base station.

Latorre ...what the Reverse Link stands for is meaning the signal **from the transmitter**, the antennas at the top of the tower, **to the receiver unit, the user equipment**, your cell phone or your iPad, et cetera, et cetera. [cited above]

Moreover, in my experience, the fact that there is a forward link and a reverse link in wireless communications is sometimes used in a way that clouds understanding by the Fact Finder. In other words, there is more power from the base station to the user than there is from the user to the base station. This means the handset may have a harder time reaching the base than the other way around.

However, there are other elements in the reverse link that help compensate for the low handset power – more sensitive receivers at the base station, better filtering at the base station, low noise receiver amplifiers at the base station, and process gain characteristic designed into the reverse link digital signal. The reverse link has its own loss and gain elements, many of which are the same as the forward link, but some of which are not. This is why it is not appropriate to use a reverse link factor on a forward link computation.

The applicant has supplied coverage maps that rely on forward (down) link analysis, which is customary in permitting proceedings. Thus, it is not appropriate to simply apply reverse link path loss to the forward link to model coverage. RLOPL is therefore not relevant to forward link analysis.

Instead, it is customary to maintain forward link characteristics that do not put the reverse link out of bounds. Applicants, in my experience, submit forward link maps that are inherently balanced with their reverse links. No further reverse link analysis is necessary.

In summary,

- In my opinion, the attempt to color the LTE coverage maps as representing “120 dB RLOPL” is revisionist and misleading.
- In my experience with more than 500 wireless facility siting matters, RLOPL has never before been used to depict coverage of a facility or network.
- Reverse link thresholds are not appropriate for forward link analysis.

It is troubling to see this position being taken by a representative of the applicant. This is particularly so because the applicant claims the coverage maps matter. Fortunately, based on my analysis, the coverage analysis discussed in this section is secondary to the prime issue in the present matter – where does the proposed facility provide significant capacity relief to stressed sectors? Dominant server analysis in a nearly full coverage situation is unaffected by the *post hoc* announcement of the applicant’s purported LTE coverage standard.

Appendix 7 – Generalizations

Various generalizations have been placed on the record as evidence. The following item is just one example of the many generalizations where the applicant speaks about what the applicant typically does as opposed to what it did in the present matter, and broadly includes a variety of specious information without tying the information to the specifics of the matter:

It Is in the Middle – Therefore It Must Be Effective?

p. 525

THE WITNESS (Latorre): Verizon Wireless has presented our data, and we've done our due diligence in terms of looking at our traffic maps¹³ and all the data that we presented here¹⁴ to show that the areas where Milford Northeast is currently providing coverage overlap of areas that the Orange North facility could potentially provide coverage, should it be built as we described in the application. Verizon Wireless does this through looking at the existing drive data¹⁵, through the maps that we're looking at here, and a host of other data that we presented today that suggests that the orientation of the sectors, the coverage, et cetera, is going to provide overlapping coverage where users can get onto Orange North, whereas today they're kind of on the fringe of Milford Northeast.

Looking at this, I mean, we have an area here bounded by Shelton 2, Derby, Derby North, the Orange 2 and 3, and Milford Northeast. We have a gap in the middle. We need something there that's going to allow for Milford Northeast and these other sectors to have a new server to use our services.

The first paragraph glosses over the information the applicant says it *typically* consults and the information it says it has placed on record. We discuss the shortcomings of this evidence in detail in this report and our previous report.

The second paragraph above is perhaps the most cogent explanation of the applicant's methodology: Place a tower in the middle of the area circled by the existing facilities, without regard to the actual dominant server characteristics of the proposed facility ("We have a gap in the middle"). The applicant may have created its search ring solely on this basis – look for a spot roughly equidistant from existing facilities and assume that its coverage will equally divide among 8 existing sectors. It is really the only explanation for the selection of this location. The selection of the Site does not appear to have been based on any engineering at all.

None of these generalizations rises to the level of fact. There is simply no evidence the proposed facility will provide significant capacity relief to 8 existing sectors.

¹³ Reiterating, the traffic map analysis is moot - the applicant stipulated there were no specific uses or customers affecting the placement of the proposed facility.

¹⁴ The "data that we presented here" consists of coverage maps and utilization trend data; no evidence of the areas of replacement service of the proposed facility.

¹⁵ The idea of drive data, discussed elsewhere in this report, is provided as a generalization with no explanation of how it connects to the present matter.

Appendix 8 – Capacity Relief Must Be Substantial to be Significant

Milford NE Alpha Needs to Be Split in Half

Looking at Milford NE Alpha, which is reportedly at capacity at 700 MHz now (scheduled eligible users), consider how much relief it will need over the next four years, based on the Cisco¹⁶ 1.5X growth curve and other factors. If the demand increases 1.5x for four years, the demand will be 5 times what it is now. Let us assume the 2100 MHz service catches up soon and divides the load by three (twice as much 2100 MHz capacity as 700 MHz). The demand on Milford NE Alpha in four years projected growth, adjusted for 2100 MHz spectrum offload is $5/3 = 167\%$ of capacity. To keep up with the four year demand assumption, Milford NE will have to split its Alpha sector in half, offloading half of its demand to one or more new sites, with a load of about 0.83 (83% capacity) per half sector.

Orange North Is a Drop in the Bucket and Not a Significant Capacity Reliever

As we have seen with the dominant server map, it is not likely that more than 10% of Milford NE Alpha will be offloaded to an Orange North facility. With projected growth curves this steep, anything that would qualify as significant capacity relief would have to offload about half of an existing sector. It would take the equivalent of five facilities like Orange North, each drawing off 10% of the Milford NE Alpha load to provide significant capacity relief just to Milford NE Alpha. This is impractical.

Meanwhile, Orange North is positioned in the center of the service area of Derby North Beta, which does not show exhaustion trending. Additional spectrum at Derby North Beta (first 2100 MHz and then 1900 MHz) may very well address the needs of this sleepy residential area of Orange for a substantial time to come.

Using both the historical trending and a first approximation of projected loading, counting only 700 and 2100 MHz channels, it is clear that Orange North cannot possibly provide significant capacity relief to 8 sectors, even if it could provide dominant service to them geographically. At, say 50% offload by Orange North taking from each of the 8 sectors, Orange North would be full from the start (8 existing sectors times 50% offload, divided by three new Orange North sectors reveals a load factor of 130% on each Orange North sector).

This is yet another example of why the 8 sector significant capacity offload claim is just not credible.

Assets Should Be Positioned Where They Will Provide the Most Benefit

Clearly, the growth in demand is concentrated where the density of population is. These areas of density are clearly identified by the exhaustion trends. As detailed above and for other reasons given previously, Orange North can't do what the applicant says it can, and the focus should be to position new facilities closer to where the loads are: near Milford NE Alpha, Sunnyside/Derby area (Beta, particularly). These might not need to be full cell towers, depending on the nature of the in-sector relief the facilities would offer (on buildings in densely developed areas for example).

¹⁶ Cisco report on administrative notice: Visual Networking Index: Global Mobile Data Traffic Forecast Update, Table 6, North America

The Applicant Could Be More Rational about Its Design

The foregoing analysis of how much relief Milford NE Alpha would need to be significantly relieved is an example of how an applicant could rationalize its network plans internally as well as to the public. It relies on the historical trends of the affected sectors, the expected availability of new spectrum to dilute the demand in a given sector, and the forward-looking trends to approximate the rate of increase in demand over several years. The applicant, instead relies on generalized statements about the nationwide growth rate, superficial analysis of the supposed benefits of the proposed facility, and a “trust me” attitude toward providing evidence of need.