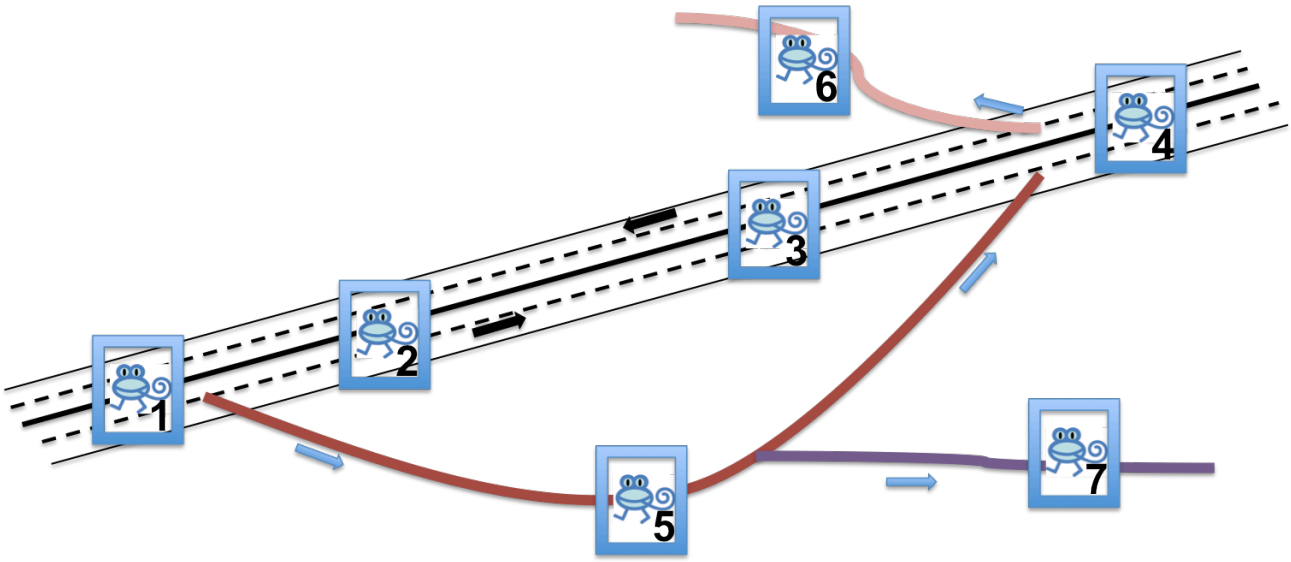
FAQ's for BlueTOAD and Dynaflow

1. What does the name BlueTOAD™ mean?

   BlueTOAD is an acronym for **Blue**tooth **T**ravel-time **O**rigination **A**nd **D**estination

2. Does the travel-time have to be from only 2 adjacent BlueTOAD units or can it span multiple ones? What about directionality?



BlueTOAD backend software allows clients to select the route(s) for which they want to display travel-times, speeds and route behaviors. Using the illustration as an example, on the main expressway, the client could create a travel-time for the following routes:

1 → 2	1 → 3
1 → 4	2 → 3
2 → 4	3 → 4
4 → 1	4 → 2
4 → 3	3 → 2
3 → 1	2 → 1

In all these travel-times routes, we are still matching MAC address from the first node to the second one listed in the example routes. (The example also assumes a narrow median in order to accurately sample both directions – circumstances may require separate installation)

If there are not enough MAC pairs that go from 1 → 6, we are able to add the segments that comprise the route to determine travel-time and speed. In this case, the model would combine (1 → 2) + (2 → 3) + (3 → 4) = 1 → 4 This procedure reinforces aggregate travel time across longer distances, particularly to assure accuracy in travel time publication for route distance > 30 miles. The need for these calculations is automatically recognized by the BlueTOAD modeling engine, and executed as required.

Alternatively, multiple travel times can be determined from a single node, for example, (1 → 4) and (1 → 5), or (4 → 3) and (4 → 6). Such combinations could enable travel times on alternate routes, to inform drivers of the travel time they might expect through an expressway work zone (1 → 4), vs. an arterial alternative (1 → 5 → 4).

3. Can BlueTOAD be used for Origin/Destination Studies, and other analysis of route decision behavior?

Again referring to the illustration, BlueTOAD supports robust data analysis of route behaviors and Origin-Destination trends by percentage factors. For example, of vehicles passing node 4, what percentage continue on the main road to node 3 vs. exiting to drive past node 6? And of the detections of (4 → 6), what percentage is ultimately detected at node 1? Similarly, what percentage of vehicles passing #1 are seen at # 2 vs. #5. And of the vehicles that pass #5, what percent continue on to #7? Such data collection, over time, will significantly enhance the understanding of route choices made by drivers in a geographic region. Analysis of such route behaviors could also include travel times, significantly adding to the value of origin-destination analysis.

4. Specifications note that BlueTOAD can detect Bluetooth signals in a radius of 150 feet. Most Bluetooth signals, that is Class II Bluetooth devices, have a range of about 10 meters, or 33 feet at most. How can BlueTOAD detect these signals when they are 75 feet away?

The range of Bluetooth signals (corresponding to transmit power) is grouped into 3 classes, according to the Bluetooth Special Interest Group- SIG, the international standards body:

- Class 1: signal range up to 100 meters
- Class 2: signal range up to 10 meters
- Class 3: signal range up to 3 meters

Most of the mobile devices in the market today include Bluetooth Class 2. The Bluetooth radio in BlueTOAD is a Class 1 radio with a 4 dBi gain omni directional antenna (typical cell phones have a unity or 0 dBm gain antenna). In essence, these factors increase the transmit and receive sensitivity and thus detection distance of the Bluetooth class 1 radio in the BlueTOAD™ unit.

Moreover, the specified range for each Bluetooth class refers to the pairing range or the range in which 2 or more devices can be synchronized with each other. When “synced,” the devices are “paired” or connected and able to share data and protocols with each other. Such synchronization is necessary for high bandwidth applications like audio transmission or streaming music.

BlueTOAD, however, does not aim to establish any of the Bluetooth protocols to actually pair with the device in the vehicle. The BlueTOAD™ only initiates a request to pair that begins with the transmission of unit's MAC address, and a receipt of the in-vehicle device's MAC address in a millisecond burst of data exchange. In other words, instead of completing a "handshake" with a Bluetooth device, BlueTOAD only offers a "hand wave". As a result, the detection range is not the limit of the Class 2 device in the vehicle but the Class 1 Bluetooth in BlueTOAD.

In addition, the BlueTOAD high gain antenna is connected to a standalone, high sensitivity Bluetooth radio receiver. This combination is an orders of magnitude increase in the ability to receive, let alone detect, a Bluetooth signal when compared to a phone or headset (especially Class 2 devices). One visual bit of evidence: the BlueTOAD Bluetooth antenna is larger than most cell phones.

5. SNMP – do we use it for your BlueTOAD devices?

We use SNMP (Simple Network Management Protocol) for monitoring our servers, not for the BlueTOAD devices. The monitoring system is part of our product offering/service as we are able to monitor any issues that arise with the device and/or communications and quickly restore it remotely if possible.

6. What level of service do we guarantee on your BlueTOAD web services?

At this point in time, we do not have a published web services uptime guarantee but the following has been our experience:

As of 5/10/10: BlueTOAD servers have been up for 367 days w/out any downtime. For system upgrades we put the site into "maintenance mode" and block access until upgrades are complete. In the past 6 months we've done 4 major upgrades and 17 minor ones. Any XML feeds during that time would have been blocked*. Assuming each major upgrade is 10 minutes and each minor upgrade is 5 minutes:

Type of Upgrade	Duration of download	# of Upgrades	Total # of minutes downloading
Minor	5 minutes	17	85 minutes
Major	10 minutes	4	40 minutes
			TOTAL = 125 minutes
Total service time for 6 months			259,200 minutes
Total downtime in past 6 months			125 minutes
Total non-blocked time in past 6 months			**99.9995179%**

* All attempts are made to download upgrades at non-critical times.

7. Aside from the web site access, can BlueTOAD data directly interface to a 3rd party system?

Yes, the BlueTOAD system has been designed for 3rd party interfacing. There is no problem for a client "pulling" BlueTOAD data into a proprietary service via an XML schema that we provide. For example, this is being done for the deployment of BlueTOAD on the Eisenhower Expressway in Chicago. IDOT systems integrator Delcan is directly interfacing with a BlueTOAD XML feed to update overhead message signs and other aspects of the IDOT ATMS system.

8. What is included in your BlueTOAD backend services package?

Please contact your TrafficCast representative for *Advanced Package List of Services.docx*"

9. Has BlueTOAD been evaluated by an independent 3rd Party?

Yes, the Pennsylvania Department of Transportation (PennDOT) compared BlueTOAD with toll tag readers (EZPass) in order to determine travel times on the Schuylkill Expressway (I-76) in Philadelphia. KMJ prepared the report on the evaluation, which is linked on the TrafficCast website: http://trafficcast.com/docs/PennDOT_BlueTOAD_final_report_incl_charts_4_Jan_2010.pdf

10. Can we upload data from the field (Cellular) and process it more frequently than every 1 minute?

The modem can be set to upload information in a shorter duration than 1 minute, but experience to date indicates that a one-minute interval optimizes the tradeoff between data delivery and battery drain. In the sample of an actual feed below, the insert time is ~ 1 minute. If you look at the measured time, you will note that there is no interruption in detections between the transmissions of data. With this configuration of 1 minute transmission intervals, BlueTOAD specifications state that the unit can provide data for 7 days solely on battery power.

ID	MAC ADDRESS	MEASURED TIME		INSERT TIME	
42	00249F78F489	5/7/2010	17:04:02	5/7/2010	12:04:38
42	00249F01C09B	5/7/2010	17:04:14	5/7/2010	12:04:38
42	002483A90907	5/7/2010	17:04:16	5/7/2010	12:04:38
42	0016D4270C3B	5/7/2010	17:04:24	5/7/2010	12:04:38
42	002376730E60	5/7/2010	17:04:47	5/7/2010	12:05:48
42	00054F78C80B	5/7/2010	17:04:53	5/7/2010	12:05:48
42	C87E75588EC2	5/7/2010	17:05:17	5/7/2010	12:05:48
42	00136C446B54	5/7/2010	17:05:21	5/7/2010	12:05:48
42	0025679DB9A3	5/7/2010	17:06:49	5/7/2010	12:06:58
42	00054F4E38F2	5/7/2010	17:07:27	5/7/2010	12:08:08
42	00054F78D2E2	5/7/2010	17:08:49	5/7/2010	12:09:18
42	00054F7BA35A	5/7/2010	17:10:27	5/7/2010	12:11:28
42	0000A06D7BC3	5/7/2010	17:12:04	5/7/2010	12:12:38
42	A0079872CE83	5/7/2010	17:12:22	5/7/2010	12:12:38
42	001F6B0BC2A5	5/7/2010	17:12:31	5/7/2010	12:13:48

11. For independent operation, what field maintenance is involved regarding the batteries and solar panels?

    The batteries and solar panels are virtually maintenance free. The battery is a sealed lead acid gell AGM battery. The solar panels were shown to recharge the battery over an extensive period even during the harsh Wisconsin winter, when the panel itself was covered a 4" snowpack. TrafficCast remotely monitors battery voltage in the units and will know if there has not been enough "sun" days to offset battery drain, perhaps requiring excess snow to be removed. That has not been our experience, however. Otherwise, no standard maintenance is required.

    The battery is specified to have about 200 deep cycles. With just minimum current flowing into the battery from the solar panel, it will never have to deep cycle. As a result, the manufacturer generally states that the expected life of the battery is five to seven years.

12. How long does a drained battery require to fully charge? How is it done?

    Hooking up a typical power supply into the solar input to the charge controller (the recommended procedure) will take about 2 days to fully charge the battery.

13. Is there a plan of offering a CDMA data communications option anytime soon? If so, when?

    A CDMA option is in process, but due to the nature of CDMA implementation on a device like BlueTOAD, it requires an extensive review process by Verizon. Moreover, our current GSM configuration for cellular data communications and its utilization of a SIM card greatly simplifies deployment and offers carrier flexibility to the client, enabling utilization of any existing GSM data plans.

14. Can the data be shared with others?

    Yes, an agency may directly share BlueTOAD data with all of its public sector partners and constituents, and may publish information resulting from BlueTOAD on its public web sites, overhead signs, and similar public communications channels. The only restriction is that raw BlueTOAD data, travel times and speeds cannot be offered in a direct data feed to TrafficCast competitors.

15. How far apart should BlueTOAD units be spaced?

    The distance between sensors depends upon the configuration of the road. BlueTOAD™ sensors can be spaced from ½ of a mile to 10 miles (or more, as may be appropriate for limited access roadways, with installation near interchanges). The greater the distance between sensors is inversely proportional to the number of matched MAC addresses as the possibility increases that a vehicle may exit the road, or a device be turned off and become undetectable. Typically, BlueTOAD spacing should be kept below 4 miles for optimum results. Spacing below ½ mile may require special configuration of antenna directionality and gain; contact TrafficCast for more information.

16. Can BlueTOAD equipment be mounted on existing structures such as light poles or sign structures?

    Yes – BlueTOAD is intended is to make installation as flexible and straightforward as possible. Common metal bands are typically employed for both the BlueTOAD box and solar panel

17. What different configurations of BlueTOAD are available? Also, what is the size and weight of the enclosure of the NEMA 4 box for independent (cellular/solar) operation?

Configuration Option	Power Source	Data Connection
Option 1	AC 110V	Ethernet
Option 2	AC 110V	Cellular Modem
Option 3	Solar Panel w/ Battery	Cellular Modem
NEMA 4 enclosure - 11.5" x 7.5" x 13" – 37 pounds with battery		**Solar Panel** – 16.5" x 20" – 12 pounds

18. What data communications formats does BlueTOAD support for integration into existing agency platforms?

    The preferred standard is XML, with CSV as an alternative. In general, these would offer time-stamped updates of travel time/speed reports for matched pairs of BlueTOAD units. Of course, a client would still have access to the reports generated on their BlueTOAD website, which also offer standard download options. We can also adapt to proprietary client interface specifications if XML or CSV are not feasible, but this work would add time and cost.

19. Is there an Apples-to-Apples comparison with other vehicle probe data, such as License Plate Recognition (LPR)?

    The PennDOT evaluation* thoroughly studied the specifics of how BlueTOAD virtually matches the travel times/speeds derived from their toll tag reader system. As much as possible and practical, they tried to install the BlueTOAD units at the same location as the EZ Pass reader – often using the same infrastructure that supports the EZ pass detectors. And where there was a discrepancy between BlueTOAD and Toll Tag travel times, the consultant attributed it to the need to install the BlueTOAD unit somewhat apart from EZ Pass. For example: "At least 16.5 seconds of the eastbound travel time difference is attributable to the spatial difference in origin device locations. As such, it is determined that the travel times produced by the devices are comparable to those produced by the EZPass tag readers..."

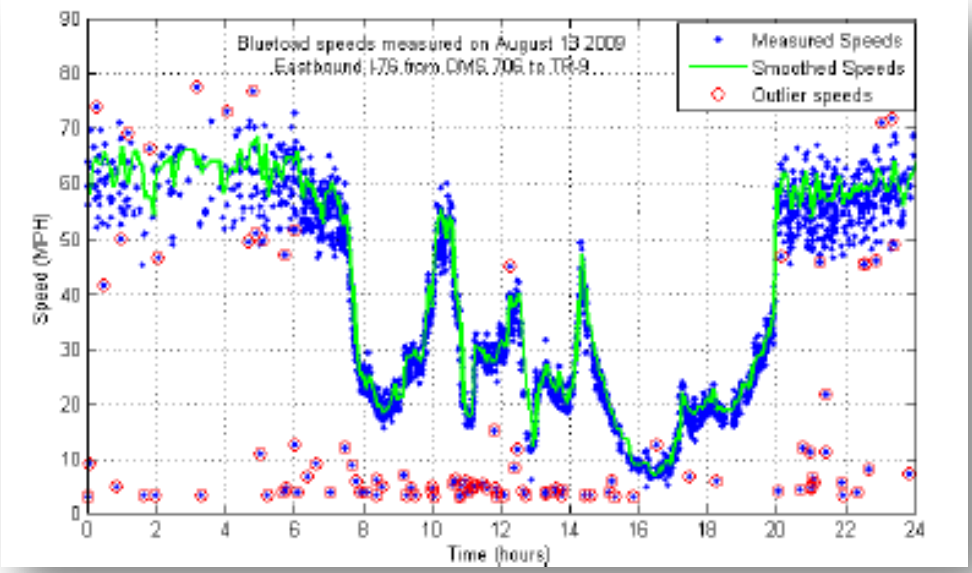
    The methodology behind toll tag readers to determine travel times is directly analogous to that of License Plate Recognition, without the added step of converting the LPR image to a data reference. And so the bottom line, with the PennDOT results, BlueTOAD is very much a comparable apple to LPR in terms of data output. And in terms of costs: the BlueTOAD apple is smaller, cheaper and the installation is much easier and takes less time.
    *http://trafficcast.com/docs/PennDOT_BlueTOAD_final_report_incl_charts_4_Jan_2010.pdf

20. How does the BlueTOAD data processing adjust for non-vehicular Bluetooth Matches?

The BlueTOAD platform filters matched pairs of Bluetooth detections for outliers and discrepancies.

While that's simple to say, the processing involves a set of sophisticated algorithms - essentially the BlueTOAD IP - that recognize detection matches which do not fit with the flow of traffic represented by the majority of Bluetooth pairs. As one can imagine, this is fairly straightforward on an expressway, where we've found slow moving outliers are fairly easy to spot.
Urban environments are more challenging, as shown during the evaluation last fall along Archer Avenue in Chicago by the City's Office of Emergency Management & Communications. The BlueTOAD system recognizes and reduces or eliminates weighting of simultaneous matches, as might occur from a passing bus. It also applies analysis against "slow moving" matched pairs, which might result from a cyclist or pedestrian, compared to overall flow as shown by the larger sample of matches. The principal is the same as with expressways, although the standard deviation might be significantly less.

At basis, travel times and speeds from BlueTOAD are not determined from a single detection match but instead factor an on-going real-time analysis of multiple matches. This filtering and processing is visualized in the following graphic which depicts measured speeds (derived from BlueTOAD travel times), in blue dots, the "smoothed" result of the algorithms in a green line, and filtered outlier data in red.



21. On arterials, if the BlueTOAD unit is within the 175 foot area of an intersection, will it be directionally agnostic?

Yes. Directionality of travel times/speeds is determined by matching detections from subsequent BlueTOAD units on the road.

22. What is the time lapse or delay for receiving enough data to build a travel time projection? One concern is that if a 4% sample is needed to deliver the accuracy required, what delay are we looking at for the calculation of travel time at peak hours?

Data sampling should not be a factor, especially at peak hours. We've seen research that indicates only a 1% sample is necessary, but peak hours always yield higher samples – which only increase with more emphasis on hands-free driving. In fact, during the PennDOT evaluation, TrafficCast actually capped the number of matches captured by the system in order to optimize the processing efficiency of the pre-production version of the back-end analytic software.

Data collection/time stamps/communications of detections is under a minute. On the backend the detections are processed, filtered and matched with additional algorithms to account for appropriate weighting of Bluetooth detections from the same vehicle, like a bus. Our default update rate is the 85th percentile of travel times every minute, but clients can adjust that for specific needs including different update rates for peak- and off-peak times.

23. Since information is processed and archived through the BlueTOAD website, what happens if their server goes down? What kind of protection/redundancy do they have built in for this?

All BlueTOAD data is processed through our production servers maintained at the Qwest collocation facility in Chicago, which provides Tier One data communications support and reliability, with industry-leading service level standards to support both live and archive environments:
https://www.qwest.com/qptcms/qCmsRepository/resources/pdfs/iQConnect_Hosting_Managed%20Services_PO080364.pdf

At Qwest, TrafficCast processes BlueTOAD data through two communications paths to provide redundancy and fail-over capacity for live data provision. For the various analytic needs of our clients, we save all data (many reports and associated data are available through the BlueTOAD web interface for download), which is backed up once a day. In the highly unlikely event of catastrophic failure of both BlueTOAD archive servers, the only data lost for analytic purposes would be whatever had been collected in the current day, up to a maximum of 24 hours.

More broadly, the BlueTOAD solution is not simply a novel application of Bluetooth signal detection for traffic monitoring. Our focus has been to wrap Bluetooth signal detection, data communications and real-time content processing into a secure, reliable, "industrial strength" package to support travel time provision and route behavior analysis. The TrafficCast team has deep experience in the cellular-wireless-telecommunications industry and fully appreciate the performance standards required when a communications device is deployed in the field.

24. Can you provide BlueTOAD references:

Yes. Please contact your TrafficCast representative.