KerrisdaleCapital

October 2014

# Globalstar, Inc. (GSAT)

## *New Data Underscores TLPS's Shortcomings and Raises Questions about Globalstar's Credibility*

[*Globalstar's*] *"test" is ludicrous, non-realistic, non-professional, and would be laughed at by 100 out of 100 wireless professionals.*

—seasoned wireless engineer overseeing a large-scale university network

Since we released our initial report and presentation on Globalstar (GSAT), the financial community has begun to question the value of the company's proposed Terrestrial Low Power Service (TLPS), even assuming FCC approval and even taking at face value the materials that GSAT has previously put into the public domain. Here we shed light on two new topics :

1. We believe that the "test results" that GSAT filed with and presented to the FCC in June 2013 do not in fact reflect the results of real-world tests. (We note that the company's initial reply to our *ex parte* letter completely ignored this issue, which we spent ~1,300 words discussing.) Moreover, when we commissioned a practicing wireless engineer to create a more realistic version of GSAT's simulation, he concluded that the company had apparently not incorporated the impact of many attenuation sources. As a result, GSAT's simulation dramatically overestimated the actual range of a TLPS access point. More importantly, our engineer also developed his own hypothetical Wi-Fi design in the same location. This far more realistic design naturally relies heavily on the 5GHz band to deliver superior bandwidth and capacity.

   For the sake of transparency, we not only provide an overview of this design in what follows; we have also posted the underlying data file in the native .esx format used by the popular Wi-Fi site-survey program Ekahau, as well as the automated summary report generated by the program. We encourage wireless-networking professionals to examine these results.

2. GSAT has asserted, based on no discernible evidence, that TLPS would not affect the performance of existing Wi-Fi systems using the unlicensed bands. Other parties have quite reasonably attacked this position but have not contributed hard data illustrating the size of the effect. We believe we are the first to conduct such testing, using an independent firm, Allion Engineering Services, which is an authorized test laboratory under the Wi-Fi CERTIFIED program and which Comcast has publicly named as the main firm it uses to test the Wi-Fi

devices it offers to its customers. Depending on the scenario, our lab tests show that TLPS activity could reduce the capacity of nearby unlicensed networks by ~60-70%. In some cases, when just two TLPS interference sources were introduced, a usable Channel 11 connection went dead. This data, the first of its kind, confirms that TLPS would cause interference. That said, we do not believe that TLPS will ever be commercially viable, so this potential interference is merely hypothetical, from our perspective. Nevertheless, the testing debunks yet another misleading claim that has been repeated numerous times by GSAT management and its consultants.

Again, for the sake of transparency, we have posted in full the report we received from Allion. We hope that other interested parties undertake their own testing and we may also follow up with additional tests.

We plan to add all of this information to the public record in the TLPS proceeding. With a $2B+ market cap founded upon fantasy, GSAT's valuation continues to defy logic.

## I. GSAT's TLPS "Test Results" Are Inadequate and Misleading

In June 2013, GSAT released three documents that together constitute the only concrete, publicly available evidence of TLPS's potential performance:

- a Globalstar/Ruckus Wireless joint press release claiming that "the combination of Terrestrial Low Power Service (TLPS) with [Ruckus's] Smart Wi-Fi show up to 5x distance and up to 4x capacity increase over traditional Wi-Fi with no impact on surrounding public Wi-Fi networks";
- a more detailed "comparative analysis of TLPS and ISM Wi-Fi" filed as an *ex parte* with the FCC; and
- a presentation to the FCC incorporating some of the images from the *ex parte* (see slide 16).

Notably, the press release attributed all substantive claims about TLPS to *Jarvinian,* GSAT's technical partner, not to Ruckus (emphasis added):

> The Wi-Fi/TLPS testing, **performed by Jarvinian**, showed that combining Globalstar's unlicensed ISM bands with 802.11-compliant, adaptive antenna array technology from Ruckus results in a carrier-grade service that vastly exceeds the performance of conventional public Wi-Fi. **According to Jarvinian**, Ruckus Smart Wi-Fi technology helped to significantly increase Wi-Fi performance and signal range within the managed channel (14) while providing a better method of managing co-channel interference between access points.

Some of the phrasing is downright strange – Globalstar has no "unlicensed ISM bands," just a licensed MSS band that neighbors the unlicensed 2.4GHz ISM band – but the point is clear: Ruckus didn't conduct any tests itself and wasn't willing to give Jarvinian's tests its stamp of approval. In fact, although these documents strongly imply that, by June, Jarvinian had completed real-world testing in Cambridge, Mass., using Ruckus's ZoneFlex 7372 access point (AP), Jarvinian's experimental license covering Channel 14

operations in Cambridge did *not* authorize the use of this particular AP model. (See our *ex parte* letter, p. 4-8, for further elucidation of these points.)

In short, we believe that the "test results" touted by GSAT as proving TLPS's benefits were only simulations, or "predictive surveys," not real tests. Yet GSAT continues to promote these "results" as if they were gospel. On its October 9 conference call designed to "set the record straight" in the wake of our initial publications, GSAT said the following, apparently drawing on the same "tests" (emphasis added):

> Kerrisdale's assessment of the potential of TLPS could not be more wrong. Initial tests confirm the superiority of TLPS to free alternatives. **These tests also confirm that TLPS outperforms the traditional public Wi-Fi by 5x the effective distance and 4x the effective capacity in perfect conditions. The more compromised the local Wi-Fi resource, the greater improvement from using TLPS.** This is a service that people will pay for. All of this is achieved with no impact on public Wi-Fi operations and adjacent channels.

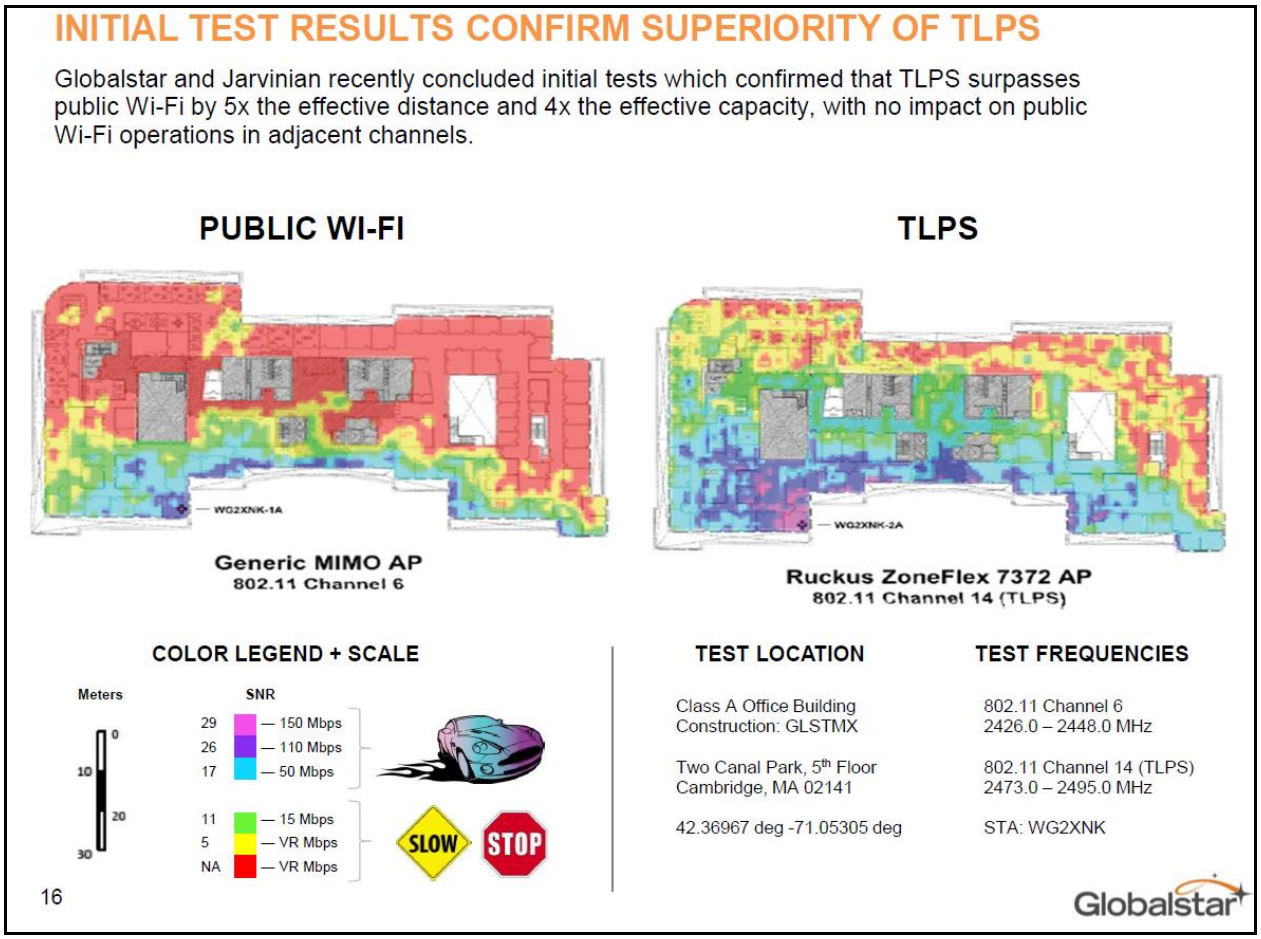
GSAT supporters might argue that the distinction between real and simulated tests ultimately amounts to little. After all, good predictive surveys can be fairly accurate. This is true, but we doubt that GSAT's survey was, in fact, competently executed. Multiple wireless engineers have told us qualitatively that GSAT's Wi-Fi heat maps simply look strange: for example, why would anyone try to cover a ~40,000-square-foot office space with a single AP, no matter what its range? 200 office users could quickly overload such a "network." And why would anyone set an AP to such a high power level instead of matching it to the capabilities of the anticipated client devices, many of which, like phones, run at fairly low power?

To go a step further, we commissioned an engineer to undertake two exercises:

1. Given the existing floor plan of the Jarvinian office space at the time of its tests, available online at a relatively high level of detail (p. 5-6), how much coverage would a single AP placed in the corner actually achieve?

2. Given the same floor plan and based on a fairly standard set of design criteria (aimed at supporting wireless voice over IP), what would a realistic Wi-Fi network actually look like in the same space?

The contrast between what GSAT has presented and what our engineer concluded is stark. Below is what GSAT told the FCC:



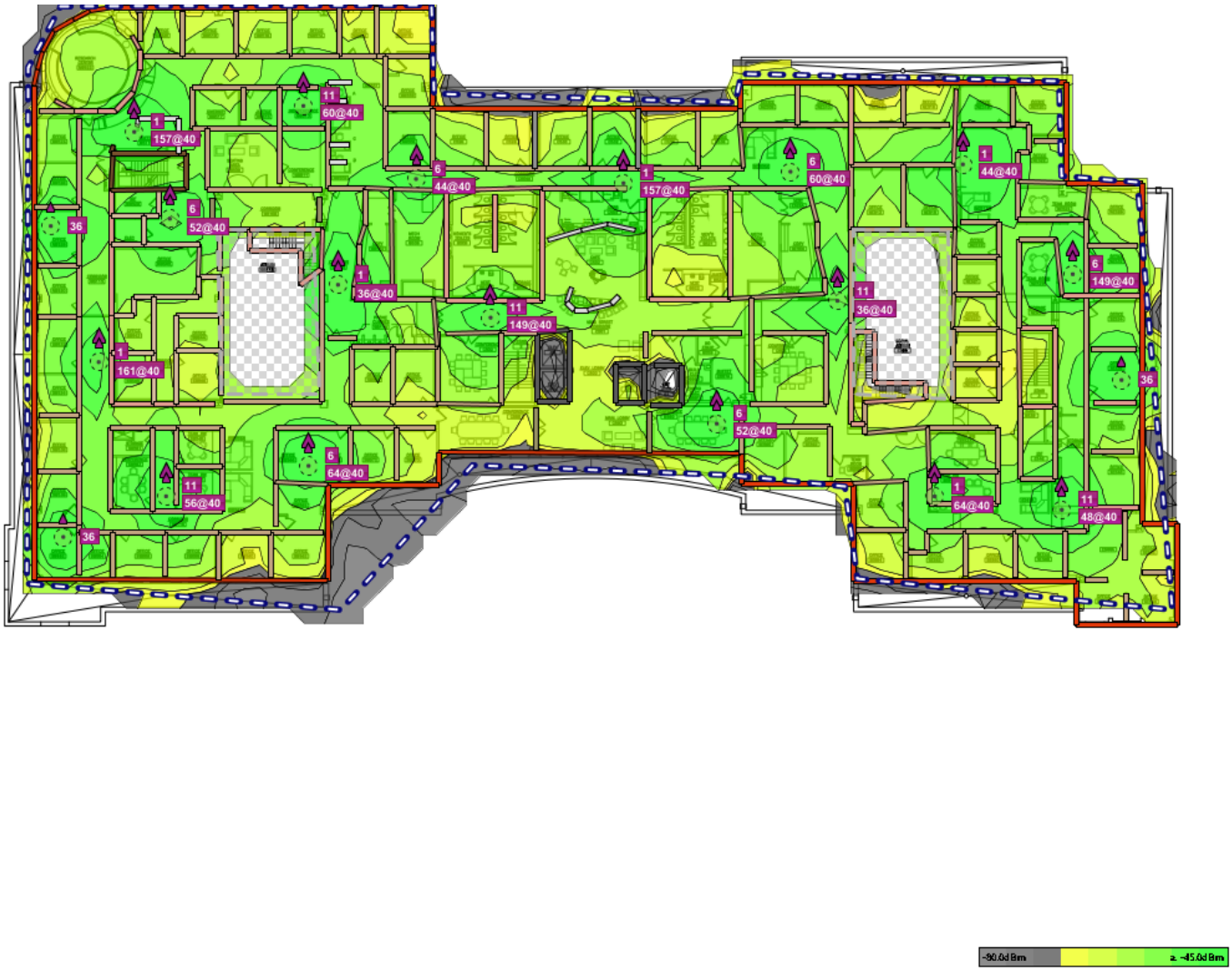

*Source: [GSAT June 21, 2013, ex parte](), attached slide presentation, slide 16*

Based on these images, it appears that TLPS would be usable throughout the space. Here, however, are our engineer's results, indicating that the signal strength would fall to an unusably low level throughout the bulk of the space and that much of the AP's high radiated power would be pointlessly wasted on the exterior of the building:


*Source: Ekahau predictive survey commissioned by Kerrisdale using publicly available Two Canal Park floor plan*
*Note: the color represents 2.4GHz signal strength measured in dBm.*

Regardless of the noise floor in TLPS's Channel 14, a sufficiently weak signal simply won't be heard by user devices. The impact of interior walls and other sources of attenuation in the environment drastically cut down the projected range of any 2.4GHz Wi-Fi signal emitted from the location Jarvinian used, TLPS or no TLPS. Moreover, while adding TLPS access points would eventually produce a uniform enough signal to provide continuous coverage, it would do nothing to increase capacity, since all of these APs would be sharing a single channel.

By contrast, what would a realistic Wi-Fi network in this space look like? The answer all depends on what the network needs to do. A lightly used warehouse network might only require a handful of APs, while a densely packed convention center might need many. For this space, we drew on Cisco's "Voice over WLAN Radio Frequency Design," a standard point of reference for many Wi-Fi professionals. Key design criteria include a minimum signal strength of -67 dBm, a minimum signal-to-noise ratio of 25 dB, and enough overlap between APs to assure smooth roaming through the space. The diagram below illustrates the resulting design, a hand-optimized revision of what the Ekahau software itself automatically suggests:




*Source: Ekahau predictive survey commissioned by Kerrisdale using publicly available Two Canal Park floor plan*
*Note: the color represents 5GHz signal strength measured in dBm.*

The design includes 20 APs, of which 17 are dual-band (including both 2.4GHz and 5GHz radios) and three are single-band (5GHz only – either dual-band APs with the 2.4GHz radios deactivated or a device like the Ruckus ZoneFlex 7321 set to 5GHz). In 5GHz, the design exploits the abundant available bandwidth and uses 40MHz channels – 10 in total, in addition to the three channels used in 2.4GHz. According to Ekahau's analytics, these APs could support 100 laptops, 50 tablets, and 50 VoIP-enabled smartphones.

To be sure, this design is not the one, true answer to how to configure a Wi-Fi network in the available space. For some purposes, it might be overkill; for others, it might not be enough. Clearly, however, no competent professional designer would attempt to support hundreds of devices without relying heavily on the 5GHz band, even to the point of disabling 2.4GHz radios. Given the vast selection of 5GHz channels, Wi-Fi "congestion" would be at best a minor concern here, since 5GHz would provide the bulk of the potential throughput.

In sum, GSAT's "test results" – likely a botched simulation – say nothing meaningful about the practical usability of TLPS. The way GSAT presented its "test" – as a single-AP network that could cover an entire 40,000-square-foot office space – is misleading and silly. Furthermore, given the local attenuation sources, the company probably overstated its single AP's effective range. But in practical terms, debating the range of one AP is a sideshow. One AP would not be able to support a realistic office network, while a reasonable design would use the 5GHz band extensively and as a result suffer from no serious co-channel contention. Even in the very location where GSAT chose to test it, TLPS is a non-solution to a non-problem.

## II. Lab Tests Confirm the Harmful Impact of TLPS on Public Wi-Fi

We reiterate that TLPS is not commercially viable and has no value to service providers. (Yet another confirmatory data point came at the Society of Cable Telecommunications Engineers' recent Cable-Tec Expo, at which the top two "Wi-Fi trends being talked about" were firstly 802.11ac, a 5GHz-only technology that TLPS could never use, and secondly "using 5 GHz spectrum for Wi-Fi deployments," which GSAT management regularly de-emphasizes in its discussion of TLPS.) We acknowledge, however, that commercial viability has less bearing on the FCC rulemaking process than potential interference, which is why we have heretofore assumed that TLPS will be approved.

Nonetheless, we conducted our own tests assessing the potential interference caused by TLPS. In its June reply comments in the TLPS proceeding, the Wi-Fi Alliance wrote the following:

> Globalstar claimed – without technical proof – that its TLPS network "would coexist successfully with other unlicensed operations below 2483.5 MHz," but that, at any rate, the Commission's precedent "in interpreting its Part 15 rules is clear – unlicensed operations do not receive interference protection." However, the former assertion is unproven … and the latter is incorrect. Wi-Fi Alliance and others acknowledged that Part 15 devices are not entitled to interference protection under the Commission's rules. Contrary to Globalstar's claim, however, the FCC has in the past recognized the need to balance different operational needs within a frequency band.

*Ex ante,* there is every reason to expect TLPS would harm nearby Wi-Fi networks operating on Channel 11 in the 2.4GHz band. While Channels 1, 6, and 11 are often described as "non-overlapping," there is always some degree of adjacent-channel interference even between nominally "non-overlapping" channels.

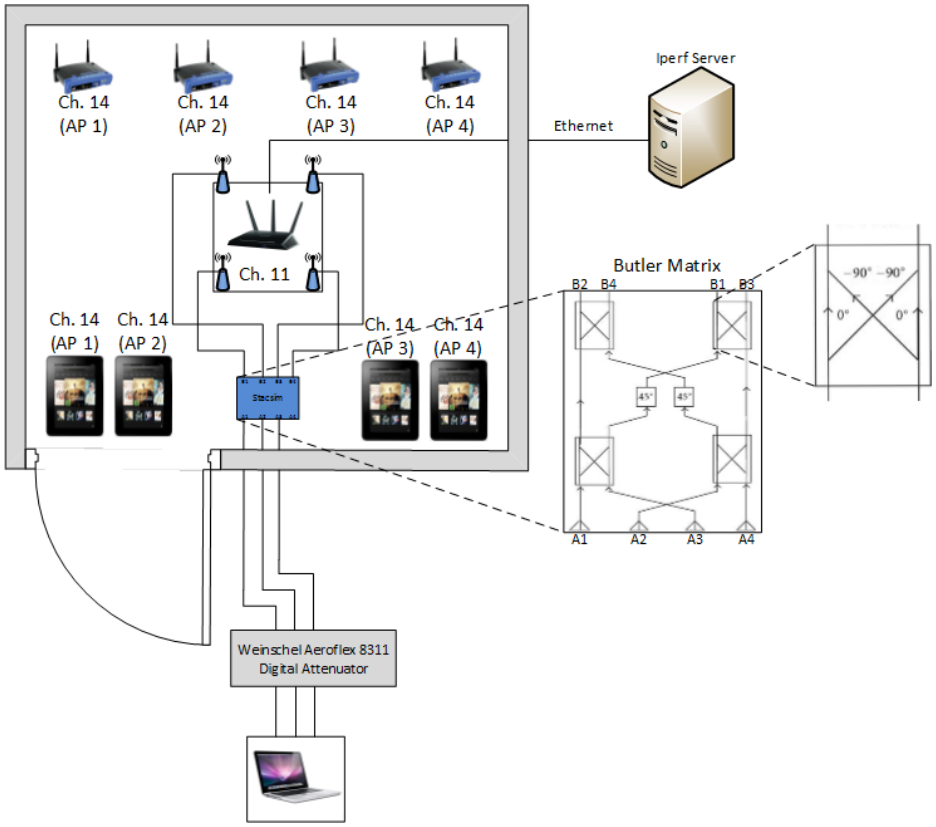
More important, the single-channel nature of TLPS, which would only ever be implemented in the hypothetical fantasy world dreamt up by GSAT bulls, would be unusually detrimental relative to unlicensed Wi-Fi. Consider the following illustrative example: a Channel 11 network is deployed in a given location in a densely populated area. Initially, there are no nearby Wi-Fi networks, so there is no adjacent-channel interference or co-channel contention. Now assume that third parties install two nearby networks using the 2.4GHz unlicensed band. Whether through explicit coordination or automatic channel-

selection algorithms, these networks are unlikely to all end up on the same channel. Instead, they will spread themselves out across 1, 6, and 11, minimizing interference and contention. If additional parties install more networks, then interference and contention will certainly increase. But the blow will be cushioned because networks actively gravitate to the least utilized channels. (Of course, networks will also shift users toward the 5GHz band, further reducing the impact.)

TLPS, however, would change this dynamic. As GSAT conceives it, TLPS would be a single-channel service. It would never budge from Channel 14. Consider our illustrative example again. Temporarily setting aside the practical reality that TLPS will never be commercially viable, assume that a standalone Channel 11 network suddenly finds itself flanked by Channel 14 TLPS APs and begins to experience adjacent-channel interference. Will any of these TLPS APs switch to a less harmful channel or nudge users onto the 5GHz band? No. Because TLPS is just a single channel, it must stay put (in spectral terms) no matter what the local environment looks like. As a result, TLPS APs, if any were ever deployed on a meaningful scale, would be far worse "neighbors" than APs using conventional Wi-Fi.

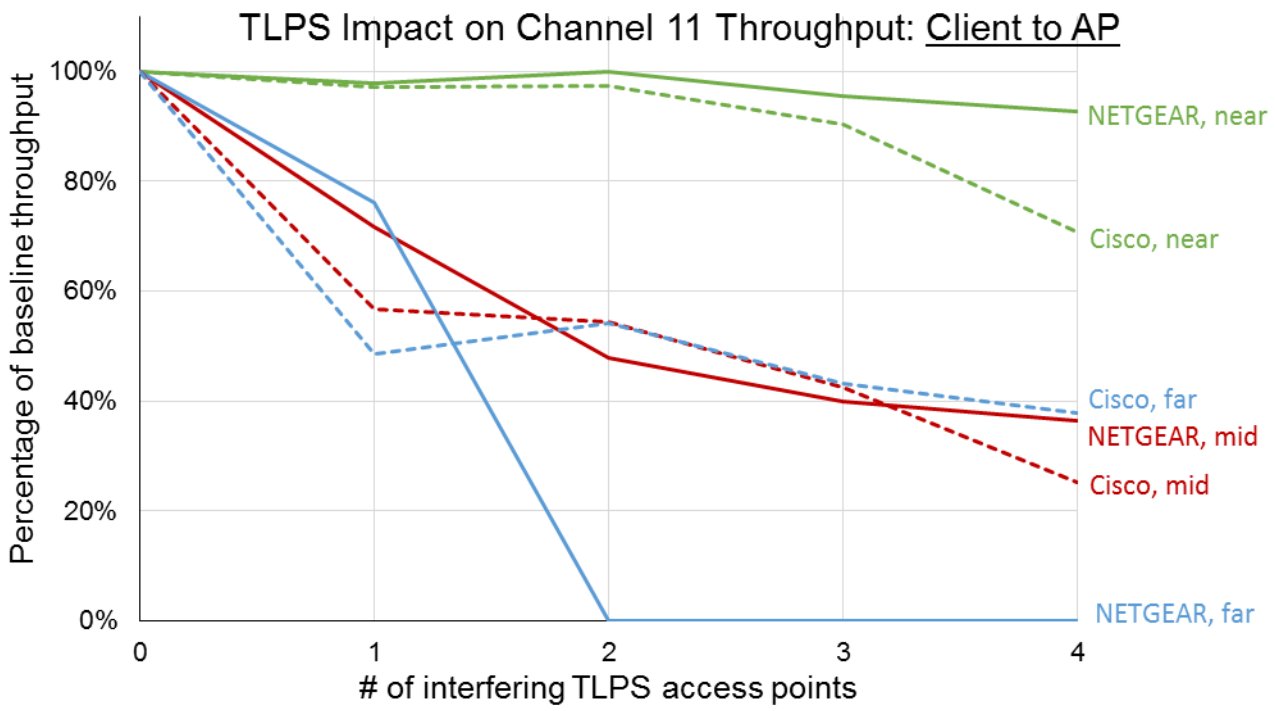
How significantly would TLPS interfere with unlicensed Wi-Fi? The true answer is that it will cause no interference because it will never be commercially viable. But if we ignore, for the sake of argument, the commercial irrelevance of TLPS and provisionally adopt GSAT's irrationally rosy view, the level of interference would be highly dependent on the details. For example, if TLPS APs were installed in low-traffic locations and no one bothered to use them, then no actual interference would result. But to assess scenarios where TLPS were placed in higher-density locations, we commissioned Allion Engineering Services to conduct a series of simple experiments assessing the impact of Channel 14 Wi-Fi activity on the unlicensed Channel 11. Since Channel 14 can't be used legally under ordinary conditions, the tests were conducted inside an anechoic chamber, which prevented outside signals from entering and inside signals from escaping.

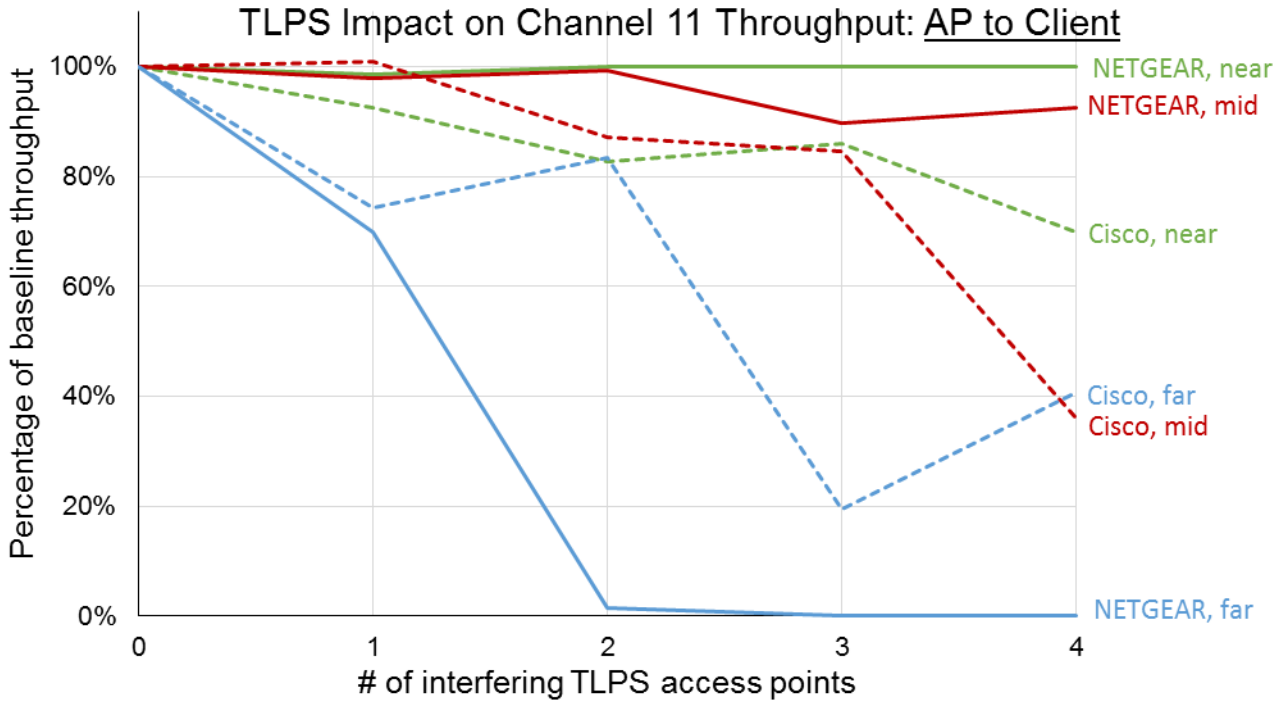
The setup was as follows: first, Allion measured the baseline throughput of a single AP (either a NETGEAR R7000 or a Cisco Aironet 1262) connecting to a single client device (a MacBook Pro) at different levels of signal strength. Think of signal strength as a proxy for distance, with "near," "mid," and "far" corresponding to 20 dB, 40 dB, and 60 dB of attenuation, respectively. Then, Allion added to the chamber a Channel 14 AP (the Linksys WRT54GL) connecting to a single client device (a Kindle Fire tablet) and re-measured the throughput on Channel 14. The Channel 14 signal was attenuated (using shielding fabric) in order to achieve a "nearby" but not unrealistically high signal strength of -60 to -70 dBm. Next, the testers added a second, third, and fourth Channel 14 AP and re-measured the Channel 11 throughput.




*Source: Allion diagram included in report prepared for Kerrisdale, p. 4*
*Note: the devices shown on the top row within the chamber are Linksys APs on Channel 14. The devices shown on the bottom row within the chamber are Kindle Fire tablets connecting to those Channel 14 APs. The Ch. 11 AP shown in the center is a NETGEAR R7000. The Iperf server shown on the right generates network traffic in order to measure throughput. The Butler matrix diagrammed on the right simulates multipath effects critical to achieving higher realized throughputs with multiple spatial streams. The digital attenuator manually reduces signal strength from the Channel 11 AP to the Channel 11 client (the MacBook Pro shown at the bottom of the diagram) at the testers' discretion in order to simulate different AP-to-client distances within a relatively compact chamber.*

What were the results? With an extremely strong connection, Channel 11 devices were sometimes unperturbed by nearby Channel 14 activity. However, in almost every other case, across both AP models tested, realistic levels of Channel 14 activity resulted in declines in Channel 11 throughput. For a Channel 11 client connected at a perfectly reasonable signal strength of -55 to -60 dBm, nearby TLPS APs cut throughput in half or worse. For a Channel 11 client connected near the "cell edge" with a relatively low but still usable signal strength of -75 to -80 dBm, throughput declines from ~10 Mbps to *zero* with the introduction of only a handful of TLPS access points. In other words, the presence of nearby TLPS activity could make or break an unrelated Wi-Fi connection.




*Source: Kerrisdale analysis of data provided by Allion Engineering Services*
*Note: "near"/"mid"/"far" represent 20/40/60 dB of Ch. 11 attenuation, respectively. Solid lines represent NETGEAR results; dashed, Cisco. Absolute throughput figures are not comparable between the two APs because the NETGEAR model is three-stream, while the Cisco model is two-stream.*

These concrete, real-world experimental results rebut GSAT's unfounded assertions that TLPS would not impact public Wi-Fi. To be sure, further testing would help paint a clearer picture of the precise nature of TLPS interference. But these initial tests, conducted by a reputable and independent lab, already confirm what many commenters have said: usage of Channel 14 would indeed result in interference to Channel 11.

## III. Conclusion

We welcome substantive critiques of our analysis of Jarvinian's "tests" and our lab results exploring interference caused by TLPS. To that end, we direct interested parties to our web site, factsaboutglobalstar.com, where we have posted more detailed materials supporting our discussion above.

This new data is relevant for several reasons. First, it demonstrates that GSAT and Jarvinian lack Wi-Fi technical expertise, which helps to explain why they would propose an idea as commercially unworkable as TLPS and why they continue to repeat absurd claims even after our report explained how Wi-Fi spectrum is used in real-world deployments. Second, we believe that the "tests" being alluded to by GSAT and Jarvinian are actually computer simulations. Furthermore, these simulations are shoddy, with flaws that professional wireless engineers would recognize immediately. Most important, the flawed conclusions drawn from these flawed simulations are highly misleading; in contrast to management's claims, TLPS will never be able to match the throughput and capacity of a competently designed network utilizing the many available 5GHz channels available today for free. We commissioned our own wireless engineer to conduct his own simulation to demonstrate these points more concretely, and his work underscores the incredible disconnect between GSAT's fantasies, on the one hand, and the views of practicing network designers, on the other.

Additionally, GSAT has argued that usage of Channel 14 would not cause interference to Channel 11. However, testing that we commissioned from a Wi-Fi Alliance-authorized laboratory – the same lab used by Comcast for its Wi-Fi tests – demonstrates that activity on Channel 14 would in fact reduce throughput on Channel 11, sometimes dramatically, disproving yet another of Globalstar's unfounded claims. We look forward to putting our results on the public record in the TLPS proceeding.

# Full Legal Disclaimer

As of the publication date of this report, Kerrisdale Capital Management LLC and its affiliates (collectively "Kerrisdale"), others that contributed research to this report and others that we have shared our research with (collectively, the “Authors”) have short positions in and own options on the stock of the company covered herein (Globalstar, Inc.) and stand to realize gains in the event that the price of the stock declines. Following publication of the report, the Authors may transact in the securities of the company covered herein. All content in this report represent the opinions of Kerrisdale. The Authors have obtained all information herein from sources they believe to be accurate and reliable. However, such information is presented “as is”, without warranty of any kind – whether express or implied. The Authors make no representation, express or implied, as to the accuracy, timeliness, or completeness of any such information or with regard to the results obtained from its use. All expressions of opinion are subject to change without notice, and the Authors do not undertake to update or supplement this report or any information contained herein.

This document is for informational purposes only and it is not intended as an official confirmation of any transaction. All market prices, data and other information are not warranted as to completeness or accuracy and are subject to change without notice. The information included in this document is based upon selected public market data and reflects prevailing conditions and the Authors’ views as of this date, all of which are accordingly subject to change. The Authors’ opinions and estimates constitute a best efforts judgment and should be regarded as indicative, preliminary and for illustrative purposes only.

Any investment involves substantial risks, including, but not limited to, pricing volatility, inadequate liquidity, and the potential complete loss of principal. This report’s estimated fundamental value only represents a best efforts estimate of the potential fundamental valuation of a specific security, and is not expressed as, or implied as, assessments of the quality of a security, a summary of past performance, or an actionable investment strategy for an investor.

This document does not in any way constitute an offer or solicitation of an offer to buy or sell any investment, security, or commodity discussed herein or of any of the affiliates of the Authors. Also, this document does not in any way constitute an offer or solicitation of an offer to buy or sell any security in any jurisdiction in which such an offer would be unlawful under the securities laws of such jurisdiction. To the best of the Authors’ abilities and beliefs, all information contained herein is accurate and reliable. The Authors reserve the rights for their affiliates, officers, and employees to hold cash or derivative positions in any company discussed in this document at any time. As of the original publication date of this document, investors should assume that the Authors are short shares of GSAT and have positions in financial derivatives that reference this security and stand to potentially realize gains in the event that the market valuation of the company’s common equity is lower than prior to the original publication date. These affiliates, officers, and individuals shall have no obligation to inform any investor about their historical, current, and future trading activities. In addition, the Authors may benefit

from any change in the valuation of any other companies, securities, or commodities discussed in this document. Analysts who prepared this report are compensated based upon (among other factors) the overall profitability of the Authors' operations and their affiliates. The compensation structure for the Authors' analysts is generally a derivative of their effectiveness in generating and communicating new investment ideas and the performance of recommended strategies for the Authors. This could represent a potential conflict of interest in the statements and opinions in the Authors' documents.

The information contained in this document may include, or incorporate by reference, forward-looking statements, which would include any statements that are not statements of historical fact. Any or all of the Authors' forward-looking assumptions, expectations, projections, intentions or beliefs about future events may turn out to be wrong. These forward-looking statements can be affected by inaccurate assumptions or by known or unknown risks, uncertainties and other factors, most of which are beyond the Authors' control. Investors should conduct independent due diligence, with assistance from professional financial, legal and tax experts, on all securities, companies, and commodities discussed in this document and develop a stand-alone judgment of the relevant markets prior to making any investment decision.